

Rob Rutten's WWW Pages — July 16, 2022

<https://robrutten.nl>

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Rob Rutten's website – *solar physicist offering astronomy texts and more*
Rob Ruttens webstek – *sterrenkunde, zonsonderzoek, 't een en ander*

!! WARNING – Since July 4 Utrecht University does not recognize my existence. Emails to ;R.J.Rutten@uu.nl or ;r.j.rutten@uu.nl no longer reach me. Use ;robenrietjerutten@pestaart-symbol@gmail.com instead.

1 Who, what, where?

Prof. Dr. Robert J. Rutten

Senior solar physicist at Lingezicht Astrophysics in Deil, The Netherlands
Emeritus solar physicist at Utrecht University and Oslo University

Research: structure, dynamics, radiation of the solar atmosphere (publications DOT images, movies)

Teaching: solar spectrum formation (lectures course notes Nederlands)

Record: CV publications teaching waters

Affiliations: Lingezicht Astrophysics (Deil) - Institutt for Teoretisk Astrofysikk (Oslo) -
Rosseland Centre for Solar Physics (Oslo)

Spouse: Riet Rutten-Vonk

Where: travel plans travel to Lingezicht: html pdf

Email: ;robenrietjerutten@pestaart-symbol@gmail.com (no longer ;R.J.Rutten@uu.nl)

Skype: robertjellerutten - but email me first

1.0.1 Lingezicht Astrophysics



Institute: smallest but most centrally located astrophysics institute in the Netherlands

Mission: make effectively thick who is optically thin, including the chromosphere herself

Record: champion ratio productivity/FTE

Organization: subsidiary of Tapanti B.V. and Riet Rutten sieraden

Location: Lingezicht, Deil, The Netherlands (directions: html pdf)

1.0.2 CV

Prof. Dr. Robert Jelle Rutten

Born: (too) long ago, Hoensbroek, The Netherlands

Spouse: Riet Rutten-Vonk

Education

- 1961: Eindexamen Gymnasium-beta, Het Nieuwe Lyceum, Bilthoven, The Netherlands
- 1968: Drs. Wis- en Natuurkunde, Rijksuniversiteit Utrecht, The Netherlands
- 1976: Dr. Sterrenkunde, Rijksuniversiteit Utrecht, The Netherlands

Employment at Utrecht University, The Netherlands

- 1963 - 1965: education assistant
- 1966 - 1968: research assistant
- 1968 - 2007: tenure-track scientist, staff member, senior scientist, program leader solar physics, project scientist

Dutch Open Telescope

2007 - present: emeritus scientist (but there is no astronomy at Utrecht University beyond this website since 2012)

Employment elsewhere

- 1977 - 1978: visiting scientist, Sacramento Peak Observatory, Sunspot, USA
- 1980: cultural-treaty exchange scientist, Main Astronomical Observatory, Kiev, Ukraine, USSR
- 1993: Fulbright Scholar, National Solar Observatory, Sunspot, USA
- 2002 - 2007: part-time professor, University in Oslo, Norway
- 2007 - present: resident senior scientist, Lingezicht Astrophysics, Deil, The Netherlands
- 2007 - present: emeritus professor, University in Oslo, Norway
- 2010: visiting professor, National Astronomical Observatory of Japan, Mitaka, Japan
- 2011: visiting scientist, Lockheed-Martin Solar and Astrophysics Laboratory, Palo Alto, USA
- 2016: consultant, National Astronomical Observatory of Japan, Mitaka, Japan
- 2018: visiting scientist, Lockheed-Martin Solar and Astrophysics Laboratory, Palo Alto, USA

Publication list

Teaching dossier

Watery exploits

2 What's new?

(apart from my publications, photos, travels)

- April, 2022: updated Compendium solar spectrum formation on arXiv/ADS.
- January, 2022: “In Memoriam Cornelis de Jager” was finally published in Solar Physics. The uncensored arXiv version is better.
- May, 2021: start of a solar file archive with old solar line tables, spectrum atlases, model atmospheres, observations.
- April 29, 2021 honoring Cornelis (Kees) de Jager on his 100th birthday: De zon op Keesdagen/The Sun on Kees days, Kees de Jager 100!
- April, 2021: this website is now at https://robrutten.nl. DOT pages at https://robrutten.nl/dot/DOT_home.html.
- March, 2021: Compendium solar spectrum formation for a NIT Calicut solar physics school. Brief but with Wikistyle page openers for a full course. This second *Lingezicht Astrophysics Report* is also livelier here than the arXiv/ADS version.
- December, 2020: Small-scale solar surface magnetism (arXiv/ADS). Summary in “*Solar Magnetic Variability and Climate*” by C. de Jager, S. Duhau and A.C.T. Nieuwenhuizen (book content, order page).
- August, 2020: SoLO campfires in SDO images. This inaugural webpost of *Lingezicht Astrophysics Reports* is updated here beyond the arXiv/ADS post and retains an epilogue on the start of this report series.

- March, 2020: hands-on demo of my SDO alignment software for a covid-postponed EU SolarNet school.
- August, 2019: solar spectrum formation for irradiancers, a brief (10 equations only) tutorial expanding my RTSA notes in a review published here - but better view the arXiv pdf because Springer destroyed 100+ citation links (more Springer nasturtia versus A&A and SoPh praise).
- February, 2018: A year at Sunspot. Reminiscences of 1977 - 1978 at the Sacramento Peak Observatory.
- January, 2018: renewed IDL programs to obtain and co-align image cutout sequences from the Solar Dynamics Observatory. See manual. Also a multi-movie browser and blinker showex.pro.
- May, 2017: The Sun with ALMA: jets and contrails! at the 72th Nederlandse Astronomenconferentie.
- September, 2016: latex macro for linkers opening specific pages with cited figures, tables, equations, etc.
- November, 2015: new edition of “Introduction to Astrophysical Radiative Transfer” by Luc Rouppe van der Voort (Oslo).
- March 1, 2012: Rietje's webstek.
- November 25, 2011: my last day at the nearly closed SIU. As farewell I scanned the courses of M.G.J. Minnaert with which I started my 50 years in Utrecht astronomy. I also scanned vintage lecture notes by C. Zwaan and his high-school texts with J. van der Rijst (all in Dutch, under Sterrenkunde dictaten). Cleaning out my desk also made me scan or retrieve ancient courses “Natuurkunde van zon en sterren” (1978), “Fotosferische snelheidsvelden” (1983), “Opwekking en transport van straling” (1991), “Introduction to Solar Spectrum Formation” (1993), “Generation and Transport of Radiation” (1995), “Solar and Stellar Magnetism” (1999).
- January 2011: end of operation funding for the Dutch Open Telescope. It is mothballed since - you are welcome to revive it.
- November 2010: “citeads” latex commands that generate citations in a pdf file which link to the corresponding ADS abstract page.
- October 2010: “solabs” solar abstracts with ADS and ArXiv links for many solar physicists.
- September 2010: updates of my simple IDL manuals.
- August 2010: a speckle demonstration movie on the DOT website.
- July 2009: USO School “Solar Magnetism” held at ASTRON, Dwingeloo, The Netherlands.
- October 2008: photographs from Nederlandsch-Indisch Java and Sumatra taken by my father during 1936-1939.
- September 2008: Concluding Remarks of the 12th European Solar Physics Meeting in a new webpost format for talks.
- April 2007: farewell party at Sonnenborgh at my mandatory retirement.
- December 2006: final report of the ESMN which I led during 1998 - 2006 (in memoriam).
- August 2006: 200-km kayak voyage circuiting the “Eye of Quebec” asteroid impact.
- July 2003: Epsilon, written in 1997 in memory of Richard N. Thomas, was finally published.
- November 2001: review of solar atmosphere modeling honoring C. (“Kees”) de Jager's 80th birthday.
- November 2000: the housing of Utrecht astronomy incurred my wrath

- February 2000: Cornelis (“Kees”) Zwaan obituaries for Solar Physics, [Bull. Am. Astron. Soc.](#), and [JOSO Annual Report 1999](#). Also a Zwaan photograph, and [Zwaan's publication list](#). Zwaan's correspondence and other science materials are archived at the [Rijksarchiefdienst Noord-Holland](#).
- November 1999: [popular-astronomy article](#) on what one did *not* see during the August 11 eclipse (in Dutch). What one did not see were [Fraunhofer lines](#)! The inner corona is the only sunshine-illuminated body in the entire solar system that does *not* show them. Walter Grotrian explained their absence in 1934 as due to enormous Doppler smearing in Thomson scattering, but without daring to suggest that such large electron velocities indicate very high temperature. He did that only much later, after identifying the few coronal emission lines in the visible as due to highly ionized iron. During a total solar eclipse you should particularly appreciate that the corona basks you in pearly sunshine without Fraunhofer lines (and polarized as well).
- November 1997: [photographs of the DOT First Light Ceremony](#) (featuring Crown Prince Willem-Alexander, Science Minister Jo Ritzen and many other dignitaries) among other [DOT pictures](#).
- August 1997: many [thirty-year old astronomer portraits](#) added to the [photo gallery](#).
- June 1995: start of this website, to offer my course notes “Radiative transfer in stellar atmospheres” electronically. I am proud that it started just when the web came of age, at the same time as the second-best astronomy site: the Astronomy Picture of the Day ([here is the very first APOD display](#)). The number-one astronomy site is the [ADS literature server](#), started in 1994 by [these people](#).

3 What's past?

Nearly everything on my website is past. I post [publications](#) when published, [talks](#) when given, [photographs](#) when taken. The items below are “closed books”. Of course, more books get closed without leaving website code suited to burial as the bits and pieces below. Saddest: [Utrecht astronomy including Dutch solar physics](#).

3.1 [Claim to fame](#)

My proudest achievement is [kayaking Manicouagan](#), detailed in [this report](#) and [this photo album](#), en in [dit artikel in Zenit](#), [dit artikel in PeddelPraat](#), en [dit rapport](#). Indeed, monitoring my website popularity delivers: 1 = [Manicouagan](#); 2 = [Ubuntu](#); 3 = [Rob's astronomer shots](#); 4 = [Radiative Transfer in Stellar Atmospheres](#). Maybe my priorities have been wrong? More kayaking impacts, less teaching?

Another travel-based claim to fame: including Manicouagan Reservoir and Trinity Site in our travels made Rietje and me fairly unique in having trod all five generic types of terrestrial rock ([igneous](#) and [sedimentary](#) and [metamorphic](#) as usual, but also [impactite](#) and [trinitite](#)). Impactite must have been [abundant](#) in the [Earth's early phase of bombardment](#) (leaving the many scars still seen on Mercury and the moon), but by now Isle René Levasseur is its major manifestation. Trinitite hopefully remains limited to its site in New Mexico.

Of course we collected this record by traveling abroad. Holland has almost no indigenous rock at or near its surface, and no impactite or trinitite yet (hopefully never). Before the ice ages it was seafloor, likely it will become that again soon. Presently, Holland consists of sedimentary sand and clay, except for an outcrop of limestone defining “Maastrichtien” as the last phase of the Cretaceous, some older sandstone, and one Carboniferous site, all in the Southern tip of Limburg. Beyond Winterswijk a layer of Trias limestone (“Muschelkalk”) is mined just below the surface. Elsewhere, all rocks were imported. Pebbles were imported by rivers, especially the Maas, along their beds. Granite boulders were imported by ice-age glaciations from Scandinavia; the largest were assembled into about 50 burial monuments by the neolithic Hunebed people (“trechterbekercultuur”) about 5000 years ago. Blocks of columnar basalt (a million or so) were imported more recently by the Dutch in barges from Germany to cap river levees and sea dikes. They came from along the Rhine between Mainz and Bonn;

their sources are now depleted, manual placement is no longer warranted. Their volcanic origin was identified in 1771 by geologist Rudolf Erich Raspe who later wrote "*The Surprising Adventures of Baron Münchhausen*". Our claim to fame is based on less extraordinary travel.



Basalt quarry, Vulkaneifel, December 2010



Limestone quarry, Winterswijk, January 2011

Another claim to uniqueness is that during 2020-2021 I was the only solar physicist worldwide working daily in the institute office.

3.2 Closure of Utrecht astronomy

The abrupt end of Utrecht astronomy in early 2012, 370 years after its start, had nothing to do with the track record or prospects of the Sterrekundig Instituut Utrecht (SIU) as partner in the Netherlands Research School for Astronomy (NOVA). It arose from personal prejudice in the Utrecht University (UU) board that there was too much astronomy in The Netherlands. Too much of a good thing, they seem to have thought, since astronomy is an activity in which Holland excels exceptionally, far beyond its GNP. In fact they killed Utrecht astronomy just when the Dutch government awarded 25 million Euro extra funding to Dutch astronomy (i.e., NOVA, including the SIU astronomers and actually with UU as formal NOVA lead agency at the time) after an international evaluation committee had judged NOVA to be one of the only two "exemplary" research schools of all disciplines nation-wide in The Netherlands. The ex-SIU staff now partakes in this renewed NOVA funding from their new bases at other Dutch universities (Amsterdam, Leiden, Nijmegen). Most kept their tenure in this relocation and took their external funding, postdocs and graduate students along. In total, two dozen astronomers moved from Utrecht to other NOVA sites. Others moved abroad. Their research continues, but gone are the superb Utrecht astrophysics education program (with the best student/fte ratio of the NOVA institutes) and the famous Utrecht solar research (effectively all Dutch solar physics).

A direct consequence of the closure of the SIU was that the planned bundling of NOVA's optical and infrared astronomy instrumentation groups at Utrecht fell through. Another consequence is that the Dutch institute for space research (SRON) decided to move away from Utrecht. The termination of astronomy didn't even improve the UU budget because the gain from firing the 10 SIU fte's amounted to less than the losses in direct government funding (for student influx and PhD production) and indirect and external funding (from NOVA, NWO, TNO, STW, EC, ERC, ESA, NSF, NASA).

The worst aspect was the diminishing emphasis on science at Utrecht University. The Dutch economy should become a "knowledge" economy, but this rosy goal is severely hampered by severe undereducation in the technical and exact sciences. The overall quality is still high but the volume is much smaller per capita or GNP than in comparable (and competing) countries. Cutting down on a prestigious exact science in which the Dutch excel extraordinarily and which attracts more public attention than any other (with NOVA's outreach program exemplary as well) is a bad mistake with respect to inspiring bright high-school pupils to choose an exact-science education. Counter example: at Nijmegen University (which accepted half of the SIU's staff, a sizable increase of its astronomy department) the restart of astronomy substantially increased the influx of physics students. Utrecht University indeed suffered the reverse. Not a win-win strategy but a lose-lose lack of perspective. At the SIU's formal burial ceremony in the packed UU aula, SIU director C.U. Keller reminded the audience that the most abundant element in the universe after hydrogen is stupidity.

How did the closure come about? It seems that in 2010 the notoriously autonomous UU board ("College van Bestuur", CvB, a dictatorial body operating without checks or balances) decided that the SIU was too small for a Masters-education discipline and proposed in secret to move the similar-sized Amsterdam and Nijmegen astronomy departments to Utrecht – meeting indignant rebuttal. What happened thereafter is detailed

in this account by C.U. Keller. The CvB set up a secret evaluation panel which advised to maintain the SIU; in December 2010 the CvB signed an agreement to do so and strengthen the SIU. However, in June 2011 the CvB decided to kill it, without consulting anybody wherever. Its non-disclosed motivation seems to have been that Utrecht University would profile itself favorably by not doing what others do – i.e., by single-handedly withdrawing from this nation-wide, exemplary, government-endorsed, student-attracting, top-level science endeavour. The CvB ignored the government's acclaim for NOVA and desire for more exact-science students. It literally shut its door and telephone to the NOVA directors even though it was the formal NOVA lead agency. It forced a freshly-appointed science-division dean (replacing a less timid one who resigned in protest to the CvB's science policies) to terminate the SIU, against his own judgment. Its only public announcement was, quite hypocritically, that it "respected the dean's decision".

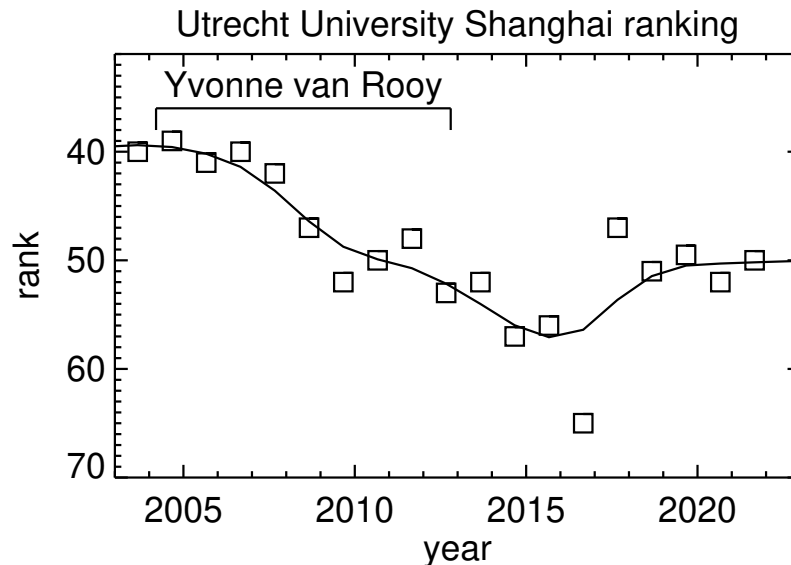
The subsequent deal, orchestrated by SIU director C.U. Keller and NOVA director W.H.W.M. Boland, to transfer most SIU astronomers to other NOVA universities, at large UU cost to guarantee their tenure, was officially concluded in March 2012. However, by February most astronomers had already left. Namely professors A. Achterberg (theoretical astrophysics, to Nijmegen), C.U. Keller (polarimetry instrumentation and solar physics, to Leiden), F.W.M. Verbunt (high-energy astrophysics, to Nijmegen), and the other permanent staff S.S. Larsen (galaxy evolution, to Nijmegen), O.R. Pols (stellar evolution, to Nijmegen), M.C. van den Berg (education, to Amsterdam), J. Vink (supernovae, to Amsterdam), A. Voegler (solar magnetohydrodynamics, left research). NOVA-paid instrumentalists F.C.M. Bettonvil and F. Snik moved to Leiden. Support staff S.J. Hogeveen and M. Wijburg accepted other jobs at Utrecht University.

At this loss of its close partner SRON decided to leave Utrecht. It first selected Amsterdam but then found better connections at Leiden (astronomy there, technology in Delft) and moved to a new building on the Leiden science campus in 2021.

Upshot: Utrecht astronomy is gone, including Utrecht (read Dutch) solar physics. UU astronomy education ended in June 2012. No more interest in the Universe at Utrecht "University" (it scrapped its subscriptions of the major astronomy journals). Less student attractivity. No more well-educated UU astronomy alumni enriching society. No more UU astronomy outreach - in which Utrecht astronomers were particularly active ever since Minnaert; the group that went to Leiden won the national "Academische Jaarprijs" for science popularization soon after their move.

By the end of 2011 the CvB had also announced new overall priority themes for Utrecht University: "sustainability", "life sciences", "institutions" [sic], "youth & identity" [sic]. In this vision the exact (beta) sciences vanish apart from "useful" applications such as medical and climate physics. UU's much-touted relatively high initial Shanghai ranking was earned in hard natural sciences, in particular theoretical physics and crystallography. Nevertheless, in 2011 UU's administration also contemplated termination of theoretical physics and pure mathematics. A climate in which the best researchers leave first, as indeed happened in these fields (they went to Nijmegen). Utrecht University went soft and mediocre. Its chemistry and physics are now negligible Shanghai scorers, public administration highest.

The responsible CvB chair, Yvonne van Rooy, had a humanities-only (gymnasium-alpha) education, characteristic of high-school pupils that stumble over mathematics and physics to become specimens of C.P. Snow's classic "Two Cultures" syndrome: intellectuals who proudly assert that not knowing the second law of thermodynamics adorns their intellectuality. She left Utrecht University in 2012, leaving as heritage the dramatic plunge of Utrecht University quality charted below. She bragged about the minor 2009-2011 rise at the time she terminated astronomy, but the plunge persisted years after her reign and stabilized at 25% loss of quality ranking.



3.3 Utrecht astronomy

It is indeed past. Utrecht astronomy started in 1642 as the second university astronomy department worldwide (after Leiden), only six years after the start of Utrecht University, a few decades after Galileo Galilei turned astronomy into astrophysics, and in the year Isaac Newton was born.

At its abrupt termination in January 2012 the SIU research topics were solar physics (including running the revolutionary Dutch Open Telescope), stellar and galaxy evolution, supernova and high-energy astrophysics, experimental spectropolarimetry. In each field, the SIU had high standing. Its astrophysics-oriented education program was particularly renowned.

The earlier history of Utrecht astronomy is described well in the brochures by M.G.J. Minnaert and by C. de Jager linked below (in Dutch). An overall summary is in C. de Jager's overview. Here I summarize the 50-year period I was part of it. I describe Utrecht solar physics - the major research topic during the past century - separately on this page.

During the 1960s, under C. de Jager and with the addition of full professors A.B. Underhill and H.G. van Bueren, the Sterrewacht diversified into many research interests next to the solar spectrum (giant stars, stellar winds, solar MHD and radio physics, solar and stellar X-ray physics, plasma-astrophysics, heterodyne detection techniques). Theoretical astrophysics and astronomical instrumentation were added to the curriculum. It became the most astrophysics-oriented institute in The Netherlands and grew rapidly to a 1970s staff of 20 tenured scientists with 30 support personnel, including large mechanics and electronics workshops. At the same time, De Jager's newly founded Space Research Laboratory (now SRON) grew to well over 100 employees. De Jager ran the Sterrewacht in the mornings, his space lab in the afternoons, edited the journals he had started (Solar Physics, Space Science Reviews) in the evenings, ran the Flemish Astrophysical Institute in Brussels (which he founded) in frequent visits, and held high-level posts in the IAU, COSPAR, ICSU, Dutch Academy of Sciences, and many more.

PhD students from that golden era of Sterrewacht Sonnenborgh who later became astronomy professor (at Utrecht or elsewhere): M. Kuperus, C. Zwaan, E.P.J. van den Heuvel, W. van Rensbergen, H.J.G.L.M. Lamers, J.M.E. Kuijpers, M.W.M. de Graauw, R.J. Rutten, H.C. Spruit, A. Achterberg, F.W.M. Verbunt, J. Heise, P.C.M. Martens, L.B.F.M. Waters. Other well-known astronomers who got their PhD at Utrecht during that period and went abroad: J.M. Beckers, A. Greve, A.A. van Ballegooijen, C.J. Schrijver, F.B.S. Paerels, R.G.M. Rutten.

In 1987 the university astronomy group moved from Sterrewacht Sonnenborgh to out-of-town campus “De Uithof”. Earlier, De Jager had laid ambitious plans to house both astronomy and space research together in a large new building in an immense 1880s fortification (Fort Rhijnauwen) just south of De Uithof, but the era of expansion was over. Eventually, the closure of some physics departments vacated a floor of the Buys Ballot Laboratorium in De Uithof for astronomy. The professors at that time were A.G. Hearn, M. Kuperus, H.J.G.L.M. Lamers, C. Zwaan. The major research interests were solar physics, cool-star activity, hot star winds, accretion disks, plasma astrophysics. Solar radio spectrometry (with the 25-m dish at Dwingeloo) had been terminated in 1984. The development of heterodyne detection in the infrared had moved to SRON Groningen with M.W.M. de Graauw, followed later by H. van de Stadt.

The space research laboratory (SRON Utrecht) moved into an adjacent former physics building in 1990. The strong ties in solar physics and ultraviolet spectroscopy were gone; the collaboration became limited to non-solar X-ray astronomy, the field of the new director J. Bleeker.

After its move the astronomy group (“Vakgroep Sterrekunde”, renamed Sterrekundig Instituut Utrecht) lost its independence and was systematically reduced by the physics administration. At the completion of the Utrecht Echelle Spectrometer for the William Herschel Telescope on La Palma, the sizable instrumentation program was killed except for Hammerschlag’s Dutch Open Telescope. Although F.W.M. Verbunt added high-energy astrophysics and H.J.G.L.M. Lamers and N. Langer added stellar and galaxy evolution to the research program, the university contingent dwindled down to only 8 academic and 2 support staff at the time of the closure. Fortunately, externally funded (NWO, NOVA, EC) graduate students, postdocs and overlap staff plus the high quality of teaching and students compensated for this trend, so that critical mass and a lively research and professional education environment were maintained.

Also in the more meager recent years Utrecht astronomy maintained a steady production of first-class astrophysicists, exploiting the field’s attractiveness to gifted students. Many now work in astrophysics abroad (seventeen in solar physics alone). In addition, numerous Utrecht-trained astronomers enrich wider society. The national Dutch meteorology institute was the largest taker, employing many in climate research where knowledge of numerical radiative transfer is a valuable asset. Others became researcher in fields ranging from physics (theoretical, nuclear, technical, medical) to Akkadian, or started a career as, e.g., teaching-academy teacher, high-school teacher, business analyst, oil explorer, systems analyst, software engineer, aerospace engineer, human resources manager, musician, publicist, popular-science journalist, car importer, and more.

C.U. Keller (chair experimental astrophysics) became SIU director in 2009 and started a new instrumentation program for spectropolarimetry. Utrecht was even slated to become the Dutch center for optical and infrared astronomy instrumentation, next to already having the main Dutch center for space research. Stronger ties with the latter were also formalized and funded by Utrecht University. There were advanced plans to co-locate the SIU, NOVA instrumentation, and SRON in a new building. The sudden stupidity of the Utrecht University board upset these bright prospects. The Utrecht astronomers moved elsewhere to continue their research, but the SIU, Utrecht solar physics, and Utrecht astronomy education are irreparably gone.

At this loss of its close partner SRON decided to leave Utrecht. It first selected Amsterdam but then found better connections at Leiden (astronomy there, technology in Delft) and moved to a new building on the Leiden science campus in 2021. All that remains in Utrecht is Museum Sterrewacht Sonnenborgh and the astronomy record embodied in the 171 PhD theses listed below. Another Utrecht University scandal is that these are not scanned into web-available pdf’s.

I spent fifty years in Utrecht astrophysics, the first half at Sterrewacht Sonnenborgh where I started in 1961 following Minnaert’s courses and practica, the second half at the Sterrekundig Instituut Utrecht in De Uithof until its termination.

Utrecht solar physics

List of Utrecht astronomy PhDs

Sterrewacht Sonnenborgh

M.G.J. Minnaert’s beschrijving van Sterrewacht Sonnenborgh uit 1953

C. de Jager’s beschrijving van Sterrewacht Sonnenborgh, 1977

Hans Nieuwenhuijzen's photographs 1956-2012

Leo Molenaar's brochure over Minnaert bij de opening van het Minnaertgebouw in 1998

Leo Molenaar's biografie van Minnaert "De rok van het universum"

C. de Jager's overview at the farewell

Sterrekundig Instituut Utrecht

Buys Ballot Laboratorium

Archived SIU webpage

Former directions to get to the SIU: [html](#) [pdf](#)

3.4 Utrecht solar physics

Utrecht solar physics = Dutch solar physics is dead. It abruptly transitioned from high international standing to nothing. At present I remain the only researcher active in solar physics in The Netherlands (excepting international scientists at ESA's ESTEC facility).

The motto of Utrecht University is *Sol iustitiae illustra nos* ("The Sun of justice enlightens us"). It should be: *Sol scientiae fabula est* ("The Sun of science is gone"). As is Utrecht solar physics. In 2007 Utrecht University stopped supporting the Dutch Open Telescope because the other Dutch universities "did not share interest in solar physics" (we had a well-orchestrated task division). In 2011 Utrecht University killed all its astronomy because the other major Dutch universities (at Leiden, Amsterdam, Groningen and Nijmegen) do astronomy too. In profiling itself as differing from them and targeting "useful" science only, Utrecht University could/should have revived its former specialistic eminence in solar physics and space-weather research – the branch of astrophysics with direct economical relevance – instead of scrapping also this world-famous expertise. I suspect that the board of Utrecht University wasn't even aware that they killed this field nation-wide when discarding its astronomy education.

The legacy of Utrecht solar physics lives on in the form of the many Utrecht alumni who remain active in solar physics research elsewhere. They collectively embody the great name that Utrecht University had in this field but discarded. At the time of closure (2011, in PhD order): Henk Spruit (Germany), Aad van Ballegooijen (USA), Piet Martens (USA), Karel Schrijver (USA), Paul Hick (USA), Han Uitenbroek (USA), Jo Bruls (Germany), Martin Volwerk (Austria), Kostas Tziotziou (Greece), Luc Rouppe van der Voort (Norway), Michiel van Noort (Germany), Alfred de Wijn (USA), Jorrit Leenaarts (Norway), Nikola Vitas (Spain), Catherine Fischer (ESA), Gregal Vissers (Norway), Tijmen van Wetum (Germany). Plus (at the time of closure) active-pensioner Utrecht alumni Kees de Jager (Texel), Jacques Beckers (USA), and myself ([Lingezicht](#)).

Utrecht solar physics has a rich history, with Minnaert, de Jager, and Zwaan as successive protagonists. It started a century ago with solar spectroscopy (including eclipse expeditions) by J.H. Julius at the Utrecht physics laboratory. His collaborator M.G.J. Minnaert, a most eminent scientist and outstanding person, had fled from Belgium (with a PhD in biology) to escape forced-labor imprisonment as convicted Flamingant. Minnaert revived Sterrewacht Sonnenborgh in the 1930s (choosing not to depart to Chicago and become director of Yerkes Observatory; Chandrasekhar got the job instead) and turned it into a well-known astrophysics institute specialising in solar spectrum analysis. He moved Julius' solar telescope and spectrograph to the observatory and developed the concepts of equivalent width and curve of growth to measure and interpret the strength of Fraunhofer lines, laying the basis for quantitative astrophysical spectrometry. In those years he also completed the three volumes of his famous outdoor physics trilogy. The Dutch originals ("De natuurkunde van 't vrije veld") are now available, with biographies and other material, at the DNBL digitale bibliotheek.

The famous Utrecht Atlas of the solar spectrum was completed just before the second world war. The spectrum plates were taken by G.F.W. Mulders at Mount Wilson. (Mulders later became a director of the US National Science Foundation while another Minnaert pupil, J.H. Bannier, became the first director of the Dutch science foundation (ZWO) and an important architect for ESRO (later ESA), ESO, and CERN.) The plates were scanned by Minnaert and J. Houtgast with an ingenious version of Moll's microdensitometer that applied analog optical conversion of emulsion opacities into solar intensities, as illustrated in the prefaces to the atlas (two, in English but also in Esperanto, one of Minnaert's many languages).

In 1942 (the year I was born) Houtgast defended his landmark PhD thesis establishing the importance of frequency redistribution in solar line formation. Minnaert was his supervisor but was then taken hostage by the Germans. A year later Houtgast permitted students C. de Jager and H. Hubenet to escape deportation to Germany by hiding at the observatory, of which they had the run at night.

Towards the end of the war, knowledge of spectral line formation gained by studying the telluric oxygen lines in the Atlas enabled H.C. van de Hulst to answer J.H. Oort's question whether potentially useful spectral lines exist at radio wavelengths. He asked Léon Rosenfeld (then professor at Utrecht) for advice, was pointed to hydrogen ground-state hyperfine structure, and predicted that the corresponding hydrogen 21-cm line should be suited for then-infant galactic radio astronomy at sufficient neutral-hydrogen gas along the line of sight. By that time solar/stellar spectroscopy was a quantitative science, but radiative transfer had become too complex for further analytical development and awaited the advent of computers. Van de Hulst moved to Leiden and turned to scattering in planetary atmospheres for which progress could still be made analytically, his main topic since.

After the war Minnaert and Houtgast undertook the gigantic task of manually measuring all Fraunhofer lines in the Atlas, with everybody at the Sterrewacht participating as so-called "computer". Charlotte E. Moore (US Naval Research Laboratory) contributed the identifications from her Revised Multiplet Table (ADS 1945CoPri..20....1M). Here is the Moore-Minnaert-Houtgast table of the solar spectrum (ADS: 1966sst..book.....M). Here is part of the Acknowledgements naming some computers (the Misses).

C. de Jager took over from Minnaert after his thesis on the solar hydrogen lines using the Sonnenborgh spectrograph. He brilliantly led a fast expansion adding groups in solar radio astronomy (A.D. Fokker), solar plasma astrophysics (M. Kuperus), and X-ray solar-flare research (at SRON). After his mandatory retirement in 1986 he concentrated on giant stars; after returning to Texel on solar climate forcing. Houtgast kept to flash-spectrum photography at eclipses taking me to Greece, Brazil, and Mexico. M. Kuperus and J.M.E. Kuijpers moved from solar plasma astrophysics to accretion disks; J.M.E. Kuijpers then moved to Nijmegen and revived astronomy there. C. Zwaan continued Minnaert's optical solar physics tradition adding emphasis on solar magnetism and sun-inspired cool-star activity, and also inspired R.H. Hammerschlag to build the Dutch Open Telescope.

Chromospheric physics with the DOT was my main emphasis during the final decade of Utrecht solar physics. I also followed Zwaan's example in teaching spectral line formation to hundreds of students. At my mandatory retirement in 2007 C.U. Keller (spectropolarimetry) and A. Vögler (numerical magnetohydrodynamics) were the solar physicists on the SIU staff. At the closure they and their postdocs and graduate students, engineers F.C.M. Bettonvil, A. Jägers and G. Sliepen, and active-pensioners R.H. Hammerschlag and me constituted the largest group in the SIU. Now Dutch solar physics consists mainly of me working at home.

List of Utrecht University PhD's with solar physics as thesis subject:

J.B. Hubrecht (1915): *The solar rotation in June 1911 from spectrographic observations*

A.S.P.J.M. Wanders (1933): *Onderzoekingen over de straling der zonnevlekken*

G.F.W. Mulders (1934): *Aequivalente breedten van Fraunhoferlijnen in het zonnespectrum*

A.P.H. van der Meer (1936): *Onderzoek naar variaties in de aequivalente breedten van Fraunhoferlijnen in het zonnespectrum*

J. Houtgast (1942): *The variations in the profiles of strong Fraunhofer lines along a radius of the solar disc*

W.J. Claas (1951): *The composition of the solar atmosphere*

C. de Jager (1952): *The hydrogen spectrum of the sun*

H. Hubenet (1960): *The influence of the photospheric model on the determination of the solar composition*

A. Schadee (1964): *The formation of molecular lines in the solar spectrum*

J.M. Beckers (1964): *A study of the fine structures in the solar chromosphere*

M. Kuperus (1965): *The transfer of mechanical energy in the sun and the heating of the corona*

J.R.W. Heintze (1965): *The extreme limb of the sun*

C. Zwaan (1965): *Sunspot models, a study of sunspot spectra*

T. de Groot (1966): *Weak solar radio bursts*

L.D. de Feiter (1966): *Analysis of the Balmer spectrum of solar flares*

J. Roosen (1968): *Some features of the solar microwave emission*

J. van Nieuwkoop (1971): *A multi-channel solar radio spectrograph*

- A.C. Brinkman (1972): *Instrumentation for the detection of solar soft X-rays and the analysis of a solar event*
 H.F. van Beek (1973): *Development and performance of a solar hard X-ray spectrometer*
 J. Rosenberg (1973): *Instabilities in the solar corona*
 J.M.E. Kuijpers (1975): *Collective wave-particle interactions in solar type IV radio sources*
 P. Hoyng (1975): *Studies on hard X-ray emission from solar flares and on cyclotron radiation from a cold magnetoplasma*
 R.J. Rutten (1976): *Solar eclipse observations and Ba II line formation*
 H.C. Spruit (1977): *Magnetic flux tubes and transport of heat in the convection zone of the sun*
 W.J. Weber (1978): *The dynamics of coronal magnetic structures*
 A. Greve (1978): *High resolution UV observations and the formation of the solar Mg II resonance lines*
 W. van Tend (1979): *Magnetohydrodynamic and thermal processes in solar flare energy build-up and release*
 A. Kattenberg (1981): *Solar radio bursts and their relation to coronal magnetic structures*
 C. Slottje (1982): *Atlas of fine structures of dynamic spectra*
 F. Middelkoop (1982): *Ca II H and K emission from late-type stars*
 N.P.M. Kuin (1982): *Stellar coronae and their mass loss*
 A.A. van Ballegooijen (1982): *Sunspots and the physics of magnetic flux tubes in the sun*
 P.C.H. Martens (1983): *Non linearity and instability in stellar coronae*
 A. Duyveman (1983): *X-Ray imaging and interpretation of impulsive solar flare phenomena*
 J.S. Kaastra (1985): *Solar flares, an electrodynamic model*
 B.J. Oranje (1985): *Solar-type stellar chromospheres, an observational study of the outer atmospheres of cool stars*
 J.J. Brants (1985): *Observational study of the birth of a solar active region*
 C.J. Schrijver (1986): *Stellar magnetic activity, complementing conclusions based on solar and stellar observations*
 G.H.J. van den Oord (1987): *Stellar flares*
 P.P.L. Hick (1988): *Interpretations of energetic phenomena in the solar corona*
 H. Uitenbroek (1990): *Partial redistribution modeling of the Ca II K line*
 J.H.M.J. Bruls (1992): *Formation of diagnostic lines in the solar spectrum*
 J.H.G.M. van Geffen (1993): *Magnetic energy balance and period stability of the solar dynamo*
 K.L. Harvey-Angle (1993): *Magnetic bipoles on the Sun*
 M. Volwerk (1993): *Strong double layers in astrophysical plasmas*
 L.H. Strous (1994): *Dynamics in solar active regions*
 K.F. Tapping (1995): *Discrete microwave sources in solar active regions*
 A.J.H. Ossendrijver (1996): *Fluctuations and energy balance in solar and stellar dynamos*
 K. Tziotziou (1997): *Dynamics of stellar coronae*
 N.M. Hoekzema (1997): *Statistical studies of dynamical structures in the solar atmosphere*
 N.A.J. Schutgens (1998): *Oscillating prominences*
 H.J. Hagenaar (1999): *Flows and magnetic patterns on the solar surface*
 J.M. Krijger (2002): *Structure and dynamics of the solar chromosphere*
 A.G. de Wijn (2006): *Dynamics of fine structure in the solar chromosphere*
 J. Leenaarts (2007): *Numerical simulations of the solar atmosphere*
 F. Snik (2009): *Astronomical polarimetry: new concepts; new instruments; new measurements & observations*
 N. Vitas (2011): *Observational signatures of the simulated solar photosphere*
 C.E. Fischer (2011): *Transient events in the solar photosphere at high spatial and temporal resolution*

3.5 Utrecht eclipse expeditions

UTRECHTSE ECLIPSEXPEDITIES

Datum	Plaats	Deelnemers
18 mei 1901	Karang Sago, Sumatra	Julius, Nijland, Wilterdink
30 aug 1905	Burgos, Spanje	Julius, Nijland, Wilterdink
17 apr 1912	Maastricht	Julius, Nijland, Moll, Muller, van der Stok, van der Bilt, Vening Meinesz en vele anderen
21 aug 1914	Harnosand, Zweden	van der Bilt, Moll
14 jan 1926	Palembang, Sumatra	van der Bilt, Minnaert, Moll, Pannekoek
29 jun 1927	Gallivare, Zweden	Pannekoek, Minnaert, Doorn, Bleeker
2 mei 1929	Idi, Sumatra	van der Bilt, Minnaert, van Wijk, Kuiper, Gorter
25 feb 1952	Khartoem, Soedan	Houtgast, Zanstra, Zwaan
30 jun 1954	Gotland, Zweden	Houtgast, Minnaert, Heintze, van Straten
20 jun 1955	Hingurakgoda, Ceylon	Houtgast, van Straten
2 okt 1959	Gran Tarajal, Fuerte Ventura, Canarische Eilanden	Houtgast, Koelbloed, de Groot, Kuperus, Schadee, Minnaert, van Straten, van den Broek
15 feb 1961	Brac, Joegoslavië	Houtgast, Koelbloed, de Groot, Nieuwenhuijzen, van Straten
20 jul 1963	Lac 'a la Tortu'e Canada	Koelbloed, de Groot, Schuurmans, Aalbers, van Straten, van den Broek
30 mei 1965	NASA vliegtuig	de Groot
20 mei 1966	Saronis, Griekenland	Houtgast, Namba, Rutten, van den Broek, de Groot, Jansen
12 nov 1966	Bage, Brazilië	Houtgast, Namba, Rutten, van den Broek
7 mrt 1970	Miahuatlan, Mexico	Houtgast, Namba, Rutten, de Graauw, van den Broek, van Amerongen
30 jun 1973	Atar, Mauretanië	Houtgast, Namba, van den Broek,

van Amerongen, van Drie

 Compilatie: Osamu Namba

3.6 Sterrewacht Sonnenborgh

Utrecht astronomy was housed from 1863 until 1987 as “Sterrewacht Sonnenborgh” on Zonnenburg, a city-wall fortification built in 1552. Its history is well described in these brochures (in Dutch) by Minnaert and De Jager:

M.G.J. Minnaert's beschrijving van Sterrewacht Sonnenborgh uit 1953

C. de Jager's beschrijving van Sterrewacht Sonnenborgh uit 1977

See also:

Hans Nieuwenhuijzen's photographs 1956-1969

The buildings at Zonnenburg now house “Museum Sterrewacht Sonnenborgh”. C. de Jager played a key role in its creation.

3.7 Buys Ballot Laboratorium

In 1987 Utrecht astronomy (“vakgroep Sterrekunde”) moved from Sterrewacht Sonnenborgh to the top floor of the “Laboratorium voor Experimentele Fysica” in De Uithof, a seven-floor 1970s concrete monstrosity on the campus of Utrecht University just East of the city.

On my instigation this building was renamed “Buys Ballot Laboratorium” after C.H.D. Buys Ballot, a physicist who in 1863 had started the Utrecht astronomical observatory together with the Dutch institute for meteorology at Zonnenburg. Actually, I proposed to call it “building” rather than “laboratory” since there was not much experimental physics anymore at that time already; most rooms held just desks with X-terminals or then new personal computers (especially Atari-STs). The director of the “Subfaculteit Natuur- en Sterrenkunde” accepted the renaming but stuck to “laboratory” although his own group in flame spectroscopy was also gone (the astronomers taking its floor).

Eventually, in 2011, the building was finally renamed to “Buys Ballot building” taking off the “Laboratory”, but already in 2000 I had suggested a much more appropriate name. Presently there is no astronomy and almost no physics anymore in this building. Only the Institute for Marine and Atmospheric Research still warrants naming the building after Buys Ballot.

It remains an monstrosity despite endless renovations. Some of these, including asbestos removal, tried and still try to remedy its ill fame of sick building. I wonder whether the persistent but ill-diagnosed breathing problem I developed during my later decades there came from my daily climbing its entire nonventilated stairwell as deep-breathing exercise.

3.8 Sterrekundig Instituut Utrecht

When Utrecht astronomy moved in 1987 from Sterrewacht Sonnenborgh to the Buys Ballot Laboratorium in campus “De Uithof”, at my suggestion it renamed itself “Sterrekundig Instituut Utrecht” (SIU). The classical spelling was maintained when the official spelling changed later to sterrenkundig, just as in “Sterrewacht Leiden”, because spelling changes should not affect given names. (I prefer the singular anyhow because one star suffices for a lifetime of astronomical research.)

Thus, the SIU started in November 1987. It ceased to exist in early 2012, ending 370 years of astronomy at Utrecht University.

Archived 2011 SIU webpage

Archived 2002 SIU webpage

3.9 Curriculum information for Utrecht University astronomy students

Warning: all this is obsolete: Utrecht University, therefore no longer a university, has no astronomy program anymore. Files that no longer open may be found in in this content tree.

F.M. Verbunt replaced me as Utrecht University astronomy education coordinator from the start of academic year 2006-2007 in which I retired. The texts and files in this directory are from 2004–2006 and not updated. They demonstrate the vigorousness of the Utrecht astronomy program at the time.

3.9.1 Utrecht education in astronomy

Warning: all this is obsolete: Utrecht University, therefore no longer a university, has no astronomy program since 2011. Files that no longer open may be found in in this content tree.

The above link leads to a directory with files which I used to maintain as coordinator of Utrecht University astronomy education. They are/were condensed versions of the information in the "studiegids".

File masters-summary.pdf summarizes the UU Masters in Astrophysics program dd. 2005. It ceased to exist in 2011.

File astron-program.txt summarizes the UU astronomy study requirements dd. 2005 in telegram style.

File astron-courses-2004-05.txt summarizes the 2004-05 UU astronomy curriculum.

File astron-courses-2005-06.txt summarizes the 2005-06 UU astronomy curriculum.

Subdirectory schedules contains files copied from the Faculteit Natuur- en Sterrenkunde education schedule site.

For course descriptions go to Courses 2004-2005 and Courses 2005-2006.

Information about astronomy minors.

Other files in the above directory concern assistant schedules and rules and guidelines.

The astronomy study adviser is Dr. Onno Pols.

3.9.2 Masters Astrophysics

File masters-summary.pdf summarizes Utrecht University's "M.Sc. in Astrophysics" program dd. 2005. It ceased to exist in 2011.

3.9.3 Courses 2005 - 2006

Click/tap on UU codes below to open the on-line description + schedule in the UU Osiris course catalog (if it isn't down).

Click/tap course titles below for information from the teacher(s).

First year any UU Bachelor program

<i>UU code</i>	<i>SIU code</i>	<i>teacher</i>	<i>title</i>	<i>credit</i>	<i>period</i>	<i>time slots</i>
<u>NS-190BP</u>	POET	Lamers + Heise + Hoyng	Het fascinerend heelal	7.5 ECTS	2	Ca + Cb

First year *B.Sc. Physics & Astronomy*

<i>UU code</i>	<i>SIU code</i>	<i>teacher</i>	<i>title</i>	<i>credit</i>	<i>period</i>	<i>time slots</i>
<u>NS-151B</u>	STAR	Verbunt	Inleiding bouw en ontwikkeling sterren	7.5 ECTS	2 +3	Ca + Cb
<u>NS-152B</u>	UNIV	Achterberg	Ontstaan en evolutie van het heelal	7.5 ECTS	4	Ca + Cb

Second year *B.Sc. Physics & Astronomy*

<u>UU code</u>	<u>SIU code</u>	<u>teacher</u>	<u>title</u>	<u>credit</u>	<u>period</u>	<u>time slots</u>
<u>NS-252B</u>	IART	Rutten	Introduction to Astrophysical Radiative Transfer	7.5 ECTS	2	Ca + Cb
<u>NS-253B</u>	IAGD	Achterberg	Introduction to Astrophysical Gas Dynamics	3.75 ECTS	3	Cb
<u>NS-281B</u>	OAF1	Bleeker	Observational Astrophysics 1	3.75 ECTS	4	Cb

Advanced Astrophysics Courses third year *B.Sc. Physics & Astronomy* and/or *M.Sc. Astrophysics*

<u>UU code</u>	<u>SIU code</u>	<u>teacher</u>	<u>title</u>	<u>credit</u>	<u>period</u>	<u>time slots</u>
<u>NS-AP427M</u>	WIND	Lamers	Stellar Winds and Mass Loss	7.5 ECTS	1	Ca + Cb
<u>NS-AP428M</u>	IAC	van Langevelde et al.	Interferometry	6 ECTS	3 + 4	alternate Wed
<u>NS-AP429M</u>	AGN	Mendez + Kaastra	Active Galactic Nuclei	7.5 ECTS	3 + 4	Ba
<u>NS-AP430M</u>	MHD	Keppens	MHD of Astrophysical Plasmas	7.5 ECTS	1 + 2	Wed
<u>NS-AP433M</u>	OAF2	Verbunt + Bleeker	Observational Astrophysics 2	7.5 ECTS	1 + 2	Ab
<u>NS-AP434M</u>	STEV	Pols	Stellar Evolution	7.5 ECTS	1	Ba + Bb
<u>NS-AP436M</u>	TRAN	Langer + in 't Zand	Stellar Transients	7.5 ECTS	4	Aaa + Ab + Daa + Db
<u>NS-AP437M</u>	NUCL	Langer	Nucleosynthesis	7.5 ECTS	2	Ba + Bb
<u>NS-AP438M</u>	BIN	Pols + Verbunt	Binary Stars	7.5 ECTS	3 + 4	Bb
<u>NS-AP439M</u>	SOL	Rutten + Keller	Solar Physics	7.5 ECTS	3	Aaa + Ab + Daa + Db

Periods:

1 = weeks 36 - 44 2 = weeks 46 - 04 3 = weeks 06 - 15 4 = weeks 17 - 26
 Weeks 45, 1, 5, 12, 16, 27 and 28 are reserved for examinations.

Time slots:

Aa = Mon 9-11 + Wed 11-13 Aaa = Mon 9-11 Ab = Mon 11-13 + Wed 9-11
 Ba = Tue 9-11 + Thu 13-15 Bb = Tue 11-13 + Thu 15-17
 Ca = Mon 13-17 + Thu 9-11 Cb = Tue 13-17 + Thu 11-13
 Da = Wed 13-17 + Fri 9-11 Daa = Fri 9-11 Db = Fri 11-17
 The national NOVA courses MHD and IAC are on Wednesdays 11-17 (the IAC on alternate Wednesdays).

3.9.4 Courses 2004 - 2005

Click on the UU codes below to open the on-line description + schedule in the [UU Osiris course catalog](#) (if it isn't down).

Click on the SIU codes below to get a pdf printer copy from [my download collection](#).

Click/tap course titles below for up-to-date information from the teacher(s).

First year *B.Sc. Physics & Astronomy*

<u>UU code</u>	<u>SIU code</u>	<u>teacher</u>	<u>title</u>	<u>credit</u>	<u>period</u>	<u>time slots</u>
<u>NS-151B</u>	<u>STAR</u>	Verbunt	Inleiding bouw en ontwikkeling sterren	7.5 ECTS	3	Ca + Cb
<u>NS-152B</u>	<u>UNIV</u>	Achterberg	Ontstaan en evolutie van het heelal	7.5 ECTS	4	Ca + Cb

Second year *B.Sc. Physics & Astronomy*

<u>UU code</u>	<u>SIU code</u>	<u>teacher</u>	<u>title</u>	<u>credit</u>	<u>period</u>	<u>time slots</u>
<u>NS-252B</u>	<u>IART</u>	Rutten	Introduction to Astrophysical Radiative Transfer	7.5 ECTS	2	Ca + Cb
<u>NS-253B</u>	<u>IAGD</u>	Achterberg	Introduction to Astrophysical Gas Dynamics	3.75 ECTS	3	Cb
<u>NS-281B</u>	<u>OAF1</u>	Bleeker	Observational Astrophysics 1	3.75 ECTS	4	Cb

Advanced Astrophysics courses (third year *B.Sc. Physics & Astronomy* and/or *M.Sc. Astrophysics*)

UU code	SIU code	teacher(s)	title	credit	period	time
<u>NS-AP426M</u>	<u>RTSA</u>	Rutten	Radiative Transfer in Stellar Atmospheres	7.5 ECTS	3	Aaa + Ab +
<u>NS-AP428M</u>	<u>IAC</u>	Icke + Portegies Zwart	Computational Astrophysics	6 ECTS	3 + 4	alterna
<u>NS-AP430M</u>	<u>MHD</u>	Goedbloed + Keppens	MHD of Astrophysical Plasmas	7.5 ECTS	1 + 2	W
<u>NS-AP431M</u>	<u>GRTA</u>	Hoyng + Heise	General Relativity in Astronomy	7.5 ECTS	3 + 4	C
<u>NS-AP432M</u>	<u>GAL</u>	Lamers	Galaxies	7.5 ECTS	1	Ca +
<u>NS-AP433M</u>	<u>OAF2</u>	Verbunt + Bleeker	Observational Astrophysics 2	7.5 ECTS	3 + 4	E
<u>NS-AP434M</u>	<u>STEV</u>	Pols	Stellar Evolution	7.5 ECTS	2	Ca +
<u>NS-AP435M</u>	<u>HEA</u>	Verbunt	High Energy Astrophysics	7.5 ECTS	1 + 2	A
<u>NS-AP436M</u>	<u>TRAN</u>	Langer	Stellar Transients	7.5 ECTS	4	Aaa + Ab +
<u>NS-AP437M</u>	<u>NUCL</u>	Langer	Nucleosynthesis	7.5 ECTS	1	Ba +

Periods:

1 = weeks 37 - 46 2 = weeks 47 - 05 3 = weeks 06 - 16 4 = weeks 17 - 27

The last week of each period is reserved for examinations.

Time slots:

Aa = Mon 9-11 + Wed 11-13

Aaa = Mon 9-11

Ab = Mon 11-13 + Wed 9-11

Ba = Tue 9-11 + Thu 13-15

Bb = Tue 11-13 + Thu 15-17

Ca = Mon 13-17 + Thu 9-11

Cb = Tue 13-17 + Thu 11-13

Da = Wed 13-17 + Fri 9-11

Daa = Fri 9-11

Db = Fri 11-17

The national NOVA courses MHD and IAC are on Wednesdays 11-17 (IAC on alternate Wednesdays, in Aardwetenschappen).

3.9.5 Student research in astronomy

Warning: all this is obsolete: Utrecht University, therefore no longer a university, has no astronomy program anymore. Many links don't work anymore.

Utrecht University *B.Sc. Physics & Astronomy* research projects in astronomy, *M.Sc. Astrophysics* research projects, and *Astrovaria* projects must be supervised by an SIU staff member (A. Achterberg, R. Hammerschlag, C. Keller, H. Lamers, S. Larsen, N. Langer, O. Pols, R. Rutten, F. Verbunt, J. Vink) or by an external staff member involved in Utrecht University astronomy education (at SRON Utrecht: J. Bleeker, J. Heise, P. Hoyng, J. Kaastra, M. Mendez, J. in 't Zand; at FOM Rijnhuizen: R. Keppens). Their colleagues, postdocs and PhD students may share in the supervision under their responsibility. Student research may also be undertaken outside Utrecht under the responsibility of one of the above as co-supervisor.

B.Sc. Physics & Astronomy research projects are 15 ECTS (10 weeks = 1 "periode" = 0.5 semester full-time).

M.Sc. Astrophysics research projects are 60 ECTS (one year full-time).

Astrovaria projects are 7.5 ECTS (5 weeks full-time).

The selection of a supervisor, the definition of a research project, and its scheduling are a matter of negotiation between student and potential supervisor. This is a free market mechanism in which the student should take the initiative. Find out who is doing what, identify research topics and supervisors that suit you, and then enter into negotiation with the appropriate staff member.

Your *B.Sc. Physics & Astronomy* or *M.Sc. Astrophysics* research must start with formal "onderzoeksagenda" registration.

Presentations: *B.Sc. Physics & Astronomy* research in astronomy must be reported at its completion in a SIU student seminar. *M.Sc. Astrophysics* research must be outlined initially, after a few weeks of literature study, in a SIU student seminar and be presented at its completion in a SIU-SRON lunch talk. It is highly recommended to submit a poster presentation of *M.Sc. Astrophysics* research for the yearly Nederlandse Astronomenconferentie.

3.10 Dutch Open Telescope

The DOT is not truly past since it still stands intact on La Palma, but it has not been used for solar observations since 2010 for lack of funding. See the [DOT webpages](#).

3.11 Students-to-the-DOT program

Warning: all this is obsolete: Utrecht University, therefore no longer a university, has no astronomy program anymore. Links may not work anymore.

The "Students-to-the-DOT" program brought pairs of students for two weeks to La Palma to receive intensive on-the-spot tutoring in solar physics, astronomical observing techniques, image processing, and data interpretation. Tutoring was by Prof. R.J. Rutten (solar physics), Dr. P. Sütterlin (solar physics and image processing), Ir. F.C.M. Bettonvil (observing techniques), Dr. R.J. Hammerschlag (telescope design), and the assorted guest observers at the DOT and SST.

Each student was assigned a solar physics research topic including analysis of recent data. The project generally started with a week of introductory solar physics study at the home institute, two weeks at the Roque de los Muchachos Observatory, and either two weeks of completion and report writing at the home institute for an allocation of 7.5 ECTS, or seven weeks of further research for 15 ECTS. Both Bachelor's and Master's students were eligible.

Additional student activities on La Palma were the giving of presentations in the Utrecht-Stockholm-Oslo Seminar Series, sharing in DOT observing, orientation at the SST, and excursions to nighttime telescopes at the Roque de los Muchachos Observatory including Grantecan, the largest optical telescope worldwide.

The highly successful program operated during 2004–2007, bringing 28 students to La Palma. It terminated when Utrecht University terminated its DOT funding on January 1, 2008.

DOT student manuals: [La Palma](#) [LaTeX & BibTeX](#) [IDL](#) [Linux](#)

DOT students 2004:

Selma de Mink & Dagmar de Rooij

Marcel Haas & Jacob van Peet

[thumbnail album](#)

DOT students 2005:

Sebastiaan Keek & Bob van Veelen

Ernst Kuiper & Incognito

Klaartje Schure & Tim van Werkhoven

Mirte Kraaijkamp & Ivana Sersic

Fedde Benedictus & Daan van Eijk

[thumbnail album](#)

DOT students 2006:

Catherine Fischer, Judith Palacios, Juan Martinez Sykora (USO), Arek Berlicki (ESMN) & Prisca Zwaan (SOZOU)

Luc Rouppe van der Voort & Peter Jonker

Hesdy Hoekstra & Marijke Huijgen-Holsappel

Gregal Vissers

Jeroen Burgers & Marcin Dukalski

[thumbnail album](#)

DOT students 2007:

Helena Becher, Vasco Henriques, Leandro Jesus, Nikola Vitas

Pedzi Girigori & Reinier Zeldenrust

[thumbnail album](#)

3.12 DOT material

This is obsolete stuff shifted here from the [DOT website](#) in 2008 when Utrecht University stopped its funding of this project (my mandatory retirement was in 2007). It described the various plans that we had for the telescope and the science we planned to make feasible. The argument for ending the DOT funding was that Utrecht University stood apart in uniquely doing solar physics in The Netherlands. The closure of all Utrecht astronomy four years later used the opposite argument that Utrecht University should not do what other Dutch universities do also.

3.12.1 DOT science context, status, projects

DOT science context The paradigm of stellar activity says that stellar coronae and chromospheres are heated magnetically, but it remains an open question how this comes about. Since the fields are anchored in the dense gas at the solar surface, the dynamics of flux tubes, pores and spots lie at the root of outer-atmosphere heating. By combining high-resolution surface imaging and magnetometry with ultraviolet spectrometry and coronal imaging from space, one may correlate and trace surface topology and motions and the corresponding chromospheric topology and dynamics in magnetic structures tomographically, all the way out into the optically-thin plasma regime.

Other DOT science goals consist of studying the emergence and decay patterns of solar magnetic fields, the photospheric-chromospheric dynamic connection in non-magnetic regions, the fine structure of plage and sunspots, and the fine structure of prominences.

More detail is given below, especially for tomographic “proxy magnetometry” which constitutes the principal DOT science strength.

Solar magnetism Magnetism lies at the root of most solar and heliospheric physics. The intricate structure of the solar field, the activity cycle and the influence of the field on the heliosphere represent major quests of (astro-)physics which bear directly on the human environment. The sun's magnetic field is generated by enigmatic dynamo processes in the solar interior, is organised into the highly complex patterns of solar activity observed in the solar photosphere, dominates the structure of the outer solar atmosphere (chromosphere, transition region, corona), regulates the solar wind, and affects the whole extended heliosphere.

In terms of pure science, solar magnetism provides the Rosetta stone of cosmic magnetism, not only in other stars but also in accretion disks, cataclysmic variables, galactic dynamics, active galactic nuclei and other cosmic objects in which MHD and plasma processes control the structure and energy partitioning. The sun is close enough to study these processes in observable detail.

Terrestrial plasma confinement machines do not reach the scales, densities and temperatures exhibited in the solar atmosphere. Solar physics complements plasma instability studies in fusion research, the sun representing a non-terrestrial plasma physics laboratory.

Space weather (the solar influence on the near-earth environment and the Earth's climate) is set by solar magnetism. Solar activity modulation affects satellite orbits, influences jet stream patterns and contributes to the causes of minor, possibly major, ice ages.

Solar surface magnetism is the key for advance in these research areas. At the surface, the magnetic field wins from the gas pressure: the plasma beta parameter (ratio of gas to magnetic pressure) flips from large to small across unity, so that the field role switches from being dominated by gas motions to dominating gas motions. At the solar surface, the field displays patterning imposed by the subsurface dynamo and convective flows while, at the same time, it controls flows and wave motions to the outer atmosphere. This flip in domination makes it desirable to observe the magnetic field patterning simultaneously in the photosphere and the overlying chromosphere. The DOT is specifically suited to such solar surface magnetometry with high spatial (angular) resolution.

The solar atmosphere changes dramatically between different regimes and presents drastically different scenes to the terrestrial observer at different wavelengths. The solar photosphere, defined as the layer where the bulk of the

electromagnetic radiation escapes as visible light (a dramatic transition from near-equilibrium photon enclosure, killing off the subsurface convection into the shallow pancake pattern called granulation) is also the layer where magnetic fields take over from gas dynamics in dictating the structuring and in supplying the key processes, and it is also the outermost layer where the sun may be regarded as spherical in zero-order approximation. The chromosphere is magnetically split into network and internetwork in quiet regions and is very finely structured above active regions. The transition to the corona consists of tiny fibrils with much variation in length, inclination, and ordering. The closed-field parts of the corona outside coronal holes are made up of bundles of very thin coronal loops. Yet unidentified processes supply energy to the gas in these loops, reaching a balance against cooling by X-ray photon losses at temperatures of 1–2 million K.

The loops are magnetically anchored (in unknown fashion) to the strong-field flux tubes that break out of the photosphere and respond dynamically on a wide variety of timescales to the footpoint forcing. These magnetic connections between very disparate regimes, from gas dynamics via magnetohydrodynamics to plasma physics and from LTE radiation enclosure to X-ray photon drain, require simultaneous study of structures, processes and radiation in the photosphere, chromosphere, transition region and corona. This calls for tomographic diagnostics sampling the different regimes at the same time.

Reference: "Solar Surface Magnetism", Edited by R.J. Rutten and C.J. Schrijver, NATO ASI Series C433, Kluwer, Dordrecht

High-resolution proxy magnetometry With its speckle data-acquisition system, the DOT became the first solar telescope to regularly provide long-duration (multiple hours) image sequences at consistent 0.2 arcsec resolution over a sizable field (90 x 70 arcsec). The DOT speckle processor enables storage and fast speckle processing for daily observing runs of up to 8 hours duration using all DOT cameras at 15-20 s speckle burst cadence. With its multi-wavelength speckle system the DOT also became an unparalleled mapper of the magnetic topology and its dynamics in tomographic fashion, simultaneously for the photosphere (G band), low chromosphere (Ca II H), and high chromosphere (tuned H α), and of the radial photospheric Doppler velocity (Ba II 4554).

This long-duration high-resolution multi-wavelength imaging capability presents a unique opportunity within solar physics to study the horizontal topology and vertical structure of solar magnetic fields. Such tomographic high-resolution imaging is also desirable as context information to high-resolution spectropolarimetry at other telescopes employing adaptive optics, and to coronal field mapping using ultraviolet and X-ray image sequences from space. This section discusses DOT tomographic imaging in terms of its "proxy magnetometry" information content in some depth.

Solar surface magnetism consists of a remarkable hierarchy of discrete strong-field structures. The basic entity is the *flux tube*, a key concept of MHD astrophysics. Solar flux tubes have tiny cross-sections (0.2 arcsec) but they have nevertheless become observable with Canary-Island seeing quality, particularly in the Fraunhofer G-band around 4305 Å. At this wavelength, the flux tubes show up as tiny bright points as in the magnified inset in this DOT image. At high angular resolution, G-band imaging provides a useful proxy diagnostic for charting photospheric flux tube patterns and their development (see Title & Berger 2001).

The brightness of the intergranular magnetic elements is explained by the "flux tube hot wall" effect (e.g. Spruit & Zwaan 1981): the tube is relatively empty because the inside magnetic pressure balances the outside gas pressure, and so it acts as a viewing tube through which radiation escapes from layers below the outside surface, with the hot tube walls producing brighter emission than the surroundings. In the G band, around 4305 Å (430.5 nm, labeled G by Joseph von Fraunhofer in his 1814 inventory of the solar spectrum) this contrast is enhanced because the CH molecules which make up most lines in this dark feature dissociate in the flux tube, so that the CH lines vanish and the tube gas gains even more transparency compared to the outside gas than at other wavelengths (see Rutten et al. 2001).

The intrinsic sharpness of the photospheric flux tubes is very high because they are very thin and the G-band photons are emitted thermally and are not much spread by scattering on their way out. At 100 km resolution most resulting G-band bright points are not resolved, but at least they are identifiable so that they can be located and traced in time. At somewhat lower resolution (say 0.5 arcsec) they vanish (because they are mostly located within dark

intergranular lanes so that smearing by atmospheric seeing cancels bright against dark, see Title & Berger 1996).

Higher up in the chromosphere, the Ca II H & K lines of once-ionised calcium and the Balmer Halpha line also provide valuable proxies for mapping magnetic topology. The low chromosphere sampled by Ca II H or K shows clusters of bright grains outlining the magnetic network and greyish internetwork features marking acoustic oscillation interference patterns. The high chromosphere sampled by Halpha portrays the intricate structure of the magnetic canopies expanding from the network in the form of fine fibrils.

The Ca II H & K lines are the strongest Fraunhofer lines and sample the chromosphere at about 1000 km above the white-light surface. At this height, the magnetic network is enhanced by yet unidentified heating processes so that the Ca II line-center intensity (at about 0.1 nm bandwidth) provides an excellent magnetogram proxy (but unsigned). This fact has been exploited extensively in gauging the magnetic activity of sun-like stars.

The sharpness of Ca II H or K images is intrinsically less than for the G band, partially because the line photons are scattered considerably on their way out before their final escape towards the observer, and partially because the flux tubes expand and merge with height. The same regime and the same patterning are also sampled by imaging in the near-UV continua, but these scatter as badly.

The Balmer Halpha line comes from the most abundant element but is much less strong than Ca II H & K in the spatially averaged solar spectrum because its lower-level population has very low weight in the Boltzmann population partitioning over the hydrogen energy levels. Nevertheless, its high excitation energy causes this line to respond to gas at high temperature and also to shocked cool gas, so that it maps low-lying fibrils in the high chromosphere when these are sufficiently dense. This regime has often been modeled as a spherical shell, but a high-resolution Halpha movie immediately shows the fallacy of such modeling by displaying a mass of fibrils with no semblance of sphericity whatsoever. The “moss” phenomenon discovered with TRACE indicates that 2 million-K plasma actually descends down to between the Halpha fibrils in plage (see Berger et al. 1999).

It is becoming increasingly clear that the chromospheric fibril topology mapped by Halpha supplies a missing link between photospheric magnetograms (such as from MDI onboard SOHO and from HMI onboard SDO) and the coronal field topology. Nonlinear force-free-field extrapolation from such magnetograms is much better determined and much more realistic when Halpha fibril topology is entered as a constraint in the extrapolation procedure (see Bobra et al. 2008). It is probable that such Halpha insertion in field topology estimation will be decisive in setting up reliable techniques for forecasting solar eruptions and near-earth space weather.

Using Halpha as magnetograph proxy to derive the field topology from the observed fibrils is not straightforward because the latter harbor length-wise flows that modulate the apparent fibril contrast through substantial Dopplershifts. The resulting mix of brightness and Dopplershift variations requires full profile modeling, so that filtergrams must be taken at a number of wavelengths and interpreted through inversions based on sophisticated radiative transfer modeling.

The intrinsic Halpha resolution can be exceedingly high because the fibrils may be effectively or even optically thin, imposing their scale on the emergent radiation without radiative-transfer smearing. This is particularly the case in filaments and prominences (the latter are filaments seen off-limb where the background radiation along the line of sight vanishes). These amazing structures, keeping very cool gas up amidst the hot corona and persisting very long, are rich sources of MHD physics. They probably consist of very thin, highly dynamic magnetic fibrils in complex topologies that are best encoded in Halpha radiation.

The DOT is operated from the SST building in close cooperation with the Swedish colleagues. The Swedish 1-m Solar Telescope (SST) achieves high-resolution imaging, spectrometry and polarimetry using adaptive optics. The two telescopes are complementary. Together, they represent a formidable facility for high-resolution solar physics.

Specific DOT research topics:

- solar wave dynamics: network and internetwork oscillations, gravity waves, umbral flashes, wave excitation;
- solar surface fields: fluxtube patterns, fluxtube dynamics, magnetic carpet topology and evolution, sunspot structure and dynamics, prominence stability and eruptions;
- topology and evolution of active regions: plage emergence and disappearance, eruption precursor topology,

sunspot breakup;

- canopy transitions: wave penetration and heating, moss structure and dynamics, fibril topology, evolution and dynamics, spicule physics, tube-loop coupling.

High-resolution Doppler mapping Charting dynamical flows along magnetic structures requires the measurement of spectral-line Doppler displacements in two-dimensional image format rather than the linear cutout selected by spectrograph slits. High-resolution Doppler mapping therefore calls for tunable narrow-band filtergraphs.

Here is a high-resolution Dopplergram which resulted from a test of a of a special tunable filter from Irkutsk. The test was done at the former SVST and is described here in detail. This filter selects a tunable narrow band in the Ba II 4554 line which possesses enhanced sensitivity to non-thermal motions due to the large atomic mass of barium atoms.

The test showed that a new domain of flow mapping opens up at the high resolution obtainable with this line, speckle restoration and La Palma image quality. At this unprecedented Dopplergram resolution, it becomes possible to chart flows in and around small basic structures such as the magnetic elements that make up the chromospheric network, in and between the fibrils making up penumbrae, and along the thin threads constituting filaments and prominences.

We have, thanks to support from INTAS and the Pieter Langerhuizen Lambertuszoom Fonds, installed the Irkutsk filter on the DOT. It was then found that it needed complete overhaul, for which R.H. Hammersclag and F.C.M. Bettonvil took it to Irkutsk in 2008. It operated on the DOT since June 2009, but the poor camera used (for lack of funding) limited the signal-to-noise ratio severely.

High-resolution Stokes magnetometry The next step in DOT postfocus instrumentation is to proceed from proxy magnetometry to quantitative measurement of the magnetic field, preferably in the form of full Stokes-vector magnetometry. The science prospects of a high-resolution Stokes-vector magnetograph are obvious. Since solar magnetic fields are the key to understanding the structures and dynamics of the solar atmosphere, precise vector magnetometry is a desirable ingredient to almost every observing program.

The DOT is particularly suited for such magnetometry. First, it provides the required angular resolution. Second, because it is a reflector the focus is co-spatial at all wavelengths. Third, the parallactic mount and the absence of image rotation make it suited to high-precision polarimetry. Fourth, its high pointing precision permits astrometric tracking in solar coordinates. Finally, the projected aperture increase will give it the high sensitivity needed for precision polarimetry.

We had hoped to turn the Irkutsk Ba II 4554 filter into a Stokes vector magnetograph by adding liquid-crystal retarders, but the present camera is too noisy to make this a realistic extension.

DOT status The science prospects of the DOT are excellent, but its long-term future is much less rosy with respect to funding. Utrecht University and NOVA terminated their support for DOT operation on 1–1–2008 and Utrecht University then closed its whole astronomy department in 2012. Thus, the DOT is in dire need of external sponsoring. If you happen to seek a worthy goal for giving a gift, for an endowment, for sponsoring science through a donation, then please consider the human endeavour of understanding (and living with) our own star and contribute to the DOT foundation (secretary F.C.M. Bettonvil at Sterrewacht Leiden) – *met een gift, schenking, leaat, hulp in sponsorwerving kunt U de DOT doen herleven*.

Our DOT development plan was to install remote targeting, integration into the worldwide Virtual Solar Observatory, aperture tripling (resolution down to 0.07 arcsec), field tripling (up to 300 arcsec), or yet larger upgrades. More detail is given below. Obviously, realization depends on renewed sponsoring,

DOT projects The DOT team is very small but there is no shortage of ideas to exploit and enhance the unique DOT capacity for high-resolution solar physics. Unfortunately, the speed of realisation is limited by funding and

manpower - the DOT funding is much lower than for comparable solar telescope projects elsewhere, and much much lower than for comparable solar telescopes in space.

The following projects constitute our original DOT to-do list, roughly in time order. The first two were completed with respect to the DOT, but have new life with respect to future telescope projects such as the EST. Currently the DOT fulfills projects 3 through 5 but only when its usage is funded. Project 6 materialized with the installation of the Irkutsk Lyot filter for Ba II 4554 in June 2006 but its camera is too noisy for project 7. We have no manpower for project 8. Projects 9 to 11 remain dreams awaiting sponsoring.

(1) Verification of DOT technology

The initial DOT post-focus equipment was limited to the verification imaging needed to prove that the DOT fulfills its design criteria. The completion and the installation of the DOT were funded by the Dutch Technology Foundation STW on the basis of the technological innovations that make the DOT a stable pointer even while exposed to strongly varying wind loads. This new (mostly mechanical) technology has indeed been demonstrated to work. There are no windshake problems, and the telescope, tower and clamshell canopy have survived multiple fierce La Palma winters without problem.

(2) Verification of the open principle

From the solar physicist point of view, DOT verification consists of testing its open principle. The DOT is the first solar telescope that relies on the ambient wind (often very strong at La Palma) to inhibit image-spoiling turbulence within the telescope. The DOT's demonstration that this strategy of wind flushing works has been a pivotal factor in the current wave of large open-telescope projects, in particular GREGOR, NST and ATST, and also inspires the GISOT concept.

(3) Proxy magnetometry

The initial observing program consisted of proxy magnetometry as described above, using imaging in the G-band to chart magnetic field structures and patterns and their evolution in the photosphere. We added imaging in Ca II H to do the same for the low chromosphere, and narrow-band imaging in H α to do the same for the upper chromosphere. The bandwidths are 1 nm for the G-band, 0.3 nm for Ca II H and 0.025 nm for H α . The first two permit the use of simple interference filters but the H α passband must not only be narrow but also rapidly tunable. The DOT team has a high-quality H α Lyot filter that was earlier employed at the Ottawa River Solar Observatory. It is mounted adjacent to the incoming beam (see DOT top design drawing) and secondary optics design drawing. This program aims in particular at obtaining high-resolution image sequences in conjunction with the MDI magnetograph and UV spectrometers onboard the SOHO mission, the high-resolution UV imaging by the TRACE mission, the photospheric diagnostics of the Hinode mission, and the upcoming large-volume solar monitoring of the SDO mission.

(4) Image restoration

High angular resolution is the science driver for the DOT - as for most other solar telescopes excepting helioseismology. Thanks to the combination of the wind-swept site, the wind-flushed open tower and telescope, and the consistent application of speckle restoration, the DOT furnishes diffraction-limited image quality whenever the seeing is only reasonably good, i.e. with Fried parameter (effective resolution permitted by the Earth's atmosphere expressed in corresponding telescope diameter) of order 6-10 cm. A major advantage of speckle processing over the adaptive-optics systems being developed for future solar telescopes is that speckle reconstruction restores the full field of observation, not just a single isoplanatic patch. The major disadvantage is that it takes a large amount of post-processing. This was remedied with the DOT speckle processor.

(5) Common-user operation

In 2004 we opened the DOT as common-user facility to the international solar physics community. Many solar observing programs at other telescopes (both groundbased and in space) can then benefit from high-resolution context imaging with the DOT. Details: White paper on future DOT observing modes.

(6) DOT data search engine

Completed in 2008 by T. van Werkhoven, see <https://dotdb.strw.leidenuniv.nl/search>.

(7) Doppler mapping

A test done at the SVST in its last season (summer 2000) demonstrated the tantalizing science capability of the

special tunable Lyot filter operating in the Ba II 4554 that was developed at Irkutsk by V.I. Skomorovsky and G.N. Domishev. They brought it to the SVST where it was combined with the DOT speckle acquisition system, on funding from SOZOU, LKBF and NOVA. The superb angular resolution obtained by the speckle processing and the large sensitivity of the Ba II 4554 line to motions (due to the combination of very large atomic mass and insensitivity of the line opacity to temperature variations) combine to Dopplergrams of extraordinary information content as detailed [here](#). An accommodation study has shown that the DOT can harbour this large and heavy Lyot filter with telecentric re-imaging optics within the telescope top (design drawing). Funding to realize its installation was been obtained from INTAS, the Pieter Langerhuizen Lambertuszon Fonds, and SOZOU, but then it was found that the filter needed extensive refurbishment, for which R.H. Hammerschlag and F.C.M. Bettonvil took it back to Irkutsk in 2008. It operates on the DOT since June 2009 but the camera is too noisy for science utilization including extension into a magnetograph.

(8) Stokes magnetometry

The development and installation of a Stokes vector magnetograph is a natural desire. Stokes vector magnetometry requires spectral selection of one or more narrow bandpasses within one or more Zeeman-sensitive lines. Our intention was to outfit the Irkutsk Ba II 4554 birefringent filter with ferro-electric liquid crystal retarders but the present camera is too bad. Another option for a compact instrument fitting the cramped DOT top is to use a multiple Fabry-Perot interferometer. A larger-scale option is the use of optical fibers to transfer the image to a classical grating spectrometer for two-dimensional small-field spectrometry by using a fiber field-to-slit reformatter combined with phase-diverse data acquisition.

(9) Remote targeting

Many international multi-telescope campaigns address phenomena related to solar activity and therefore require selection of the common field of view on short to very short notice (the latter for example when observing flares or filament eruptions). Co-pointing diverse instruments at different telescopes is therefore greatly assisted by facilities for (nearly) instantaneous remote targeting. At the DOT, such a remote pointing interface can be a low-bandwidth emulation of the actual telescope control interface in the DOT control room (already remote itself). It will also enable staff elsewhere to look over the shoulder of observers on La Palma. Details are also given in the white paper on future DOT observing modes.

(10) Triple aperture increase

The mechanical structure of the DOT accepts a larger mirror than the current 45 cm one, at least 140 cm without replacing the telescope mount nor the multi-wavelength secondary optics and camera system. A detailed design has been made to verify the opto-mechanical feasibility (optics diagram). A new light-weight parabolic primary mirror of 140 cm diameter will feed the existing multi-wavelength recording system via new beam folding and reformatting optics. A super-reflective, water-cooled field stop with air suction around it in prime focus reflects most of the solar image and passes the field of view to the relay mirrors, of which the first one is parabolic and cancels the coma of the parabolic primary, producing a large field of view. A telecentric region can harbour polarisation encoders for magnetometry. A choice of beam reformatting lens combinations and a fixed pupil stop permits flexible user-selectable trade-off between resolution and field size, producing a 1:45 beam into the multi-wavelength system just as in the present 45-cm DOT. The projection will be via a low-order adaptive optics system which serves to increase the signal-to-noise ratio of the speckle processing. The G-band channel will no longer be on-axis so that the central obscuration will be small. The beam reformatter permits flexibility in usage. At superb seeing, when speckle restoration will work down to the 0.07 arcsec diffraction limit of the 140-cm aperture, the aperture tripling will fully regain the DOT's role of tomographic imager even in the Hinode era — and actually enhance Hinode through co-observing: the DOT can then image at 0.07 arcsec (50 km on the solar surface, equal to the photon mean free path in the photosphere) what Hinode diagnoses at 0.2 arcsec. When the seeing is less good one opts for lower resolution but a concomitantly larger field of view on the camera chips. A pupil shifter then permits selection of an obscuration-free off-axis aperture.

(11) Triple field increase

The introduction of a parabolic secondary mirror will cancel coma from the parabolic primary which presently limits the useful DOT field of view to three arcmin. Since much larger CCD chips with the 10 frames/s readout speed needed for speckle burst registration should become affordable with time, we intend later in this decade to

revamp the DOT cameras and speckle pipeline with state-of-the-art hardware and so increase the field of view considerably at any resolution. For example, during non-superb seeing 4K x 4K chips would register 300 x 300 arcsec at 0.2 arcsec resolution and enable studies of the topology and dynamics of whole active regions including complete coronal loop anchoring. When the seeing turns excellent - as flagged by our reliable Seykora-Beckers scintillometer - shift to 0.07 arcsec resolution then reduces the field to 100 x 100 arcsec, still large enough to contain a complete mature sunspot with its moat. Increasing the disk storage (or accelerating the speckle processing to real-time turnaround) will increase the maximum sequence duration.

(12) *Upgrade options beyond tripling*

Preliminary designs for yet larger-scale upgrades of the telescope, the tower, and the platform are described in [Aperture Increase Options for the Dutch Open Telescope](#).

3.12.2 DOT schedules

[DOT schedule 2010](#)

[DOT schedule 2009](#)

[DOT schedule 2008](#)

[DOT schedule 2007](#)

[DOT schedule 2006](#)

[DOT schedule 2005](#)

3.12.3 DOT pictures

June 2005:

Darrel Torgerson: [DOT with Rob Hammerschlag](#)

Daan van Eijk: [DOT top](#) [DOT mirror](#) [DOT platform](#) [DOT cross-leg resonance damper](#)

[DOT legs, shadow, data pipe, and SST](#)

Sylvain Rondi: [DOT googled from above](#)

October 2004:

[DOT overview](#) [DOT in codeso](#) [DOT & WHT in codeso](#) [DOT & WHT](#) [DOT close-up](#)

[Rob Hammerschlag & Felix Bettonvil at lunch](#) [Pit Sütterlin at speckle](#)

[Rafael Keizer opening up ATST seeing monitor](#) [Rafael Keizer and ATST seeing monitor](#)

[SST](#) [SST top](#) [SST turret](#)

[Rolf Keizer opening SST drive](#) [Rolf Keizer & Rob Hammerschlag repairing SST drive](#)

[Viggo Hansteen, Mats Carlsson & Luc Rouppe van der Voort in SST control room](#)

[Misty Magic](#) [TNG](#) [Grantecan](#)

[Caldera at sunset](#)

Photographs by Sylvain Rondi, October 2004:

[Rob Hammerschlag opening up](#) [DOT at sunset](#) [DOT at night](#)

Installation of the Halpha filter, September 2004:

[Lyot filter in control box](#) [Mounted on DOT](#) [DOT pointed at sun](#) [DOT top](#)

During a Utrecht University site visit, August 2003:

[DOT seen from the SST](#)

[Platform and telescope \(by Henrik Rudolph\)](#) [Platform from below \(by Henrik Rudolph\)](#)

[Mount and mirror](#) [Telescope top \(by Henrik Rudolph\)](#)

[Norbert Langer, Willem Hendrik Gispen, Will de Ruijter, Rob Hammerschlag & Pit Sütterlin on the DOT platform](#)

[Ed van den Heuvel, Werner van der Weg, & Göran Scharmer](#)

Felix Bettonvil & Rob Hammerschlag at the SST
SST seen from the DOT, with DOT image pipe
ATST site survey tower

During a KNVWS Werkgroep Zon visit, April 2003:
Group assembly

Mounting more channels, March 2003:

Multi-channel support Multi-channel support with Bettonvil Multi-channel support with Aswin Jägers
Four-channel optics complete Six-hand four-camera cabling

Utrecht, DOT speckler definition, November 2002:

Alfred de Wijn + sketch Aad van der Steen Felix Bettonvil Pit Sütterlin Michiel van Noort
result

Observing after snow, April 2002:

Roque de los Muchachos overview DOT, WHT, SST: three very different telescopes
DOT with ice DOT ladder with ice
DOT top within closed canopy DOT, WHT, SST during solar observing DOT pointed at the sun
DOT pointed at the sun: cutout
Open DOT with Bettonvil & Sütterlin
Sütterlin observing the camera in DOT control room Sütterlin observing the sun in DOT control room

Darrel Torgerson's 2001 DOT photographs:

DOT with sunrise mountain shadow DOT with low sun DOT in full glory
DOT with setting sun DOT with binary sun
DOT with green flash DOT with clouds

Data-acquisition system, February 2001:

Hammerschlag mounting a filter
New G-band channel (on-axis tube) Close-up of G-band tube Close-up of prime focus
Fiber connectors on DOT Fiber exits in Swedish building
Five-computer image acquisition rack
UPS (safeguard against lightning damage)

Mechanical structure, 1999–2001:

DOT with cooling water tank & pipe DOT on its platform Close-up of DOT on platform
DOT drives DOT primary
Tower bottom with workshops Tower bottom with workshops Tower bottom with fallen ice

In less good weather, October 1999:

DOT open, with water tank DOT top, with prime focus tube
Primary mirror (covered) with declination wheel, support struts, guider scope
Mirror with strut connectors, suction hose
Hour-angle wheel and mirror support
Seykora-Beckers scintillometer with anti-falcon needle
Data pipeline to the Swedish building
R. Hammerschlag in his telescope R. Hammerschlag as DOT surgeon
C. Denker, Ph. Goode, L. Strous, R. Hammerschlag R. Hammerschlag, F. Bettonvil, F. Paletou
R. Hammerschlag, F. Bettonvil, G. Molodij
SVST from DOT, F. Bettonvil on the ladder DOT closed, R. Hammerschlag on the ladder
Clouds over DOT and WHT

During optics tests, November–December 1997:

DOT pointed at the sun DOT close-up DOT at sunset in Sahara dust

At the First Light Ceremony, October 31, 1997:

Site overview looking North DOT and WHT: two telescopes sharing royal interest

G. and R. Hammerschlag, C. van Scheijndel, E. van der Zalm, T. van Schie, F. Bettonvil
J. Carlos Torres and L. Pérez Machin with champagne
V. Martinez Pillet, O. von der Lühe J. van Himbergen, F. van den Beemt
J. Veldhuis, W. Bentinck van Schoonheten, J. Ritzen, M. Hermoso Rojas, Prins Willem-Alexander van Oranje
Speech by R. van Duinen Speech by J. Veldhuis Speech by J. Ritzen
DOT First Light Ceremony performed by Prins Willem-Alexander and M. Hermoso Rojas
Prins Willem-Alexander and R. Hammerschlag in DOT elevator

Within the canopy, 1997:

DOT mirror + focus DOT mirror + laser DOT mirror covered, with Rob Hammerschlag
DOT focus DOT focus with Felix Bettonvil
DOT with ghosts

On La Palma, 1996:

DOT on its tower, with Anke and Rob Hammerschlag
DOT and SVST DOT as part of the skyline
DOT platform hoisting DOT tower fastening
DOT christening ceremony

In Delft, 1990 - 1996:

DOT clamshell canopy
DOT builder Rob Hammerschlag and his telescope
DOT technician Piet Hoogendoorn with DOT gears

On paper, 1975:

DOT sketch

3.12.4 DOT addresses

WWW:

DOT: https://robrutten.nl/dot/DOT_home.html
DOT database: <ftp://dotdb.strw.leidenuniv.nl>
DOT search engine: <https://dotdb.strw.leidenuniv.nl/search>
DOT observer wiki: <https://dotdb.strw.leidenuniv.nl/wiki>

Dutch Open Telescope

phone office (= recorder = fax): +34-922405571
phone control room: +34-922405573 mail:
C/O Grupo Sueco
Apartado 66
E-38700 Santa Cruz de La Palma
Islas Canarias, Spain

Swedish 1-m Solar Telescope (SST)

phone: +34-922405590
fax: +34-922405592 mail:
Grupo Sueco
Apartado 66
E-38700 Santa Cruz de La Palma
Islas Canarias, Spain

3.13 European Solar Magnetism Network

3.14 USO School "Solar Magnetism"

3.15 My Utrecht University courses, practicals, student projects

Note: much of this is obsolete. There is no astronomy anymore at Utrecht University, which shouldn't call itself "university" anymore (a university should study the universe). Below there are links under "courses" and "practicals" to older material that I haven't polished (yet) for non-past posting among my current educational material.

3.15.1 Courses

Directory with course schedules, also older ones

- *B.Sc. Physics & Astronomy* course "Introduction to Astrophysical Radiative Transfer"
(IART = NS-282B = NS-252B = AIST = NGSB = OTS = "Opwekking en transport van straling")
information, schedule, diary 2006-2007
Minnaert seminar topics
course notes English translation
practical Stellar Spectra A: Basic Line Formation
practical Stellar Spectra B: LTE Line Formation
simple IDL manual
simple LaTeX and BibTeX manual
report example
- *M.Sc. Astrophysics* course "Radiative Transfer in Stellar Atmospheres"
(RTSA = NS-AP426M = STEAT = AFYC = AFY2b = "Steratmosferen")
information, schedule, diary 2006-2007
presentation topics
course notes
equations
practical
- *M.Sc. Astrophysics* course "Solar Physics"
(SOL = AP439M; jointly with C.U. Keller, F. Snik, A.G. de Wijn, P. Hoyng)
schedule 2005-2006
solar spectrum formation
solar 5-minute oscillation observations
solar 5-minute oscillation theory
practical "Image and Fourier processing"

3.15.2 Practicals

- Computer exercises "Stellar Spectra A: Basic Line Formation", part of my *B.Sc. Physics & Astronomy* course "Introduction to Astrophysical Radiative Transfer" (IART/NGSB/AIST), including a simple IDL manual, a simple LaTeX and BibTeX manual, and a report example.
- Computer exercises "Stellar Spectra B: LTE Line Formation", also part of my *B.Sc. Physics & Astronomy* course "Introduction to Astrophysical Radiative Transfer" (IART/NGSB/AIST).
- Computer exercises "Stellar Spectra C: NLTE line formation", not yet available but see the 2003 version of the practical accompanying my *M.Sc. Astrophysics* course "Radiative Transfer in Stellar Atmospheres" (RTSA/AFYC).

- A.G. de Wijn's 2006 practical "Image and Fourier processing"
- Handleiding P1F1 - ZNSP for the B.Sc. Physics & Astronomy physics practical using the ancient solar spectrograph at Museum Sterrenwacht Sonnenborgh to determine the Sun's rotation speed (in Dutch).

3.15.3 Research projects

Much recent research of the solar physics group at the Sterrekundig Instituut Utrecht exploits our ownership of the Dutch Open Telescope (DOT) on La Palma. The DOT research projects are described on the next page.

I welcome astronomy and physics students at Utrecht University or from other universities for *Astrovaria* projects (7.5 ECTS), *B.Sc. Physics & Astronomy* research projects (15 ECTS), and *M.Sc. Astrophysics* research projects (60 ECTS). The project content may vary widely, from technical via observational to theoretical. Student research in our group often includes work abroad.

3.15.4 DOT research projects

The Dutch Open Telescope on La Palma is an innovative solar telescope built and operated by our group. The DOT produces high-resolution image sequences simultaneously at different wavelengths that sample the solar atmosphere at different heights. There are beautiful examples on the DOT website. Amongst other phenomena they chart the topology, dynamics, and evolution of the enigmatic magnetic structures in the solar atmosphere.

In addition, an advanced speckle processor on La Palma enables us to frequently participate in international observing campaigns combining the DOT with other telescopes in the Canary Islands and with EUV and X-ray telescopes in space. Such combination permits studying solar magnetism from the deep photosphere out to the corona.

You are welcome to share in this exciting research in a Bachelor or Masters research project. Specific research topics are:

- solar wave dynamics: network and internetwork oscillations, gravity waves, umbral flashes, wave excitation;
- solar surface fields: fluxtube patterns, fluxtube dynamics, magnetic carpet topology and evolution, sunspot structure and dynamics, prominence stability and eruptions;
- topology and evolution of solar active regions: plage emergence and disappearance, eruption precursor topology, sunspot breakup;
- solar canopy transitions: wave penetration and heating, moss structure and dynamics, spicule physics, tube-loop coupling.

We also perform detailed comparisons with numerical simulations in order to identify the underlying physics.

Technical research projects target telescope engineering, astronomical instrumentation, polarimetry, optics, image processing, information technology, software engineering, etc.

In addition, the DOT team is investigating further development of the open-tower and folding-canopy technology originally defined for the DOT. This is done through a sizable grant from the Dutch Technology Foundation STW. Potential applications include future telescope installations on Antarctica. This development work can accommodate technical physics and technical university students.

Contacts for solar physics DOT projects: [;R.J.Rutten at uu.nl](mailto:R.J.Rutten@uu.nl);

Contacts for technical DOT projects: [;bettonvil at strw.leidenuniv.nl](mailto:bettonvil@strw.leidenuniv.nl); and [;R.H.Hammerschlag at astro-uu.nl](mailto:R.H.Hammerschlag@astro-uu.nl);

[DOT website](#)

[DOT publications](#)

3.15.5 Students to the DOT program

3.16 My courses elsewhere

Since 1993 I have given courses IART = “Introduction to Astrophysical Radiative Transfer”, SSF = “Solar Spectrum Formation”, and SP = “Solar Physics” abroad, wherever and whenever I got invited to do so. They varied from a few days to a full month but usually took one (full) week. The course schedules are in [this directory](#).

Since I like teaching my specialty and miss doing so at Utrecht University (which first pensioned me off and then [quit astronomy altogether](#)) I am open to invitations to give similar undergraduate and graduate/postdoc courses on solar spectrum formation. The materials (displays, course notes, exercises) I use are [found here](#). In 2021 I published an extensive overview in [Compendium solar spectrum formation](#).

Consumer report: “Rutten, it is quick-mouth” (Google-translate).

3.17 Collegedictaat ”Fotosferische snelheidsvelden”

Scanned course notes (1983, 100 pages, in handwritten Dutch)

I wrote these Dutch-language lecture notes on velocity fields in the solar photosphere while teaching a ”nakan-didaats” (Masters) course at [Sterrewacht Sonnenborgh](#) in 1983, building on a similar course I had given there in 1979. Literally ”wrote”: in that pre-LaTeX era I produced lecture notes in pencil, with an eraser as text editor. The poor students had to decipher my handwriting to get to the content.

Major topics were the history of the solar five-minute oscillation and the theory of atmospheric acoustic and gravity waves. Much later I summarized these in my lecture displays [Five-minute oscillation: observations](#) and [Five-minute oscillation: theory](#).

The scanned copy linked above uncompresses to hundreds of megabytes postscript in a printer (black & white suffices). Printing them takes ages, better do so in parts with the from-to print option.

3.18 Collegedictaat ”Opwekking en transport van straling”

Scanned course notes (1991, 178 pages)

These Dutch-language lecture notes accompanied my yearly course during 1985 - 2007 for second-year students at [Sterrewacht Sonnenborgh](#) and the [Sterrekundig Instituut Utrecht](#). They treat the basics of astrophysical radiative transfer with emphasis on [spectral line formation in optically thick stellar atmospheres](#), with the solar spectrum as principal example. They cover the material in the first chapter of *Radiative Processes in Astrophysics* by Rybicki & Lightman, but much more extensively. Instead, the rest of their book is summarized in chapter 6 of these lecture notes.

I wrote them in 1988 and added content until 1991. The scanned copy linked above has penciled-in corrections.

There is also a [computer-aided translation into English](#).

In 1993 I summarized this course, inserting new figures, for NSO summer students in an English-language [Introduction to Solar Spectrum Formation](#). Later I also summarized this course in the second chapter of my [English-language masters-level Radiative Transfer in Stellar Atmospheres](#).

The scanned copy linked above uncompresses to hundreds of megabytes postscript in a printer (black & white suffices). Printing them takes ages, better do so in parts with the from-to print option. And then decipher my handwriting...

3.19 Course book "Solar and Stellar Magnetism"

Scanned course notes (1999, 196 pages)

This book-like set of lecture notes resulted from a course at the Sterrekundig Instituut Utrecht during the first months of 1999. The motivation for this "nakandidaats" (masters) course was the presence of S.K. Solanki as Minnaert Guest Professor. The lecturers were S.K. Solanki, J.P. Goedbloed, P. Hoyng, and myself. The students were asked to produce lecture notes, including S.K. Solanki's formal Minnaert Lecture for a wider audience, splitting the lectures between them. Their writeups were checked by the teachers and then edited and collected in this volume by J.M. Krijger and me.

This scanned copy uncompresses to hundreds of megabytes postscript in a printer (black & white suffices). Printing the full text takes ages, better do so in parts with the from-to print option.

3.20 Coimbra conference proceedings editing

4 Publications

Invitation: you are welcome to use figures from my work in your own publications and presentations.

Inhibition: you are welcome to download my publications for personal use, but further distribution may violate copyrights.

All publications with pdf, bib, ADS, DOI links.

Compact ADS-based list with ADS links. (Similar lists for many colleagues, collection described here)

My most-read "publication" (and claim to fame): self-posted expedition report.

My most-used "publication" (and claim to teach): self-posted radiative transfer course.

My most-cited astronomy publication is non-solar but nighttime and the most boring, whereas the best (I think) got only few citations: this one about a funny little line formed deeper than its continuum background, and this one about a funny little line that actually is the only non-funny line in the entire photospheric spectrum. I wrote their texts - something wrong with my style?

4.1 Selective lists

These lists contain blue buttons for each publication opening the full-text file ("pdf", present for most), the corresponding bibtex entry ("bib", for all), the ADS abstract page ("ADS", when existing), and the DOI access ("DOI", when available at ADS).

All: everything whatsoever [corresponding bibfile pdf's bibtex entries]
 Selective: refereed reviews contributions presentations books book reviews memorials
non-solar solar photosphere chromosphere NLTE fine structure
education instrumentation proposals reports
nederlands

4.2 Lists elsewhere

Publications on arXiv

Publication list with summaries, publication links and metrics on ADS

Incomplete error-prone citation-ranked publication list with links and unreliable metrics on Google Scholar

5 Nederlandstalige verhandelingen

In deze lijsten leveren de blauwe "pdf" knoppen de tekst (op een paar oude na) en de "bib" knoppen de bijhorende BiBTeX gegevensinvoer.

[allemaal](#) [onderwijs](#) [populair-wetenschappelijk](#) [expedities](#) [herinneringen](#)

6 Onderwijsmateriaal sterrenkunde op VWO niveau

6.1 Sterrenkunde voordrachten: zon, zonnenspectrum

Projectiebestanden gebruikt bij voordrachten op VWO niveau. Zonder mijn mondelinge toelichting zijn ze nogal cryptisch. Ook werken de links naar films en ander materiaal alleen in mijn eigen laptop.

[De zon van binnen en van buiten: zonzang, zonsoppervlak, coronale uitbarstingen](#)

[Vorming van het zonnenspectrum: zichtbaar continuüm en Fraunhoferlijnen](#)

6.2 Sterrenkunde opgaven: spectra van sterren, de zon, de planeten

"Spectra van sterren, de zon, en de planeten"

Werkcollege in de module Astrofysica van het Junior College Utrecht.

[Opgaven](#) [Antwoorden](#)

6.3 Sterrenkunde opdrachten: sterspectra, rotatie van Saturnus en zijn ringen, spiraalstructuur van de Melkweg, uitdijning van het heelal

"Spectraallijnen in de sterrenkunde: natuurkunde op afstand"

- de classificatie van sterspectra
- de rotatie van Saturnus en zijn ringen
- de spiraalstructuur van de Melkweg
- de uitdijning van het heelal

[Instructie](#) [Antwoord op de eerste opdracht](#)

6.4 Sterrenkunde lespakketten uit de jaren zeventig

Scans gemaakt eind 2011 bij de sluiting van de Utrechtse sterrenkunde.

[J. van der Rijst, C. Zwaan, "Leerlingentekst keuze-onderwerp Astrofysica", 1975](#)

[J. van der Rijst, C. Zwaan, "Docentenhandleiding keuze-onderwerp Astrofysica", 1975](#)

[R.J. Rutten, J.E. Geuzebroek-Frederik, "Natuurkunde van zon en sterren", Onderwijsmap Stichting De Koepel, 1978](#)

7 Oud Utrechts onderwijsmateriaal sterrenkunde op voorkandidaat-niveau

De scans hieronder betreffen pre-kandidaats (tegenwoordig Bachelors) onderwijsmateriaal van de toenmalige opleiding sterrenkunde in Utrecht in de periode 1950 - 1975 (plus twee latere dictaten van mij). In deze fase was sterrenkunde een bijvak bij wis- en natuurkunde; de andere bijvakmogelijkheid was scheikunde (vanaf 1963 ook geofysica). Na het kandidaatsexamen was sterrenkunde een hoofdvak naast natuurkunde en wiskunde, met één of twee van de andere als groot of klein bijvak; later een Masters opleiding tot de abrupte en onverkleerde sluiting in 2011-2012.

Dit vroegere onderwijsmateriaal was grotendeels afkomstig van M.G.J. Minnaert of volgde zijn voetsporen na zijn emeritaat in 1963. Minnaert's beroemde eerdere boeken "De natuurkunde van 't vrije veld" zijn alle drie beschikbaar, met de voortreffelijke biografie door Leo Molenaar, in de DNBL digitale bibliotheek. Het is bijzonder zwaar dat Minnaert's eigen vak, zonnefysica, sinds de sluiting niet meer in Nederland beoefend noch onderwezen wordt - een uitzondering in Europa en nota bene nadat Minnaert en opvolgers de Utrechtse school wereldfaam bezorgden. Zelf doceer ik het nog immer maar uitsluitend buitenslands.

Om natuurkunde en sterrenkunde te studeren kun je niet meer terecht bij de zogenaamde Universiteit Utrecht maar moet je naar Amsterdam, Groningen, Leiden, of Nijmegen. Voor specialisatie in zonnefysica kun je het best naar Göttingen, Oslo, Stockholm, La Laguna.

7.1 Scans ten afscheid

Scans van oude Utrechtse collegedictaten en practicum instructies sterrenkunde op voorkandidaatsniveau (eerste studie jaren universiteit), gemaakt eind 2011 bij de sluiting van de Utrechtse sterrenkunde.

M.G.J. Minnaert, collegedictaat "Algemene Sterrenkunde deel A: Het planetenstelsel", 1961

M.G.J. Minnaert, collegedictaat "Algemene Sterrenkunde deel B: Het sterrenstelsel", 1953

De scanner miste een paar regels per bladzijde (wisselend onder en boven).

Het bijgeschreven commentaar is van Aert Schadee.

C. Zwaan, collegedictaat "Algemene Sterrenkunde deel B: Zon, sterren en sterrenstelsels", 1967

M.G.J. Minnaert, handleiding bij het astronomisch practicum, deel A: "Het planetenstelsel", 1959

M.G.J. Minnaert, handleiding bij het astronomisch practicum, deel B: "Het sterrenstelsel", 1958

R.J. Rutten, collegedictaat "Opwekking en transport van straling", 1991

R.J. Rutten, collegedictaat "Fotosferische snelheidsvelden", 1983

7.2 Scans door Johan van Dorp

Scans van Utrechtse collegedictaten, practicum instructies en tentamenopgaven sterrenkunde op voorkandidaatsniveau (eerste studie jaren universiteit) uit 1972-1975, verzameld en bewaard door toenmalig student Johan van Dorp en door hem gescand in 2018.

[Link naar Johan's bestanden](#)

[Zip met alle bestanden](#)

8 Astronomy course material: lectures, exercises, course notes, manuals

This material mainly concerns solar and stellar spectrum formation and solar physics. I developed it while teaching at Utrecht University during 1985-2007. Since then I expand it for teaching elsewhere.

8.1 Lectures

Display collections used in my lecturing. Without my oral explanation they are rather cryptic (perhaps no less with it). I use these displays when invited to [teach elsewhere](#).

Many displays contain links to full-size figures, zoom-ins, blinkers, movies and publication cutouts that reside elsewhere in my laptop and will not open for you. Most have buttons at the bottom that return to the opening page and serve a thumbnail index. With Acrobat the title returns to the last-shown page.

[Introduction to the solar spectrum](#) (1-2 lectures in a last-year high school or first-year undergraduate course)

[Physics of \(eclipsed\) sunshine](#) (1-2 lectures for eclipse tourists, including the above introduction)

[Solar spectrum formation: theory](#) (3-8 lectures in a graduate course)

[Solar spectrum formation: examples](#) (2-4 lectures in a graduate course)

[Observations of the solar five-minute oscillation](#) (1 lecture in a graduate course)

[Theory of the solar five-minute oscillation](#) (2-3 lectures in a graduate course)

8.2 Exercises

[Assignments spectral lines: stellar spectra, rotation of Saturn and its rings, spiral structure of the Milky Way, expansion of the univers](#)
(last-year high school or first-year undergraduate course)

Computer exercises Stellar Spectra A "Basic Line Formation" (undergraduate course): [instruction](#) [directory](#)
[complete tar.gz set](#) [thumbnail album](#)

Computer exercises Stellar Spectra B "LTE Line Formation" (undergraduate course): [instruction](#) [directory](#)
[complete tar.gz set](#)

Introduction to Stellar Spectra exercises: [displays](#)

[Simple IDL manual](#). These computer exercises are from the 1990s and therefore use the IDL programming language. The cheaper IDL Student Version sufficed but is not available anymore. Gnu's GDL may work too. Nowadays Python is preferable.

[Simple LaTeX and BibTeX manual and example](#) for report writing.

8.3 Course notes

These are all variations on the theme of solar (and some stellar) spectrum formation. The ordering below is by date. The first course is an extensive text for bachelor students physics and astronomy. The second is a condensed version concentrating on the solar spectrum. The third is an in-depth treatment at masters astrophysics or graduate student level. The fourth is a summary for chromosphere researchers. The fifth is a researcher-level overview. The last and latest is a brief summary but contains many page-opening links turning it into an extended course.

Start with the first course if you don't know what the Wien approximation is. Try the second if you wonder about solar source functions. Study the third if you need detail on the Lambda operator or NLTE radiative equilibrium. The fourth is for IRIS spectrometrists and (optically) thin types. The fifth summarizes full-disk solar spectrum modeling. The last can be read as quick up-to-date overview or studied as comprehensive course encompassing the others.

I assert the moral right to be identified as the author of these notes. I explicitly permit multiplication and distribution for non-commercial educational purposes. I appreciate weblinks, citations, acknowledgements - but not sloppy stealing. I also appreciate invitations to [teach elsewhere](#).

8.3.1 Introduction to Astrophysical Radiative Transfer

Course notes (2015, 140 pages)

Course notes (1995, scanned, 140 pages)

Shorter summary (1993, 42 pages)

Original in Dutch (1991, scanned, 187 pages)

This is an introductory course on radiation and spectrum formation in astrophysics. Formerly it was called “Generation and Transport of Radiation”. I gave it yearly during 1985 - 2007 to second-year bachelors students (341 in total) at the former Sterrekundig Instituut of Utrecht University. It treats the basics of astrophysical radiation production and transfer, with the solar spectrum as key example. It covers the material in the first chapter of *Radiative Processes in Astrophysics* by Rybicki & Lightman, but much more extensively. The rest of Rybicki & Lightman is summarized in a chapter on photon processes.

My numerical exercises Stellar Spectra A “Basic Line Formation” and Stellar Spectra B “LTE Line Formation” accompanied this course.

I wrote the course notes in Dutch during 1988 - 1991. They were translated computer-aidedly into English by Ruth C. Peterson (Santa Cruz) in 1992. She did a splendid job, but the result was somewhat constrained by the Dutch input and the computer output. I therefore started to rewrite these notes in less computerish English in 1993, adding computer-drawn rather than hand-sketched figures, but I completed new drafts only for chapters 2 and 3. The 1995 edition was a hardcopy version of “Generation and Transport of Radiation” made by Dan Kiselman at Stockholm by inserting printout of the two new chapters into a photocopy of Ruth’s translation. I scanned this version as well as the Dutch original in 2011 on my last day at the near-dead SIU and posted them here.

The first link above is a new pdf produced in 2015 by Luc Rouppe van der Voort at Oslo. He latexed Ruth’s files, mine for for Chapters 2 and 3, applied corrections, and inserted figures and sketches by cut-and-paste from the scan. At present this edition still lacks the references, appendices, and answers to questions of the Dutch version. A complete rewrite into my own English remains on my long-term to-do list since 1993.

In 1993 I also wrote a short Introduction to Solar Spectrum Formation, including my new figures, for summer students at the US National Solar Observatory at Sacramento Peak, New Mexico.

In 1995 I summarized this course in the second chapter (“Basic Radiative Transfer”) of my masters-level course Radiative Transfer in Stellar Atmospheres.

The definition of the collisional destruction probability was wrong in the older versions. In 1997 I wrote an essay Epsilon about this mistake, honoring astrophysicist Richard N. Thomas.

8.3.2 Introduction to Solar Spectrum Formation

Course notes (1993, 42 pages)

A short course on the formation of the spectral continua and lines from the Sun, first in LTE and then in NLTE. The equations were distilled out of my regular course Opwekking en transport van straling for Utrecht University bachelors students, later posted as Introduction to astrophysical radiative transfer.

I wrote this short English-language text for summer students at NSO/Sacramento Peak (New Mexico) in 1993, where I was working on, but did not complete, a full rewrite with new figures of my Utrecht course to replace R.C. Peterson’s computer-aided translation Generation and Transport of Radiation. I inserted the figures that I did complete at the time also into this text.

8.3.3 Radiative Transfer in Stellar Atmospheres

Course notes (2003, 275 pages)

Equation compendium (2003, 90 pages)

ADS (2003rtsa.book.....R)

I gave this course RTSA yearly during 1994 - 2007 to masters students (132 in total) at the former Sterrekundig Instituut of Utrecht University. The main topic is the classical theory of radiative transfer for explaining stellar spectra. It needs relatively much attention to be mastered. Radiative transfer in gaseous media that are neither optically thin nor fully opaque and scatter to boot is a key part of astrophysics but not a transparent subject. These course notes represent a middle road between Mihalas' *Stellar Atmospheres* (graduate level and up) and the books by Novotny and Boehm-Vitense (undergraduate level). They are at about the level of Gray's *The observation and analysis of stellar photospheres* but emphasize NLTE radiative transfer rather than observational techniques and data interpretation.

The printing of these course notes may take hours because they unpack to about 160 Mbyte PostScript, due to many scanned graphs. If you share a printer with others you might print them overnight, or in parts using the "from-to" button in your pdf reader print menu. A black & white printer suffices.

The accompanying equation compendium displays all numbered equations in the course notes, identically and with the same numbers, grouped per topic and in large font for projection (in portrait format for 1990s-style overhead transparencies). You have to skip the first pages.

The second chapter is a summary of my introductory course for bachelor students Introduction to Astrophysical Radiative Transfer. Part of that course I also summarized for NSO summer students in 1993 as Introduction to Solar Spectrum Formation.

Teachers and self-studiers may request my answers to many problems in the last section.

Erratum (not the only one): $\text{FWHM} = 2 \sqrt{\ln(2)} \Delta\lambda_D = 1.6651 \Delta\lambda_D$ below (3.66) on page 59.

An update including filling many missing paragraphs remains on my long-term to-do list since 2003. However, in 2021 I wrote Compendium solar spectrum formation (arXiv, ADS) summarized on this page. It is a brief-looking but comprehensive webbased course which links directly to many RTSA pages for basic radiative transfer theory while also linking to many didactic displays made in the meantime. It then adds newer developments, in particular non-equilibrium analysis and chromospheric spectrum formation, and treats many specific line formation issues and related solar physics topics in detailed optional endnotes, with many direct page openers of ADS-public literature.

8.3.4 Graphical Introduction to NLTE Chromospheric Line Formation

Presentation plus explanation (2012, 56 displays)

Refresher course for solar physicists based on a brief tutorial at the 2012 SDO-4/IRIS/Hinode Workshop in Monterey. Each original display page is followed by a page with explanation (replacing my oral comments).

8.3.5 Solar Spectrum Formation for Irradiancers

Article (2019, 26 pages)

ADS (2019SoPh..294..165R)

Brief (10 equations only) overview of NLTE and non-E solar spectrum formation including key displays from my more recent lectures as update of my RTSA notes. It was published in Solar Physics but I prefer and post the arXiv version because the publisher destroyed the citation links.

8.3.6 Compendium solar spectrum formation

Newest (this website)

ADS (2021arXiv210302369R)

Write-up for a [NIT Calicut school](#) in March 2021. It treats radiative transfer in the solar atmosphere in complexity order of non-local control in space, wavelength, time and uses classic literature for illustration. It adds many yellow-page endnotes detailing specific cases. On-screen reading with web access is a must because it contains many page-opening hyperlinks to my on-line materials and to public literature. It may be read cursorily for a quick overview but it becomes a comprehensive course when studying all notes and links, the latter serving as convenient pointers and page openers. These are also useful for researchers selecting a topic suiting their interest.

8.4 Manuals

[Very brief unix/linux instruction](#) for windie students: [\[.txt\]](#) [\[.pdf\]](#) [\[.html\]](#)

[Simple IDL instruction](#) for astronomy students: [\[.txt\]](#) [\[.pdf\]](#) [\[.html\]](#)

[IDL datacube analysis](#) for [DOT students](#): [\[.txt\]](#) [\[.pdf\]](#) [\[.html\]](#) [\[zip with all files\]](#)

[IDL software for SDO](#) for solar-physics colleagues: [\[.txt\]](#) [\[.pdf\]](#) [\[.html\]](#) [\[zip with all programs\]](#)
[\[hands-on practical\]](#)

[Simple latex and bibtex instruction](#) for astronomy students: [\[.txt\]](#) [\[.pdf\]](#) [\[.html\]](#)

[Latex and bibtex example](#) for astronomy students: [\[example.tex\]](#) [\[directory\]](#) [\[zip of all files\]](#)

9 Recipes for latex and bibtex

LaTeX is a programming language to produce documents using TeX and is widely used in the physical sciences. Most publishers of journals in astronomy, physics, and mathematics prefer or require authors to use this language. I use it also for snailmail, presentations and this website. It offers extensive facilities to automate most aspects of publishing, including numbering and cross-referencing of sections, tables, figures, pages, contents, indices, and citations. For the latter, BibTeX automates the citation and reference production. In astronomy, coupling of LaTeX and BibTeX with the fabulous near-complete [ADS literature database](#) is splendidly efficient. My own habits in this combining are [detailed here](#).

The first subsection below contains a succinct manual for writing a report or article with LaTeX and BibTeX, with a fairly complete example. The second treats the production of multi-panel figures within LaTeX. The third treats linking citations to ADS.

9.1 Report recipe for astronomy students

The instruction below is a brief manual for writing a report looking as an astronomical publication. File `example.tex` serves both as example and as template. The zip collection enables you to process `example.tex`, see how it works, and how it adheres to the instruction.

File `example.tex` contains latex macros to generate citations that link to the ADS abstract and also linkers to published figures, equations, tables when available on ADS.

[Simple latex and bibtex instruction](#): [\[.txt\]](#) [\[.pdf\]](#) [\[.html\]](#)

[Latex and bibtex example](#): [\[example.tex\]](#) [\[directory\]](#) [\[zip of all files\]](#)

9.2 Multipanel figure assembly in latex

Often in multi-panel figures a single x or y-axis should hold for multiple panels stacked sideways and/or vertically.

I use IDL to make figures for articles but I do not produce multi-panel figures sharing axes in IDL. Instead I make separate figures, each with full axis annotation, and combine these by multi-panel assembly in latex. The advantage

of this approach is that I can so choose the panel layout (e.g., as page-wide horizontal rows or with column-wide vertical stacking) while writing the article, and can do so with figures from coworkers without bothering them.

My latex macros to remove superfluous (identical) axis annotation between adjacent panels and rescale different graphs to the same panel size are given in file [cutmultipanel.tex](#). The figures used in the example in this file sit in this [zip file](#). With these you can try the example yourself.

9.3 Turning citations into ADS links

Citation linking. My latex and bibtex example defines and uses `\citeads` etc. latex citation commands (“macros”). These turn citations within the text into links that open the corresponding ADS abstract pages in the browser (if your pdf reader permits web access, as do the chrome and firefox pdf viewers, evince, xpdf, macOS Preview. In Adobe Acrobat/Reader adjust Edit ↵ Preferences ↵ Trust Manager ↵ Change Settings). Such one-click/tap ADS page opening is convenient in on-screen article or manuscript inspection because it shows the abstract and links to the full article in parallel to one’s reading, without jump to the reference list as happens with most hyperlinked journal files. Instead, you stay where you are in your publication reading.

In addition, these commands together with a modified .bst style file can add ADS links to the references.

These commands require that you use separate `\citeads` commands per cited article using its ADS bibcode label. My [example.tex](#) also shows how to treat sequences as Vernazza et al. (1973, 1976, 1981). Using ADS bibcodes as `\cite` labels is a good idea anyhow when working with collaborators to avoid label mixups and confusion as to which article is meant.

This latex trick survives the pdf generation by arXiv (Astroph). It also survives A&A production and is recommended in EDP’s [readme.txt](#) for A&A authors (but use the macros in [example.tex](#) which are adapted to “new” ADS). Unfortunately, this trick does not survive ApJ’s conservative editorial processing before the IoP production (while it does for other IoP journals). Reversely, for Solar Physics it survives editorial processing but not the nasturtium-prone Springer production.

Page linking. A similar latex trick is the addition of links to open specified figures, tables, equations etc in cited publications. The macro is also given in [example.tex](#). Rather like clicking/tapping blue items in Wikipedia pages to open the pertinent page directly, instead of the usual roundabout publisher way of jumping you to the reference list when you click/tap a citation, to let you find the ADS link there (if present), use that to open the pdf via ADS (if you are licensed), yet more roundabout for silly publishers via their website (even if you are licensed), flip through its pages to find the specified one, finally inspect the cited item - while with the jump and all this clicking/tapping you lost the sentence and page that you were reading and may have trouble returning there. Wikipedia-style direct page opening is much better! Example: when clicking/tapping Fig. 3 in “See Fig. 3 of Rutten et al. (1991)” in a publication pdf made with this macro this direct linker opens the very page with that (not me) figure in your browser so that it can be inspected in parallel with the publication, not disturbing its reading.

ADS taught me this trick in 2016 and made it survive its 2019 “classic” to “new” transition. It also survives arXiv and A&A pdf production, and can even survive at Springer. It works with the ADS bibcode for most publications with a full-text publisher pdf-symbol button with a green open-access dot on ADS serving the pdf directly. A&A and ApJ yielded such buttons after one year, from 2022 directly. MNRAS does after three years. Springer publications never do even when they are open access. When there is none you may use the ADS altcode for the arXiv version (also shown in [example.tex](#)) but often the classic ADS page opener does this itself.

This pdf page opening is handled correctly by Adobe Acrobat/Reader, evince, xpdf, the chrome and firefox pdf viewers and other pdf readers, but tablet, smartphone and macOS users may be stalled at the first page.

10 Recipes for publications

ADS collections. Since many years I collect complete bibliographies of all [ADS](#) abstracts for all solar-physics

colleagues whose work interests me, over 900 by now. This solar author abstract collection consists of plain-text author-named files (from abbett to zweibel) that are easy to search with `grep` or an editor while limited to solar physics only, more effective than searching entire ADS or Google scholar. I expand and refresh this collection regularly, together with its 1:1 companion bibfile collection for use in `bibtex`. Newest zips in abs.zip and bib.zip. The scripts that I use are here.

From the plain-text abstract collection I also generate “solabs_author.html” abstract files with links to ADS. The prefix “solabs_” gives link uniqueness so that googling “solabs_;name;” (from solabs_abbett to solabs_zweibel) is often a fast way of getting a compact complete solar-physicist bibliography including abstracts on your screen. My `bibtex` test of each `bibfile` for error pruning also delivers yet more compact personal publication lists with ADS `bibcodes` and links.

Some authors have hard-to-separate namesakes (most =author:”Rutten, R.” ADS entries are not mine). I weed out many by excluding the physics database and fine-tuning ADS search name strings. These also serve for directly getting ADS info for a solar physics colleague from your terminal command line by using scripts ads-name-open and ads-name-metrics with my namestring as parameter.

Citing with ADS. Fully automated with the above collections. I usually find the ADS `bibcode` of a publication I want to cite by searching off-line in my abstract collection. For their citing I use my citeads LaTeX commands that add ADS links to the resulting citation in the pdf. I simply copy-paste the ADS `bibcode` into a `\citeads` command in my manuscript, that’s all. One copy-paste, done! I often add page links so that the reader directly sees the cited figure or equation along with the reading, Wikipedia style.

The citations and `.bbl` references are then produced automatically by `bibtex` with my entire concatenated bibfile collection. BibTeX uses the first entry for a `bibcode` and skips duplicates from coauthors. This way I never have to distill a specific `bib` file for a manuscript.

Reading with ADS. I choose which publication to read by searching in my abstract collection. Wherever I am I then get any publication that is available as pdf on ADS or via ADS directly on my screen by simply copy-pasting the ADS `bibcode` into terminal command

```
acads "1991A&A...252..203R"
```

where script acads finds and opens the pdf file in my laptop if I had it already. Otherwise it gets the pdf from ADS via a remote server with IP-checked library licenses, using wrapper script getads which remotely runs script adscode2tmp to put the pdf in the remote `/tmp` dir, then pulling that over and putting it as `1991Aap...252..203R.pdf` in my local `/tmp` (in this A&A example the double quotes accommodate the linux-troubling ampersand in A&A which the macro changes to AAp.) It then opens this publication in my preferred pdf viewer. That usually appears within a few seconds. One copy-paste, there it is!

This works from anywhere (say a pensioner or covid home office) for any publication with silent license check, i.e., having a publisher pdf-symbol button on the ADS abstract page. Earlier these included A&A and ApJ (my staple diet). They became open-access per January 2022; before that they imposed license checking during the first year but acads opened them directly.

When I add an author name as in

```
acads "1991A&A...252..203R" rutten-rene
```

acads stores this article by my famous namesake in directory `.../lit/perauthor/rutten-rene`. The next time acads will find it there and open it yet faster.

Reading silly. Publishers that require passing through their website I call “silly”. These never yield a silent-check publisher pdf-symbol button on ADS, not even for open access. Even then, and also when you are subscription-licensed, they impose a silly browser detour of pdf-button hunting through their silly website that they are sillily proud of. My script acads does not function for them and they can not be page linked via ADS. I then use acads with the ADS arXiv altcode found in my abstract collection to read the arXiv version, assuming its content is not too different from the published version. For page linking via ADS I also use the arXiv altcode if ADS does not select this itself already (its “classic” opener often does).

Non-arXived silly-publisher articles I have generally ignored because of the irritating effort formerly needed to get

them: start vpn into a remote licensed library server, hunt laboriously via that server for the journal link there to the publisher and then through the usually bad publisher website for the desired publication and then finally for its local-license pdf button. Since 2018 they are easier to get with the Lean Library browser extension bypassing most silly-publisher detours if your remote library offers that. They cannot be page-linked so I still avoid citing them.

Publishing silly. If you publish with a silly publisher you should always post a prepublication on arXiv (don't use "preprint" or "paper" anymore in these electronic times), preferably the accepted and language-corrected version after the referee iteration to ensure that the content is the same, or update an earlier one to the eventually published content, or even keep the arXiv version "living" beyond the published version through subsequent improvements. Use the ADS-copied arXiv comment entry to specify identity or differences with the published version (as I did here and here, respectively).

Publishing in A&A. Sharing my latest A&A lessons:

Consumer report - Everything (submission, peer review, language editing, production by EDP) was handled competently and went smooth and pleasant. The web interfaces are transparent and easy to use. The A&A language guide is particularly instructive.

Citation linking - In its readme.txt for A&A authors EDP recommends my latex citation linking to ADS since 2011. The macros given there were for "classic" ADS but keep working. Updated versions for "new" ADS are given in my student-report example.tex.

Page linking - My newer ADS page linking latex command to open specific cited pages with pertinent figures, equations, etc. alongside the article viewing works well in A&A. Example: "Fig. 3" in the third line here.

Movie and blinker linking - In this article we added a new latex trick supported by A&A: direct links to open movie versions and blinkers of figure panels given in the figure captions. Solar physics publications often display selected movie frames as successive image panels, or images or image cutouts side by side with location markers for special features that should be inspected comparatively. Actual movie playing and image blinking using your cursor as self-controlled location marker are often much better options. As usual our files for doing this are supplied as zips in the A&A online-material data base, but here we also added direct openers that furnish movie or blink inspection modes directly while reading the article (by using latex `\href` links to specific application-opening files at an open site). These also work in the arXiv version. Example: blinkers at the end of the caption here (try to spot fibrillar black-on-black retarded correspondence in the 4-6 last one).

Acronym popups - One desirable latex trick in which I did $\not\zeta$ succeed is to add popups for acronyms that spell out their definition when you hover your cursor over them in on-screen pdf viewing. It would be good if (in my little solar backyard), LTE, NLTE, CRD, PRD, CS, SE, CE, MHD, GOL, NLFF, FOV, LOS, ROI, SDO, AIA, HMI, EVE, SST, GST, EST, RBT, AO, MCAO, MOMFBD, SOT, PSP, SolO, AR, QS, PIL, CME, MBP, MC, EB, QSEB, RBE, RRE, PHE, RPW, MMF, MPS, KUL, AIP, IAP, IAS, IAC, ITA, IIA, LMSAL, JSOC, JPL, NRL, NSO, HAO, LASP, CFA, ADS, AA, ApJ, MNRAS, SoPh, JQSRT, LRSP, EPS, SPS, EAS, IAU, AAS, SPD, and the already nostalgic SIU, SOZOU, KIS, LPARL, ESMOC, MDI, EIT, TRACE, VTT, SVST, DOT, NST, DST, IBIS, CDC, IBM, TI, HP, DEC, VAX, VMS, IDL - (LOL), etc. would pop their meaning. I earlier used command `pdfdooltip` in `pdfcomment.sty` for such popups but they were insufficiently robust and worked too variedly between different pdf viewers - even non-functioning in macOS Preview whereas (far too) many solar physicists remain Mac-challenged. No go so far. Help?

Revision marking - The A&A office showed a great trick for revision marking. I used to do this by defining latex environments as `\revisiona{...}` and `\revisionb{...}` that boldfaced and colored new text, setting different colors for successive revisions. They required embedding any change, large or small or tiny, in such calls, a laborious but seemingly unavoidable chore. Deletions I marked with a command inserting a special symbol. I would then turn these commands on for single-column double-spaced referee-style output and turn them off for journal-style output. Subsequently I simply maintained all these calls set inactive to avoid errors from undoing them and to keep a revision change record for myself. They then sat also inactively in the accepted-version latex files submitted to arXiv, but these can be freely downloaded whereas you and your referees may prefer to keep peer-review changes private (likewise, I do first remove all comment-line coauthor debates - sometimes very private - with script `rmtexcomments`).

The great trick is to not code revisions at all but to use `latexdiff` for difference marking between the old and

new version with a command as:

```
latexdiff --flatten --encoding="ascii" --append-textcmd="abstract,revision,LEt" ms_old.tex ms_new.tex
```

where option `--flatten` permits calling extra input files as your macros and where any command-defined environment using text inside (as A&A's `\abstract{...}` and the language editor's `\LEt{...}` insertions) should be appended as shown. The resulting `ms_diff.tex` file produces a referee-style pdf with all revisions clearly marked, including deletions. This way you do not have to embed-code any change you make: you may alter, delete and add as much as you want without further ado; you only have to keep the preceding `ms_old.tex` submission as reference. A lot easier!

Publishing in Solar Physics. Flower-casting recent Solar Physics experience:

Solar Physics garland 1 - Solar Physics furnished outstanding refereeing.

Solar Physics garland 2 - Solar Physics furnished excellent scientific editing.

Efficient and pleasant affair up to acceptance (and selection as “Editors’ Choice”). So far so good! - But then.....

Publishing with Springer. Springer’s production of the above Solar Physics article made me cast this dozen bitter malapropism flowers after “*He’s been a long time in the firm and doesn’t like any nasturtiums cast at it*” (Dorothy L. Sayers “Murder Must Advertise”) where “*he*” is a manager and “*the firm*” a whiffle-piffle commercial publisher:

Springer nasturtium 1 - Springer journals, unfortunately including Solar Physics, never become public and therefore arXiv posting is a must. Only ancient 1967 - 1996 Solar Physics articles from the more glorious pre-Springer Reidel-Kluwer era are freely available at ADS and can be page-linked via ADS. Instead, direct page-linking of any Solar Physics article from 1997 up to the present, even when open access, requires an arXiv post.

Springer nasturtium 2 - Worse: at acceptance I got astounding stipulations on self-archiving from Springer permitting to arXive only the initial first-submission pre-peer-review manuscript. This policy clashes head-on with the sound and commendable solar physics practice of posting only when accepted.

However - soon after the acceptance email I got a Springer email request for contractual copyright transfer via a webform for “signing” a “Copyright Transfer Statement” including Springer’s self-archiving stipulations. Springer allowed me a few days to do this. I suggest that first ArXiv posting your newest pdf with status “accepted for Solar Physics” within these days is morally and legally in order because the peer review was a nonpaid noncommercial volunteered community service intended to improve your manuscript, the resulting accepted version remains fully written and produced by you and your coauthors, you still hold the copyright, you didn’t sign anything yet, and your posting then occurs before what Springer calls its “processing” and regards/claims/guards commercially as proprietary valuable. At this stage Springer didn’t do anything yet. The Solar Physics scientific editor spent effort in peer review handling and should support and appreciate posting the resulting version. The referee spent most effort so far and likely dislikes finding only the raw version spread instead, insultingly disavowing his/her scrutiny and improvements. Springer’s contributions so far are only its latex and bibtex macros (clumsy, I helped repair), style guide (bad), and its upload interface (the worst I have tried, unclear and requiring unnecessary and cumbersome remote compilation for the initial submission and peer-review iterations where just sending your initial or latexdiffed pdf would suffice, as with A&A). Springer supplies these meager services entirely in its own interest to keep you from submitting traditional “manuscripts” as mailed stacks of unformatted hand- or typewritten pages that Springer would really have to typeset instead of your doing this work for free (where a better style guide would make you deliver latex closer to their quaint formats).

Upshot - post at acceptance with corresponding arXiv comment. You will be in good company: ADS showed that many Solar Physics authors including editors did this, likely in ignorance of Springer’s ban of this standard practice.

Me too - I posted my accepted version before I became aware of this forbidding stipulation, unclearly formulated in a link I got at acceptance - but if I had been aware of the ban I would still have posted nevertheless for compliance with my institute’s Plan S green open access condition for permission to publish in Solar Physics even though Springer disqualifies that through hybrid double-dipping. In astronomy “green” open access implies the immediate presence on ADS of a full-text pdf-symbol button with a green open-access dot serving the accepted version directly (side note: ADS might give arXiv pdf buttons serving a not-(yet)-accepted version an orange dot rather than a green dot). A&A and ApJ are fully public from 2022; earlier they were hybrid by providing publisher

pdf buttons on ADS that were green-dotted for paid-for open access or became green-dotted already after one year, and they welcomed arXiv posting without condition and therefore were immediately greenable by adding a green-dotted arXiv pdf button, hence permitted by my institute and directly page-linkable from latex (also mandatory at my institute). MNRAS is similarly hybrid with a three-year wait but welcomes arXiv greening. Springer never does and never yields direct pdf buttons on ADS (“silly” publisher).

Springer nasturtium 3 - Springer starts its “processing” after your copyright transfer or your pledge to pay. It consists of what Springer calls “copyediting”, meaning language and style adaptations - actually mainly done by the Solar Physics scientific editor - (which you may not copy to your arXiv post so that the publication diverges in this comma-level textual detail), and then what Springer calls “typesetting” - as if they still melt and pour lead to cast type to press on paper to produce proofs, whereas you yourself type 99% of the latex obeying the crummy Springer macros and check their functioning yourself by test-compiling with the crummy Springer upload interface while not getting 99% (or any) of the non-crummy Springer earnings and extraordinary profits from your work. Nor do Donald Knuth and Leslie Lamport, the true typesetters. Nor does the referee who after you volunteers most effort in this “bizarre triple-pay system” (“predator” publisher).

Springer nasturtium 4 - Springer decided automatically and erroneously what my affiliation is and whether that institution pays for Springer open access, without asking me and regardless of the affiliations specified in my manuscript - then Springer obstinately kept disbelieving my immediate denial during many weeks.

Springer nasturtium 5 - Springer could not handle copyright transfer when its webform automation failed - then Springer resorted to falsification. This pleased me because I never got nor saw nor “signed” a “Copyright Transfer Statement” and so was free to post and cast as I like.

Springer nasturtium 6 - Springer destroyed my 118 citation links in the proofs, while they worked with the Springer macros and survived the Springer upload processing and copy editing, giving me confidence that they would work - but they did not and Springer refused repair, arrogantly, still in the proof iteration when fixing was trivial. When I protested Springer took a full month to re-affirm this refusal and so motivated these bitter casts.

Springer nasturtium 7 - Springer mucked up my text yet further by adding weird errors in subsequent proofs - luckily the Solar Physics scientific editor caught most. Be aware that every Springer proof must be checked minutely throughout, beyond reported modifications and again including everything that was in order in a previous one.

Springer nasturtium 8 - Springer will not react non-automated at all when you report failures in Springer macros, interfaces, protocols, production. Instead, Springer will “ticket” you with “escalation” into a black hole. I suffered both treatments until I identified Springer programmers and managers with email addresses to trigger response.

Springer nasturtium 9 - Springer needed 100 days for my acceptance-to-publication processing (instead of the advertized 17) - plus 120 emails (not counting automated).

Springer nasturtium 10 - Springer forbids arXiv posting beyond your initial submission (nasturtium 2), but nevertheless requires a final arXiv correction that specifies the eventual publication within that text (but ADS shows that most Solar Physics authors including editors do not do this). Springer stipulates a lengthy ill-phrased formula, but essentially wants the journal reference and DOI inserted with the acknowledgements at the end, an illogical and ineffective place. I suggest to instead replace the ugly incomplete manuscript banner with these by adapting the (obtuse) Springer style files (as I did here).

Springer nasturtium 11 - Springer forbids posting the final version on your institute or sponsor website (permitted explicitly by A&A and ApJ) during a one-year embargo period - but instead maintaining the arXiv pdf there not only during this embargo year but forever (as my institute does here) serves well to circumvent Springer mutilations of your article. Then comment via arXiv on ADS that it is better to read the non-Springer-mutilated arXiv version (as I did here) and also in the arXiv post itself (as I did here).

Springer nasturtium 12 - Springer deemed their version of my article the answer to every question in the universe and therefore charged 42 Euro per download initially (their Deep Thought yielding triple my customary price at A&A). This version remains free and better.

In hindsight it is unfortunate that C. de Jager and Z. Švestka started Solar Physics in 1967 as proprietary venture of a commercial publisher (Reidel ζ Kluwer ζ Springer), similar to De Jager's start of the journal Space Science Reviews in 1962 at Reidel which liked its success and pushed De Jager to start another journal. A year later S.R. Pottasch and J.-L. Steinberg did much better, urged by J.H. Oort who was upset about the commercial nature

of Z. Kopal's new journal *Astrophysics and Space Science* also at Reidel, and founded A&A as a non-profit astronomer organization that contracts production to a publisher (Springer & EDP), similarly to the non-profit AAS contracting ApJ production out (Univ. Chicago & IoP). Some editorial boards of well-established Elseviers journals have quit the over-profitable publisher and started a fresh non-profit make-over; following suit should suit the editors of *Solar Physics*.

Publishing on arXiv. The sad Springer saga above made me not offer my next study to *Solar Physics* but only post it on arXiv as *Lingezicht Astrophysics Report*. Its version here is the living latest and retains an epilogue on pros and cons of selfpublishing. I update the arXiv version irregularly. Any reader can easily inspect all differences (or lack of difference) between any pair of arXiv versions by downloading the source material for each and run `latexdiff` as shown under A&A above. Similarly, inspection of tex and macros in my source material details my tricks including hyperlink generation.

11 Recipes for presentations and meetings

Meetings recipe list suggesting workshop and symposium organisers what to do and what not to do.

Hans-Peter Doerr's count-down display script for the 12th European Solar Physics Meeting, keeping even me in time in my Concluding Remarks.

Piet van der Kruit's old hints for presentations. They date back to transparency (viewfoil, "sheet" in Dutch) overhead projectors rather than video projectors ("beamer" in Dutch) but remain instructive.

Leslie Lamport's yet older How to present a paper.

Chris Sterken's hints for writing articles.

12 Recipes for linux/unix

A mixed bag of tricks I learned over the past decades.

Emacs. In file `~/ .emacs` I have:

```
(custom-set-variables
  ;; custom-set-variables was added by Custom.
  ;; If you edit it by hand, you could mess it up, so be careful.
  ;; Your init file should contain only one such instance.
  ;; If there is more than one, they won't work right.
  '(blink-cursor-mode nil)
  '(inhibit-startup-screen t)
  '(save-place t nil (saveplace))
  '(show-paren-mode t)
  '(tooltip-mode nil))

(custom-set-faces
  ;; custom-set-faces was added by Custom.
  ;; If you edit it by hand, you could mess it up, so be careful.
  ;; Your init file should contain only one such instance.
  ;; If there is more than one, they won't work right.
  '(default ((t (:inherit nil :stipple nil :background "ivory" :foreground "black" :inverse-video nil
    :strike-through nil :overline nil :underline nil :slant normal :weight normal :height 106 :width normal
    :foundry "unknown" :family "DejaVu Sans Mono")))))
```

```

;; set window geometry = size and position
;; do here instead with --geometry option in Xwindow call
;; to avoid the irritating superfluous gtk error message in Ubuntu 14.04
(add-to-list 'initial-frame-alist '(height . 38))
(add-to-list 'initial-frame-alist '(width . 78))
(add-to-list 'initial-frame-alist '(top . 1))
(add-to-list 'initial-frame-alist '(left . 1000)) ;RR = flush right

;; color theme
(require 'color-theme)
(color-theme-initialize)
(color-theme-feng-shui)

;; take all bars off (get menu instead by CNTRL + rightclick)
(tool-bar-mode -1)
(menu-bar-mode -1)
(scroll-bar-mode -1)

;; general settings
(global-unset-key "\M-t")
(global-unset-key "\C-z") ;; take out minimize to hidden

;; general settings copied from Han Uitenbroek
(setq meta-flag t) ;; enable the Meta key
(setq default-major-mode 'text-mode) ;; make text the default mode
(setq require-final-newline t) ;; terminate the file with a newline
(setq next-line-add-newlines nil) ;; don't add new lines at end
(global-unset-key "\C-h") ;; don't want help
(global-set-key "\M-n" 'goto-line) ;; faster goto line: ALT N
(global-set-key "\M-h" 'help-command) ;; use M-h for help
(global-set-key "\b" 'backward-delete-char) ;; restore backspace
(setq-default case-fold-search nil) ;; make searches case sensitive

;; text mode for my own extensions and for mutt
(setq auto-mode-alist (cons '("\.jot$" . text-mode) auto-mode-alist))
(setq auto-mode-alist (cons '("\.pln$" . text-mode) auto-mode-alist))
(setq auto-mode-alist (cons '("\.man$" . text-mode) auto-mode-alist))
(setq auto-mode-alist (cons '("\.idl$" . idlwave-mode) auto-mode-alist))
(setq auto-mode-alist (cons '("mutt\ $" . text-mode) auto-mode-alist))

;; IDLWAVE preferences for IDL
(setq idlwave-shell-automatic-start t) ;; t = yes, nil = no
(setq idlwave-shell-use-dedicated-frame t)
(setq idlwave-shell-save-command-history t)
(setq idlwave-shell-automatic-electric-debug nil)
(setq idlwave-main-block-indent 0) ;; indentation of a pro body
(setq idlwave-block-indent 2) ;; indentation of a begin-end subblock
(setq idlwave-end-offset -2) ;; align the end with the begin
(setq idlwave-continuation-indent 2) ;; indent a line after $ continuation
(setq idlwave-max-extra-continuation-indent 10) ;; no far-right alignment
(setq idlwave-special-lib-alist '("/rutten/idl/rridl/" . "rridl"))
(setq idlwave-shell-debug-modifiers ;; H-c = compile (in separate shell)

```

```

;; (H = hyper, for me the redefined Windows key)
(setq idlwave-no-change-comment ";") ;; don't change my comment layout
(setq idlwave-expand-generic-end t) ;; convert END to ENDIF etc
(setq idlwave-shell-frame-parameters ;; wide low frame for shell window
  (quote ((top . 400) (left . 50) (height . 20) (width . 140)
    (unsplittable))))
(add-hook 'idlwave-mode-hook (lambda ()
  (idlwave-auto-fill-mode 0) ;; no auto filling
))
(add-hook 'idlwave-shell-mode-hook (lambda ()
  ;; custom mouse examine commands (click twice)
  (idlwave-shell-define-key-both [H-mouse-1] ;; print value(s)
    (idlwave-shell-mouse-examine "print,___"))
  (idlwave-shell-define-key-both [H-mouse-2] ;; print dimensions
    (idlwave-shell-mouse-examine "print, size(____,/DIMENSIONS)"))
  (idlwave-shell-define-key-both [H-mouse-3] ;; generic print/plot/play
    (idlwave-shell-mouse-examine "sv,___")) ;; sv = my routine to show variable
))

; cutout the annoying yes/no caveat at C-x C-c closure that there are
; still active processes running (namely in the **IDL** frame from IDLWAVE)
(add-hook 'comint-exec-hook (lambda ()
  (process-kill-without-query (get-buffer-process (current-buffer)))))

; comment/uncomment
(global-set-key "\M-c" 'comment-region) ;; comment region
(global-set-key "\M-u" 'uncomment-region) ;; uncomment region

;; insert date, from Han Uitenbroek
(defun insert-date()
  "*insert the current date in the text buffer"
  (interactive)
  (insert
    (let ((now (current-time-string)))
      (concat (substring now 4 8)
              (substring now 8 11)
              (substring now 20)
              " "))))
(global-set-key "\C-xd" 'insert-date) ;; C-x d (instead of dired)
(global-set-key "\C-x\C-d" 'insert-date) ;; C-x C-d too

;; bibtex mode
(autoload 'reftex-mode "reftex" "RefTeX Minor Mode" t)
(autoload 'turn-on-reftex "reftex" "RefTeX Minor Mode" nil)
(add-hook 'LaTeX-mode-hook 'turn-on-reftex)

;; fill out
(defun my-fill-sentence ()
  "Fill sentence separated by punctuation or blank lines."
  (interactive)
  (let (start end)
    (save-excursion

```

```

    (re-search-backward "\\(^\\s-*$\\|\\.?!\\)" nil t)
    (skip-syntax-forward "^w")
    (setq start (point-at-bol))
  (save-excursion
    (re-search-forward "\\(^\\s-*$\\|\\.?!\\)" nil t)
    (setq end (point-at-eol)))
  (save-restriction
    (narrow-to-region start end)
    (fill-paragraph nil)))
(setq normal-auto-fill-function 'my-fill-sentence)

;; redefine ESC q in .tex files = new-sentence-on-new-line paragraph reform
;; Modified from http://pleasefindattached.blogspot.com/2011/12/emacsauctex-sentence-fill-greatly.htm
(defadvice LaTeX-fill-region-as-paragraph (around LaTeX-sentence-filling)
  "Start each sentence on a new line."
  (let ((from (ad-get-arg 0))
        (to-marker (set-marker (make-marker) (ad-get-arg 1)))
        tmp-end)
    (while (< from (marker-position to-marker))
      (forward-sentence)
      ;; might have gone beyond to-marker---use whichever is smaller:
      (ad-set-arg 1 (setq tmp-end (min (point) (marker-position to-marker))))
      ad-do-it
      (ad-set-arg 0 (setq from (point)))
      (unless (or (looking-back "^\\s *")
                  (looking-at "\\s *$"))
              (LaTeX-newline)))
      (set-marker to-marker nil)))
  (ad-activate 'LaTeX-fill-region-as-paragraph)

```

I start emacs sessions with a csh alias em:

```
alias em 'env XMODIFIERS="@im=none" emacs --title !^ !^ &'
```

where the XMODIFIERS bug repair needed in Ubuntu 14.04 makes the Compose Key (CAPS LOCK for me) work also in emacs. I have a special alias for my todo file:

```
alias emtodo 'emacs -Q -D --title TODO -bg LightPink
-fn "--dejavu sans mono-*-*-*-*-*106-*-*-*-*"
-fg black -geometry 78x40+250+50 ~/todo &'
```

Remote machine use without password. Great for fast and unattended use of ssh, scp, and rsync. Go to (or mkdir) ~/.ssh, type ssh-keygen -t dsa, press enter until you get the prompt again, skipping the requested passphrase, then append the content of your newly made local file ~/.ssh/id_dsa.pub into the remote file ~/.ssh/authorized_keys2.

Remote backup. I use scripts as

```
#!/bin/csh
# script: syncwork2server
xhost +
setenv RSYNC_RSH ssh
rsync --delete -bvauz --backup-dir=~ /syncbck-work ~/work machine.dept.univ.nl:/diskname/groupname/
| tee ~/synclogs/sync-work.txt
```


which makes directory `~/work` on a large server disk elsewhere identical to the directory `~/work` in my laptop, with the files that are deleted or changed in the remote machine back-upped into a directory `syncbck-work` there and with a log of `rsync`'s latest doings written in file `synclogs/sync-work.txt` in my laptop. I run such scripts daily from a startup "good-morning" script wherever I am, to ensure that I have an up-to-date and always reachable backup in a safer place than my laptop whereabouts.

Mutt. For my mailing I was advised many years ago to transit from `elm` to less-sucking `mutt` (<http://www.mutt.org>) and have been happy with it ever since. It gives great flexibility in cleaning out html duplicates and attachments and it stores mails as straight text files that can easily be searched and edited. I use `mutt` with `msmtp` serving to Google's gmail as IMAP server. [Install: `mutt`], [install: `msmtp`], [install: `mp`], add a file `~/mutt_alias` with your aliases in the form `alias doe John Doe <johndoe@gmail.com>` and a file `~/muttrc` specifying your preferences, see [the mutt manual](#). Pertinent parts of my `.muttrc` (modified to John Doe where appropriate):

```
source ~/.mutt_alias
set sendmail="/usr/bin/msmtp -a google"
set sendmail_wait=1
set imap_user = 'JohnDoe@gmail.com'
set imap_pass = 'JohnDoegmailpassword'
set spoolfile = imaps://imap.gmail.com:993/INBOX
set folder = imaps://imap.gmail.com:993
set smart_wrap      # wrap long lines at word boundary
set pager_stop      # Don't jump to next message at end of message
set weed            # weed headers, when forwarding with forward_decode
set reverse_alias   # use my person names through reverse alias lookup
set from="J.Doe@JohnDoe.com" # always same sender wherever it comes from
set use_from=yes
set envelope_from=yes
set connect_timeout=-1
ignore *
unignore from date subject to cc # copy minimal headers in forwards
color header black default .    # I don't like color crowding
color body black default .
color quoted black default
color attachment black default
color tree black default
color indicator black default
color status black default
color tilde black default
color normal black default
color hdrdefault black default
color quoted black default
color signature black default
color error black default
color tree black default
color tilde black default
color message black default
color markers black default
color attachment black default
color search black default
color underline black default
color body black default "(ftp|http|https)://[^\ ]+" # point out URLs
color body black default "[-a-z_0-9.]+"@[-a-z_0-9.]+" # e-mail addresses
```

```

macro index \cb "|urlview\n" "open url with urlview"
macro pager \cb "|urlview\n" "open url with urlview"
set use_8bitmime
set abort_nosubject=ask-yes
set abort_unmodified=no
set alias_file=~/.mutt_alias"
set allow_8bit
set arrow_cursor
unset askcc
set attach_sep="\n"
set attribution="On %d, %n wrote:\n"
unset autoedit
set auto_tag
set bounce_delivered
unset beep_new
unset confirmappend
unset confirmcreate
set copy=yes
set date_format="!%a, %b %d, %Y"
set delete=yes
set editor="emacs -nw --color=no"
unset fcc_attach          # do not save my own sent attachments
set forward_decode
set forward_format="%s [fwd]"
set include=ask-no
set index_format="%4C %Z %{%b %d %Y} %-15.15L (%4c) %s"
set ispell="/usr/lib/ispell"
set mail_check=120
set mime_forward=ask-no
unset mime_forward_decode
set move=no
set postpone=yes          # keep mails that weren't sent
set postponed=~ /mail/postponed" # go there with R (recover)
set print=yes # no question whether to print just do it
set print_command="/usr/bin/mp -a4 -left 60 | lpr -Pprintername"
unset prompt_after
set realname="John Doe"
set recall=no
set record=~ /mail/sent"
set reply_to=yes
unset save_empty
unset save_name
set sort=reverse-date-sent
set status_format="Mutt: folder %f Msgs:%?M?%M/?%m%?n? New:%n?%?o? Old:%o?%?d? "
set status_on_top
bind pager <Up> previous-line # up-down cursoring within mail
bind pager <Down> next-line # left-right = previous and next mails
unset suspend
set timeout=60
bind pager <Up> previous-line # cursor & page up/down, wheel in messages
bind pager <Down> next-line
auto_view text/html

```

Pertinent parts of my `~/msmtprc` file:

```
# defaults
defaults
tls on
tls_starttls on
tls_certcheck off
logfile ~/.msmtp.log
# gmail
account google
host smtp.gmail.com
port 587
auth on
user johndoe@gmail.com
password johndoe@gmailpassword
```

Pertinent parts of my `~/mailcap` file:

```
text/html; elinks %s; nametemplate=%s.html
text/html; elinks -dump %s; nametemplate=%s.html; copiousoutput
application/pdf; mutt_bgrun acroread -tempFile -openInNewWindow %s; test=sh -c 'test $DISPLAY'
macro attach E <save-entry><kill-line>/home/johndoe/attachmentsdir/<enter>
image/*;          xv %s > /dev/null
```

Photos. I unload the SD-card of my camera by sticking it into the card reader of my laptop and using a script as:

```
#!/bin/csh
# script: unloadcamera, thanks to Cees Bassa
cd /media/*/DCIM
cp -uprv *PANA ~/photos/camera/origs
foreach dir (*PANA)
  cd $dir
  chmodopen
  chfil JPG jpg
  jhead -n%y%m%d-%H%M%S-%f -autorot *.jpg
  cd ~/photos/camera/origs
end
setenv TODAY `date "+20%y-%m-%d" `
mkdir -p $TODAY
mv *_PANA/* $TODAY
rmdir *_PANA
rm -rf /media/*/DCIM/\*
```

where [install: `jhead`] is used to redefine photo filenames starting with date-time. They go into an `camera/origs` subdirectory with the present unload date as name. I run similar scripts for other cameras so that merging their files puts all photographs in sequential time order (if the camera clocks were synchronous; in group travel one should ask everybody to reset their camera to local time, but if this was not done one can readjust the exif time stamps afterwards with the `jhead -ta` and `jhead -da` options). Script `chmodopen` resets directory and file protections in the current directory and underneath to read permission for others:

```
#!/bin/sh
# script: chmodopen, from Wim Lavrijsen
```

```

chmod 755 .
find . -maxdepth 10 -type f -exec chmod 644 {} \;
find . -maxdepth 10 -type d -exec chmod 755 {} \;

```

of which the reverse `chmodclose` has `chmod` settings 600 and 700. Script `chfil` modifies filenames in the current directory by replacing filename parts:

```

#!/bin/csh
# script: chfil, by Alfred de Wijn
foreach file (*$1*)
  mv ${file} `echo ${file} | sed -e "s|$1|$2|g"`
end

```

and has a counterpart `chfildeep` to do so also in underlying directories:

```

#!/bin/csh
# script: chfildeep, by Alfred de Wijn
find . -mxdepth 10 -type f -name "*$1*" | sed -e "s/\(.*\) $1 \(.*\) /mv \1$1\2 \1$2\2/" | bash

```

After manually weeding out bad photos in the `origs` dir with `qiv`, I use the following script to produce XVGA (1024x768) versions for spreading and projection in another directory:

```

!/bin/csh
# file: cameraconvertall
# usage: cameraconvertall dir/filenamestart
foreach file (*.jpg)
  setenv FILETAIL `echo $file | sed -e "s|.jpg||"`
  convert -linear-stretch 0.1%x0.1% -sharpen 2.0x2.0 -geometry x768 -quality 90 $file ${1}${FILETAIL}
end

```

ImageMagick used by `convert` has lots of worthwhile commands, e.g., `convert -sigmoidal-contrast` which emulates the nonlinear growth-curve response of photographic emulsions that made my Kodachrome slides span large contrasts much better than digital projection does. For example, `convert -sigmoidal-contrast 3,0%` brightens too dark objects.

I then use [Install: `album`] from <http://marginalhacks.com/Hacks/album> to generate linked albums like my travel albums and the DOT solar image album and the DOT photograph album with:

```

album -clean -index album.html -no_image_pages -no_embed -geometry 300x300 -no_crop -columns 3 .

```

generating captions with a file `captions.txt`.

Movies. I use [Install: `mpv`] as versatile successor to `mplayer`. I call `movies` in `pdflatex` with (for example):

```

\def\movie{/home/USER/PATH-TO-MOVIE}
\def\figs{/home/USER/PATH-TO-FIGS}
\href{run:\movie/movie.mov}
  {\epsfig{file=\figs/movie-snap.jpg,width=180mm}}

```

where I obtain the linker image `movie-snap.jpg` as a snap from `album`. I also use `album` to add `.avi` and `.mov` versions of solar `.mpg` movies made with IDL from DOT image sequences to the DOT movie album with:

```

#!/bin/csh
# script: dotmovie2album = convert .mpg movie into .avi and .mov

```

```
# params: $1 = desired fps (f.s) playing rate, $2 = filename.mpg
ffmpeg -sameq -i $2 $2:gr.avi
avifix -f $1,1 -i $2:gr.avi
ffmpeg -sameq -i $2:gr.avi $2:gr.mov
mv $2:gr.avi ../dot-albums/movies
mv $2:gr.mov ../dot-albums/movies
cd ../dot-albums/movies
album -clean -index album.html -no_embed -geometry 400x400 -no_crop -columns 2 .
```

needing [install: ffmpeg] and [install: transcode] which contains avifix. They may need non-free codecs from the medibuntu repository:

```
sudo echo "deb http://packages.medibuntu.org/ jaunty free non-free" >> /etc/apt/sources.list
sudo apt-get update && sudo apt-get install medibuntu-keyring && sudo apt-get update
sudo apt-get install non-free-codecs
```

The .mov versions play even in the simplest QuickTime players.

Grep manual. I often use a special alias rr meaning "Rob-asks-Rob-a-question":

```
alias rr 'grep \!^ ~ /manuals/rrmanual.txt'
```

which answers my questions "rr some-term" such as "rr chmod". File rrmanual.txt has many one-liner linux reminders to myself, including:

```
colors Ubuntu    em /usr/share/texmf-texlive/tex/latex/graphics/dvipsnam.def
xfontsel &      select a font
xlsfonts > fonts.fil    write all font names to file
chmod 644 file      -rw- r-- r--    others may read (umask 022 default)
chmod 600 file      -rw- --- ---    others may not read file
chmod 755 dir       drwx r-x r-x    others may enter (umask 022 default)
chmod 755 script    drwx r-x r-x    others may execute
chmod 700 dir       drwx --- ---    others may not enter dir
chmod 744 script    drwx r-- r--    others may read; I may execute
chmod 444 file      -r-- r-- r--    even I may read only, protection
chmod 711 dir       drwx --x --x   others may enter but not list dir
chmod root.root file      reset to owner/group both root
cp -uprv dirname dir > cp dirnamedir.txt    copy update all, with log file
convert -density 300 -quality 80 -crop 0x0 -geometry x768 file.ps file.jpg
convert 'vid:*.jpg' directory.miff    make thumbnail index album
display directory.miff &              show thumbnail index album
gqview                                image browser, slide show
qiv -fim *jpg                          fast image viewer, d=delete to subdir
qiv -fis -d 1.5 *jpg                    fullscreen slide show 1.5s cadence
feh                                      fast image viewer
eog                                      eye-of-gnome image viewer
jpeg2ps -h fig.jpg > fig.eps            good image converter
ps2pdf -dPDFsettings=/prepress file.ps file.pdf    like acrodist
psnup -2 file.ps > file2.ps             2A4-on-one pdf talk printout
ps 612 792 <-> 595 842 (pt)             hack ps to convert USA B4 <-> A4
ps x | grep processname                 list all processes called processname
ifconfig                                check ethernet
iwconfig                                check wireless
recode ibmpc:latin1 file                decode windows file to unix
xset s off                              screensaver off
```

```

screen (in remote terminal) = start window for remote processing
  CNTRL-a      screen commando
  CNTRL-a c    screen new terminal
  CNTRL-a space screen cycle terminal
  CNTRL-a d    screen detach terminal (then log out of remote)
  screen -r    screen recover detached terminal (after remote login)
renice +18 pid put pid job in batch, sort of (eg when using screen)
tar cvf *17Jul96.??? tar with joker/wildcard: xx.100-999
tar hcvf dir.tar dir tar dir with all under, also linked files
tar xvf files.tar extract files into directory structure
tar tf files.tar list files only
wget -r http://etc get everyting below and above this URL
wget -r -l 1 -nd http://etc get everything in this URL dir only
lftp ftp://... or lftp http://... better than wget
lftp mget -d * get all subdirs and files
lftp mirror -n . get update with newer files only
mgdiff file1 file2 linux: differences between two files
diff -y -W170 --suppress-common-lines file1 file2 differences files
aspell -t --dont-tex-check-comments check file.tex latex spell checker
env TZ=UTC date give current date and time in UT

```

13 Recipes for Ubuntu linux on Toshiba laptops

I started this section in March 2009 after installing Ubuntu 8.10 on a Toshiba Portégé R600 laptop to replace a MacBook Pro that I didn't like. Summary: the Portégé R600 proved a great computer except for its fan noise, and a far better daily companion than my MacBook Pro. Ubuntu worked very well on it. The basic installation was easy, but many applications needed laborious nontrivial fine-tuning. Adaptation to my preferences and habits took weeks of heavy googling. I then posted the details here to make such a job easier for others like me. In December 2009 I added hard-learned recipes "[how not to sudo-cide Ubuntu and how to revive it if you do](#)", and "[how to undo an Ubuntu update](#)". Since then I installed [Ubuntu 12.04](#), [Ubuntu 14.04](#) and [Ubuntu 18.04](#) on successive Toshiba Portégé laptops.

13.1 My laptop history and usage

My laptop history. My first laptop information carrier, after passing from 8-bit punched paper tape via 80-byte Hollerith cards and 80-Mbyte magnetic tape reels to floppies of various kinds, was an Atari ST-Book bought secondhand in 1993, a complete 8-MHz 1-Mbyte Atari ST computer in a slim, lightweight, silent form with six hours battery life, a fantastic machine. Only 400 were sold, of which two in Holland. I used mine happily to latex articles, [course notes](#), and [this website](#) until its battery gave out in 1998. Its replacement was a many-kilo Dell Inspiron 7000 "Schlepptopf" running Redhat. It was too heavy to carry in a rucksack so that its power inlet broke from rattling on my bicycle carrier in 2002. I replaced it with a marvelous 1-kg Toshiba Portégé 2000. By that time I gave up relying on my institute's computer experts for support; instead, Debian was installed and maintained by a helpful and most knowledgeable graduate student. When the Toshiba died in 2007 from a keyboard spill, he had left to postdoc elsewhere and advised me to transfer to a Mac as "Rob-proof" unix replacement. I did so, but quickly got fed up with the MacBook Pro's unix-deviant and unix-hiding idiotsyncracies, its weight, and its bad keyboard. So, even though MacBook Pro's then became the fashion in my line of work, in March 2009 I decided to switch back to a lightweight Toshiba running straight linux. This time I dared to rely on Google alone for installation just by myself. It worked; Google may indeed replace graduate students. This post resulted from this non-trivial but eventually successful exercise. I then became much happier with the Toshiba than I ever was with the Mac; a considerable boost of my daily life.

My laptop usage. As an astronomer I use latex for all my writing: articles (with BibTeX, see [Bibtex and ADS](#)), proposals, reports, course notes and problems and examinations, letters, websites (latex2html), and talks (pdflatex). As a solar physicist I program in IDL with the SolarSoft library. I use emacs as editor, mutt for email, xfig for drawing, xv for image inspection, acroread for reading and presentations. All ancient but robust, reliable, and thoroughly familiar. I do almost all my work, mostly reading and writing, on my laptop, using a remote server mainly for backup and to provide my websites (including this one) and weblinks into my work directories for collaborators. I carry my laptop everywhere and type (or search) notes all the time. Next to my notes, work, and a lot of data, this veritable "information carrier" also contains thousands of [downloaded abstracts](#) and hundreds of [downloaded articles](#) on my research topics. I find my way in it not by GUI buttons but via the terminal command line, using many shortcut aliases and the locate command.

13.2 Toshiba Portégé R600 hardware and comparison with my MacBook Pro

Weight. In the spring of 2009 Toshiba offered four Portégé R600 models in The Netherlands, three at 1.1 kg including a DVD/CD drive and 6-cell battery, differing only in harddisk (160 GB or 320 GB spinning ones or an expensive 128 GB solid-state one), and one of only 0.8 kg with the solid-state disk, a 3-cell battery, no DVD/CD drive. I bought model R600-11Q with the 320 GB spinning disk at 1700 Euro. At 1.1 kg it is still too heavy but it was lighter than all other full-function laptops. The DVD/CD drive weighs only 70 grams, the battery difference is 140 grams. I guess Toshiba thought that with the drive its customers would play DVDs on long flights and would then complain about the too small battery. The internal G3 modem includes a GPS receiver not mentioned in the documentation. The transfective screen mode (on/off with `sudo toshset -trmode 1/0`) can be useful in very strong sunlight (nothing new; the ancient transfective screen of my Atari ST-Book was better). The R600 loudspeaker is mono and lousy; music needs external speakers or a headset, but there is a well-placed volume wheel. I haven't tried the fingerprint reader, nor the keyboard spillfreeness (so far).

Noise. I was shocked by the R600's unbearable noise under Ubuntu. A continuous hissing which is less noticeable when you hold the laptop up in the air, being some resonance that starts up close to a desk surface of whatever nature. It comes from a little fan which runs full-speed after the Ubuntu install. Charles Schwieter's [toshset](#) commands did not help. Eventually I got the noise down to that of the harddisk (details below; toshset includes that setting now), still irritating but bearable. The solid-state-disk should be a quieter option, but Ubuntu's fan control problems probably remain. Windows seems to provide better fan regulation.

Comparison with my Portégé 2000. The earlier model was quieter, lighter, and thinner. Of course the new model has better chips: faster, larger memory, ten times larger disk, USB2's, SD-card reader. However, there is nothing I do with the Portégé R600 that I did not do already with the Portégé 2000. The latter had no CD drive which I never missed. What I do miss on the R600 is the extra clip-on battery of the 2000 (I had two of those, giving me day-long power when traveling while the lightweight internal battery sufficed for my daily train rides). I also liked the screen mount of the 2000 better: it left a gap that gave my fingers a good hold when hurrying with open laptop in one hand (coffee mug in the other) to the lecture room. Since my 2000 died from a keyboard spill, the R600's spillfreeness may be a valuable asset. A final difference: the brand name on the lid is now upside down for the user, aping the Mac gimmick.

Comparison with my MacBook Pro. The R600 is much lighter but as sturdy by using magnesium alloy instead of aluminum, a better choice. It is much smaller, fitting economy-class airline tables. Nominally it runs slower (1.2 Ghz versus 2.3 GHz) but I barely notice the difference. It is much noisier, see above. I find its keyboard much much better, far less typo-prone. It also has the Page Up, Down, DEL keys and the second touchpad button that I sorely missed on the Mac. Also, Ubuntu copies-and-pastes with the mouse between all windows, another relief. The R600 screen is excellent, much brighter than the Mac's. Its 1280x800 resolution suits my needs. The R600 connectors, Kensington slot, and DVD slide are placed in just the right places instead of the bad locations on my Mac. The R600 also has a useful SD-card reader and a useful third USB slot. The latter is also eSATA which I never used, nor the express card slot and fingerprint reader. Suspend and hibernation work fine whereas my Mac often remains dead, necessitating endless frustrating reboot trials. The R600 battery (6-cell version) lasts about twice as long as the one in my Mac. I wouldn't even contemplate the underequipped MacBook Air because that

isn't light, only thin, the one laptop dimension I do not care about. The penalty paid in preferring the R600 is the Ubuntu installation effort, but I had as much trouble adapting the unix that sits awkwardly hidden under macOS (spaces in directory names, argh) to my needs. Upshot: I find my R600 a much better daily companion than my MacBook Pro. I thus joined the small elite of post-Mac scientists.

13.3 Ubuntu 8.10 on a Toshiba Portégé R600

Warning: this section remains a snapshot anno spring 2009.

In the below, [install: XXX] is shorthand for:

```
sudo apt-get install XXX
```

which needs addition of extra "repositories" = software collections: System & Administration & Synaptic Package Manager & Settings & Ubuntu Software; check all on except Source code, and under Third-Party Software check on intrepid extras and medibuntu. Similar commands are:

```
sudo apt-get remove XXXX
```

```
sudo apt-get install --reinstall XXX
```

```
sudo dpkg --purge --force-remove XXX
```

Installation. I followed then extent guidelines now gone. I installed version 8.10, writing the installation CD on my MacBook Pro, with checksum check. In a Toshiba press F12 during power-up to get the boot menu, cursor to the CD icon. First check the installation CD, then boot from it. I wiped Windows off the disk but six 1.5 GB Toshiba partitions remain. There is 272 GB left for me, I wonder where the rest went.

Shell. Long ago I was advised to use the csh shell and therefore my many scripts and aliases use csh syntax (setenv VARIABLE something; alias aliasname 'something'). Ubuntu has bash as default shell, while csh did not give me tab completion and cursor history. On the advice of a colleague I tried tcsh which does combine those with csh syntax, and so tcsh became my choice: [install: csh] and [install: tcsh]. I then followed a Googled advice to change the symbolic link /bin/sh to tcsh which killed all rebooting so that I ended up having to reinstall Ubuntu including a full disk wipe. This time I added tcsh at the end of ~/.bashrc, typed chsh -s /usr/bin/tcsh, and have the following (with some more not shown here) in ~/.cshrc:

```
# resource .alias
source ~/.alias

# switch from VI to EMACS
setenv EDITOR emacs-snapshot

# add local dir scripts to path
set path=( . $path )

# LaTeX and BibTeX paths
setenv TEXINPUTS ~/tex/macros:~/tex/styles:
setenv BIBINPUTS ~/bib:~/tex/styles:
setenv BSTINPUTS $BIBINPUTS

# IDL paths
setenv IDL_PATH +/usr/local/itt/idl64/lib:~/idl/rridl:~/idl/textoidl:
setenv IDL_DIR /usr/local/itt/idl64/

# define prompt = user@machine/dir>
set prompt="rob@tosh:%c3> "
```

Some aliases in my ~/.alias:


```
alias cd 'setenv OLDDIR $cwd; chdir \!*'
alias back 'setenv BACKDIR $OLDDIR; cd $BACKDIR'
alias cdl 'cp ~/.cdldummy cdldummy; db; cd \!*; l'
alias ls 'ls -aF'
alias l 'ls'
alias ll 'ls -l'
alias pwd 'echo $cwd'
alias cleanM 'dos2unix -q \!^; chmod 644 \!^'
alias dud 'du -h --max-depth=\!^'
alias findbelow 'find . -name \*\!^ \* -print'
alias rmbelow 'find . -maxdepth 6 -name \*\!^ -exec rm -f {} \;'
alias rm 'rm -i \!*'
alias db 'rm -rf cdldumm* .save* core* nul*.log ### *.bak *.BAK MAI* *~* .*~ .#* .nfs* .DS_* ._.DS*
alias rmtex 'rm -f *.aux *.dvi *.lis *.blg *.log *.log ### *.bak *.BAK *.inx MAI* *~* fileentries.
```

Passwords. The following password removals may be considered for laptops like mine which are not very likely to be ever touched by somebody unfriendly. I haven't tried the R600's fingerprint reader.

Remove the root password check by sudo (near the end): <https://help.ubuntu.com/community/RootSudo>

Avoid the Gnome wake-up password check after suspending by calling `sudo pm-suspend` instead of lid closure.

Fan control. The R600's fan operated unbearably noisily at large speed after the Ubuntu install. Eventually, I ventured into the BIOS (press ESC during powerup, hit F1). On the second BIOS page (PGDN) I changed battery mode ζ user settings and cooling method ζ battery optimized. The fan is then mostly off, but it frequently kickstarts momentarily with a loud whoosh, for example at every opening of an emacs window. Between whooshes you only hear the spinning harddisk, not silent either but at least quieter than the fan. I also found that choosing battery mode ζ performance (apparently meaning "not high performance" in Toshiba-speak) has the fan running at low speed without whooshes, but still too loud for me. Also, the `toshset` fan commands did work in the battery optimized mode (but not if I touched the cooling method with `toshset -c` which flipped its BIOS setting back to cooling optimized). I then found that after suspend or hibernation the fan returned to maximum noise with an error response to `toshset`. Since frequent BIOS resetting is not a desirable solution, I googled more and found an older voodoo recipe: "remove `/usr/share/initramfs-tools/hooks/thermal`" which worked. The same ex-student who took care of my earlier Portégé then happened to visit and hacked an 1/8 fan setting into the `toshset` code. Charles Schwieter's [newest toshset](#) includes it as mode 5 (labeled "on"; ignore the error message). I don't hear the fan above the harddisk now and it doesn't whoosh either. I can live with the noise now, but may switch to a solid state disk when they become affordable and bootable. The fan restarts after suspend through this script in `/etc/pm/sleep.d`:

```
#!/bin/bash
# file: fan-on = switch fan on at 1/8
# note: see http://en.opensuse.org/Pm-utils#Creating_your_own_hooks
case "$1" in
  hibernate|suspend)
    # Stopping is not required.
    ;;
  thaw|resume)
    sudo toshset -fan 5
    ;;
  *) exit $NA
    ;;
esac
```

Workspace shifter, panel. I had much trouble with the workspace switcher freezing up the laptop if workspace shift-left or shift-right keys were defined instead of disabled in System ζ Preferences ζ Keyboard Shortcuts and

used within an Emacs window. Unfreezing: CNTRL+ALT+F1 (another session), then CNTRL+ALT+F7 (your session). The eventual solution was simple but hidden in confusing Ubuntu webposts: System ↵ Preferences ↵ Assistive technologies, uncheck "Enable assistive technologies", whatever that is. I use 12 workspaces available under F1 - F12 and shift with CNTRL cursor-left and CNTRL cursor-right. I deleted the lower panel and have the shifter in the upper panel with three-letter names for the workspaces to keep their icons narrow (tex, idl, eml, web, etc). I usually shift the panel out of view to have a maximum clean screen. Shifting left and right presents an excellent iconized indicator that stays as long as CNTRL is pressed. I minimized the panel hide buttons by checking auto-hide in the panel Properties menu (right-click on a hide button), uncheck arrows, and typing gconf-editor, then ↵ apps ↵ panel ↵ default_setup ↵ top_panel ↵ auto_hide_size 6 ↵ 1.

Wireless, nm-applet. Much trouble too. My home wireless (hidden ADSL) came up by itself, asking for security settings, but later I lost the corresponding applet, called nm-applet and appearing as a blue four-pipe organ in the panel. I lost it unknowingly, probably when trying to re-arrange panel applets by removing the spacers showing as vertical lines. I so lost wireless adaptability; only restart (loosing my session) would restore a connection, also for ethernet at work. Misleading Ubuntu discussions made me first [install: wifi-radar], then [install: wicd] which removed network-manager and wifi-radar, and then backtrack with [reinstall: network-manager-gnome] which removed wicd. The eventual solution was the realization that this nm-applet is a special one belonging to a "Notification Area" on the panel which I had removed entirely. It was restored by: right-click vacant area in panel ↵ add to panel ↵ notification area, which brought the nm-applet back, and also the Update Manager that I hadn't missed yet.

Second monitor / beamer / projector. (Linguistic note: in the USA "beamer" means a BMW car.) Getting the VGA output to work also took much googling. My solution is a combination of toshset (see <http://www.schwieters.org/toshset>) and xrandr (see <http://www.graphics-muse.org/wp/?p=336>) which I combined in csh aliases to switch output to different types of external monitors on and off:

```
alias vga-open 'sudo toshset -video both'
alias vga-beamer 'vga-open; xrandr --output LVDS --mode 1024x768 --output VGA --mode 1024x768'
alias vga-home 'vga-open; xrandr --output LVDS --mode 1280x800 --output VGA --mode 1280x960'
alias vga-work 'vga-open; xrandr --output LVDS --mode 1280x800 --output VGA --mode 1280x1024'
alias vga-off 'sudo toshset -video int; xrandr --output LVDS --mode 1280x800 --output VGA --off'
```

If I boot the laptop with the external cable connected, the external screen becomes the principal one and the resolution only XVGA (1024x768).

Cursor blink off. gconftool-2 --set "/desktop/gnome/interface/cursor_blink" --type boolean "False"

Caps-lock to Compose key. Go to System ↵ Preferences ↵ Keyboard ↵ Layouts ↵ Other options ↵ Compose key position, check: Caps Lock is Compose. I agree with [Tina Russell](#) that switching caps-lock off in its own menu would be easier to find and less annoying. I don't need Compose, being a latex typer.

Emacs. Also gave me much trouble. Ubuntu's default version (emacs22) offered no fonts that I can work with. After far too much googling and trials the rescue came from <http://ubuntuforums.org/archive/index.php/t-803119.html>: [Install: emacs-goodies-el] and use emacs-snapshot-gtk with font monospace-10 specified in ~/.Xresources. Run xrdb -merge ~/.Xresources after changing this file. I use color theme feng-shui specified in ~/.emacs. In my case, not all color themes M-x color-theme-select were available; type M-x color-theme- in another emacs window and hit tab, the possible completions then show what you can choose from. Emacs key bindings in firefox:

```
gconftool-2 --set /desktop/gnome/interface/gtk_key_theme Emacs --type string
```

Latex, bibtex, xdvi. Ubuntu's default tex installation failed my first test. The solution from <https://help.ubuntu.com/community/LaTeX> was to [install: texlive-full]. It added as much as 800 MB, mostly support for languages that I will never use. It made my test work, but I would be happier with some partial installer for a few selected languages only. (Later I found that [install: texlive-latex-extra] and [install: texlive-

bibtex-extra] provide smaller selections). For `xdvi` I habitually use alias:

```
alias xdvitex 'xdvi -offsets 15mm -expert +statusline -bg White -geometry 920x680+100+75 -s 5 !^ &'
```

Acrobat reader. To install acroread follow the recipe in <http://ubuntu-tutorials.com/2008/06/23/install-adobe-acrobat-reader-812-on-ubuntu> which needs the Medibuntu repository. Acroread also serves to steal pdf figures from publications: `Tools` `;` `Select & Zoom` `;` `Snapshot Tool` `;` cut out the desired figure `;` 3rd mouse `;` print `;` print to file `;` specify `figfile.eps`. Cut to bounding box with `epstopdf` and `pdftocrop --margins 5`, convert to projector-size X VGA png with `convert -density 300 -geometry 1024x768 -background white -flatten figfile-crop.pdf figfile.png`.

Firefox. [Install: `msttcorefonts`]. I copied the Safari bookmarks from my Mac by installing Mac application Bookmarks Exporter there, exporting to `bookmarks.html`, pull that over into the R600, Firefox `;` Bookmarks `;` Organize bookmarks `;` Import and Backup `;` Import html. Videos: [remove: `gnash`] and [install: `flashplugin-nonfree`]. When Firefox takes long to open a save or print specification window, reboot the laptop. When these windows go haywire, run `firefox -safe-mode` and click "Reset toolbars and controls" on.

Skype. This also gave me a lot of trouble. Installation from <http://www.skype.com/intl/en/download/skype/linux> requires following the recipe at <https://help.ubuntu.com/community/Skype>, but without `uninstall` of `pulseaudio` and replacement with `esound`. Switch off Skype control over your mixer. Getting the microphone on was the hardest. Go to Applications `;` Sound & Video `;` Sound recorder `;` File, switch Capture on. Under File `;` Open volume control. Device: HDA Intel (Alsa mixer). Under Playback open Master and PCM, close both microphones, all sliders to full. Under Recording both speaker and mike on, slider to full. Under Options make Front Mic input source. Under Preferences check all. Then System `;` Preferences `;` Sound check Master, PCM, and Microphone, or all of them (press SHIFT and CNTRL). That also makes the volume wheel control your music. I find the microphone quality bad.

Google Earth. This also gave me trouble: [install: `googleearth`] from the Medibuntu repository just hang. The version 5 binary from <http://earth.google.com/download-earth.html> installed properly but crashed immediately. Version 4.3 worked but after that my `sudo apt-get install` didn't work anymore, stopping at some incomplete `googleearth-4.2` operation. Eventually I got it to work again with `sudo dpkg --purge --force-remove googleearth-4.2`. I haven't tried the GPS inside the R600. Connecting Google Earth with Earth Bridge needs Microsoft I fear. The SIM slot is hidden behind the battery and not mentioned in my documentation. I guess the card should be out when using the laptop in a plane.

Images. Installation of the vintage but very useful image viewer `xv` from [John Bradley](#) was grievously problematic. I followed no longer extant recipes. This versatile viewer also accepts astronomical fits files. It doesn't work properly: the window shifts between images. The [Install: `gthumb`] viewer is good for photograph display, rotation, show-list selection, Exif display. Faster image viewers are [Install:] `feh`, `qiv`, `gqview`, `eog`.

13.4 How (not) to kill Ubuntu and how to revive Ubuntu

My killing Ubuntu is a silly story of suicide. Prior to departing to faraway in October 2009 I decided to backup my system on a new USB disk. I hadn't liked the FAT32 format (even though it was developed by Bill Gates himself) needed for my MacBook Pro, for clipping large files and for spoiling file attributes and so not permitting `rsync`. So I google-found that `sudo mkfs /dev/sdb1` formats the preferable `ext3`. But then the disk ownership became `root:root`. I tried to correct that with `sudo chown -R myusername:myusername` but that did not operate in the disk directory that (I thought) I was in but on my system disk. I killed it fast but it had done damage, at least to files in `/root`. In a repair trial I typed `sudo chown -R root:root /root/.*` where I added the period because the files and directories in `@/root` are `.XXX-hidden`. This was a bigger mistake: the wildcard `.*` apparently implies also `..*` so the operand does not only go down the tree but also back up, into the system top and then down that. This is perhaps logical but was quite unexpected by me. And so all files on the disk became `root:root`, also all mine, and `sudo` would no longer work ("must be setuid root") so that I could not reclaim ownership of my own directories and files. Upshot: I had suicided my usage.

Reviving my Ubuntu usership became a long story. Help came via email via my discarded MacBookPro from a Utrecht University system manager (the best I ever met) and the former graduate student mentioned above (not to be replaced by Google after all). Power on and press ESC fast before the grub loader starts, or SHIFT all the time in case yours is a single-system setup. Select and boot the recovery-mode version (probably the second entry). Cursor down to get the root command line prompt (without net access). Now you are root (superuser). Type:

```
chown -R myusername:myusername /home/myusername
chown root:root /usr/bin/sudo
chmod 111 /usr/bin/sudo
chmod +s /usr/bin/sudo
```

and then restart. That helped a lot, but many system files still had ownership root:root instead of something else. So I followed this advice to try complete package reinstallation:

```
sudo su -
dpkg --get-selections | egrep -v deinstall | awk '{print $1}' |
egrep -v '(dpkg|apt|mysql|mythtv)' | xargs aptitude -y reinstall
```

but that stopped after the deinstall for lack of connectivity, perhaps loss of proxy settings in the process. Much more didn't work then. The eventual remedy, after returning home, was to update from Ubuntu 9.04 to Ubuntu 9.10 which had then become available, letting it reinstall all packages properly.

13.5 Undoing an update to Ubuntu 9.10

Updating from Ubuntu 9.04 to Ubuntu 9.10 solved the sudo-cide trouble described above but posed its own problems: the VGA output to a second monitor or a video projector didn't work anymore on my Toshiba Portégé R600. Google gave a [bug thread](#) with the recipe to set a parameter nomodeset to the kernel and [these grub parameter instructions](#) showed how to do that. It helped, but the projection kept quitting in movies. Projecting is an important part of my work and probably for many others, but this bug seemed to get no attention. So I eventually decided to reinstall Ubuntu 9.04 "cleanly", meaning a full disk wipe. This reinstall was also problematic. The top Ubuntu website (google install ubuntu) offered only the offensive 9.10 version and the supposedly stable 8.04 version, but the disk that I burned with the latter gave endless CD-reading noise and weird video, and made the grub loader contain only an eternal memory test. Eventually I found [Ubuntu 9.04](#) and then found that one should not, after the F12-depressed Toshiba startup and CD-icon selection with the cursor, cursor down to the install choice but instead must select "Try Ubuntu without changing your computer" and then click on the install icon that appears after the lengthy Ubuntu startup.

I then made the mistake to follow the recipe below from [this Ubuntu forum thread](#):

To replicate your packages selection on another machine (or restore it if re-installing), you can run this:

```
dpkg --get-selections > ~/my-packages
```

This will save a file called my-packages in your home directory.

Make a backup of it, install the fresh release, then restore the

file "my-packages" to new home partition and run this code in the

terminal:

```
sudo dpkg --set-selections < my-packages && sudo apt-get dselect-upgrade
```

It will download and install all the programs for you, except those

that you installed manually, if they are not in the new repository.

Then restore your backup of /home so all your programs settings

will be as they were previously.

which deselected `network-manager-gnome` and so killed the `nm-applet` wireless, and with that any further downloading. Remedy: yet another reinstall, without such package recall but instead using my notes (posted above) on installing Ubuntu 8.10 to find which packages to reinstall and how to tune many settings and adjustments (such as the shell choice). An unpleasant multi-day effort to re-invent this wheel, but eventually successful. I now wonder when or whether ever to update Ubuntu in the future. Is the recipe not to heed October updates?

Another quote from [the same thread](#):

```
Call me old fashioned, but I still don't see why I or anyone else
has to become an expert at saving this and that, tweak the other
and tweek the same, stand on your head and drink a pint of beer
from the far side of a glass, just so you can upgrade your
Ubuntu 9.04 to 9.10 without any problems.
I just want to use my computer..... not program the damn thing!
```

Wouldn't it be nice to have an "Undo Ubuntu update" button next to the "Update Ubuntu" button in the update manager?

13.6 Ubuntu 12.04 on a Toshiba Portégé R600

By 2012 my Ubuntu 9.04 was no longer supported so that I couldn't even install Chrome or such. Updating was also no longer possible. I still regarded my Portégé R600 as a much better daily companion than my former MacBook Pro. Still amazed at its lightness and happy with its faultless heavy-duty high-productivity performance. At the size and weight of the now-fashionable tablets, it was a full-fledged computer with full connectivity, excellent keyboard and screen, running everything I need identically to the large server I use too. This made it desirable to renew its software. I therefore did a clean install of Ubuntu 12.04, inspired by its LTS (long-term support) promise of at least five years not having to muck with my operating system. Let me cite [this Ubuntu forum](#) again:

```
Call me old fashioned, but I still don't see why I or anyone else
has to become an expert at saving this and that, tweak the other
and tweek the same, stand on your head and drink a pint of beer
from the far side of a glass, just so you can upgrade your
Ubuntu [...] without any problems.
I just want to use my computer..... not program the damn thing!
```

It took me a week of googling to get Ubuntu 12.04 to work my way. Eventually Gnome Classic gave me a similar 12-desktop 24-terminal environment as I had before. With welcome improvements in addition to regaining support and updatability: automount for USB gadgets, better control of the noisy Portégé R600 fan, easier and better sound control, easier second-monitor projection, and more.

Installation detail (warning: this remains a snapshot anno June 2012):

Backup. I started by backing up my whole 9.04 system on a new USB disk. I formatted that with `sudo mkfs -L BACKDISK /dev/sdb1` followed by `sudo chown myusername:myusername /media/BACKDISK`. I wrote the backup with `sudo rsync -vau --exclude /media/ //media/BACKDISK/backup0904/`, which is better than with `cp -upr` because it also copies the `.xxx` files and logical links. It needs `sudo` for root-root etc ownership files.

Installation. The initial install of Ubuntu 12.04 was problematic because my Portégé R600 wouldn't write an error-free boot CD-rom from the downloaded `ubuntu-12.04-desktop-i386.iso` file. After too many endless installation tries I found that the check is that the CD should contain many folders, not just one large file. I then tried to produce a boot USB stick using `usb-creator` found in my Ubuntu 9.04. Apparently that was too old to produce a viable booter. In the end, also in multiple tries, I wrote a working CD-rom on my discarded Mac (my wife has it) and installed Ubuntu 12.04 from that on my Portégé R600. Font selection: English (US)

with the Euro on 5 (with the ALT GR key to the right of the space bar). I then installed my user directory with `rsync -vau /media/BACKDISK/backup0904/home/myusername/ /home/`. And returned to the tcsh shell by adding tcsh at the end of `~/ .bashrc` and typing `sudo chsh -s /usr/bin/tcsh`. Note: toshset no longer works but can be compiled back into the kernel following this recipe. I did not because the fan noise and second monitor problems I had under Ubuntu 9.04 are solved in Ubuntu 12.04.

Desktop. Ubuntu Unity was an unpleasant surprise. Far too alike to macOS that had made me, in disgust, transfer to Ubuntu in 2009. A too cluttered dock, too much mouse-clicking, as bad a workspace gadget as the Mac's (instead of the twelve clean desktops under the function keys that I am addicted to). Fortunately, Gnome Classic [no specials effects] is at hand in Ubuntu 12.04 (`sudo apt-get install gnome`) and likely will be supported the coming years. I installed it following [this complete-concrete-concise instruction](#). Style: Applications ζ System Tools ζ Preferences ζ Advanced settings ζ Theme. For the window theme I like Metabox best but not its too loud Ubuntu-brown active-window title strip. [This theme collection](#) furnished a Mint-theme. Combining this under GTK+theme with Metabox under Window theme made the active-window title strip mint-green, perfect on my lightgreen background (get the menu by rightclicking with the cursor in the background; I prefer a smooth background). Using this theme with emacs produced many Gtk warnings that went away with `sudo apt-get install gtk2-engines-pixbuf` following [this thread](#).

Remaining bug: I get nested terminals that do not vanish at typing `logout` or `exit`.

Ubuntu packages. Applications ζ Ubuntu Software Center ζ Edit ζ Ubuntu Software, turn on all types of software except source code. Other Software: turn all on. Statistics: turn Submit on. I installed (`sudo apt-get install packagename`): `tcsh`, `csh`, `gnome`, `screen`, `xdotool`, `gconf-editor`, `emacs-23`, `emacs-goodies-el`, `auctex`, `gtk2-engines-pixbuf`, `texlive`, `texlive-lang-dutch`, `texlive-publishers`, `acroread`, `libreoffice`, `ap2s`, `paps`, `abiword`, `xfig`, `gv`, `mgdiff`, `xpdf`, `libjpeg62`, `gthumb`, `feh`, `qiv`, `gqview`, `mplayer2`, `ffmpeg`, `mencoder`, `transcode-utils`, `jhead`, `mutt`, `msmtp`, `elinks`, `fbreader`, `xine-ui`, `xine-plugin`, `lftp`, `libstdc++5`, `libxt-dev`, `dos2unix`, `adobe-flashplugin`, `mc`, `curl`, `youtube-dl`, `rar`, `gparted`, `disper`, `hfsprogs`, `ttf-inconsolata`, `git-core`, `tesseract-ocr`, `tesseract-ocr-eng`, `gpac`, `pdftk`.

OpenOffice has become LibreOffice. Adobe Reader (`acroread`) needs green light for website opening, defined under Edit ζ Preferences ζ Trust Manager ζ Change Settings. `Latex2html` gave deprecation error messages that went away by commenting the offending lines out. `Xpdf` gave segmentation faults; the remedy was to install an older version following [Michael Gilbert's recipe](#) after first installing `libjpeg62`. `Mplayer` didn't play some .mov movies anymore; the remedy was to install `mplayer2` instead with `reinstall` (`sudo apt-get install --reinstall packagename`) of `ffmpeg` and `mencoder`.

Other software. Dropbox, Skype, Google Chrome, Google Earth, Calibre from their websites, usually downloading the xxx.deb into `~/Downloads` and installing with `sudo dpkg -i xxx.deb`. Chrome: in URL `chrome://plugins/` disable `/opt/google/chrome/PepperFlash/libpepflashplayer.so` to get `/usr/lib/adobe-flashplugin/libflashplayer.so`. IDL: not a (far too expensive) update but simply copying my old IDL 6.4 from my Ubuntu 9.04 backup with `sudo rsync -vau /media/usb0/backup0904/usr/local/itt /usr/local/` including the license (opened by `setenv LM_LICENSE_FILE /usr/local/itt/idl64/license.txt` in `~/ .cshrc`). The IDL help didn't work, which I repaired with `sudo apt-get install libstdc++5`, adding this older version to Ubuntu's `libstdc++6`. Viewer `xv`: again following [this recipe](#) plus installing `libxt-dev` and `converter jpeg2ps`.

Emacs. Again a long day of trouble. Why remains emacs so unpredictable and incomprehensible? My workhorse `emacs-snapshot-gtk` was gone. Color theme `Feng Shui` was not recognized. Google delivered `emacswiki`, a warehouse of nerd stuff without useful information. Finally, the answer [found here](#) is to add a line (`color-theme-initialize`) to file `~/ .emacs`, not needed in Ubuntu 9.04. For within-the-terminal sessions and my `mutt`-window mail answering I now need to use `emacs -nw --color=no`. My special sessions now need `--title windowname` instead of the former `-name windowname`. I keep my emacs windows clean with lines (`tool-bar-mode -1`), (`menu-bar-mode -1`), (`scroll-bar-mode -1`) in `~/ .emacs`; `CONTROL + rightclick` delivers the menus when I need them.

Remaining bug: at session start the Emacs default windows flash distractingly and irritatingly into view before my specified layout comes up.

Cursor blink off. Applications ∷ System Tools ∷ System settings ∷ Keyboard.

Caps lock key to Compose key. In Keyboard ∷ Typing ∷ Layout settings (left bottom) ∷ Options (right bottom) ∷ open Compose key position ∷ flag Caps lock on. Now you can type German: typing caps lock, ”, and a gives ä. Und so weiter. [This Wikipedia compose table](#) specifies many more.

Panels. For panel adaptations: ALT + rightclick on panel ∷ Properties (this was rightclick without ALT in Ubuntu 9.04). I have the panel bar with Applications, Places and notification area hidden at top right, a second panel bar with the workspace indicator and this-workspace window clickers hidden at bottom right. No arrows on the unhide clickers to minimize their width.

Remaining bug: the applet icons in the notification area do not resize with the panel width.

Workspaces. I again have 12 labeled workspaces accessible with the function keys, defined in Applications ∷ System Tools ∷ System settings ∷ Keyboard ∷ Shortcuts ∷ Navigation. I set CNTRL + cursor left/right to shift one workspace left/right, and CNTRL + ALT + cursor left/right to shift the currently active window one workspace left/right. I have two terminals in each workspace and perform specific tasks in each (like to-do, diary, and journal files under F1, mail under F11, browsing under F12).

Reboot. With googled help I wrote [script initworkspaces](#) to auto-start my standard 12-workspace 30-session desktop layout at login.

Mime defaults. Define the defaults for the application that should open when clicking on linked files in .html or .pdf displays with `mimeopen -d examplefile.typ`. This is a faster and better way than clicking on an example file of the given type in Places, for which the GUI does not offer command-line application specification anymore (it did in Ubuntu 9.04). For example, to play movies in my talks I set them to click-start with a shell script calling `mplayer -fs ${1} -loop 0` playing them full-screen in a loop without interruptions. I click graphs and images into full-screen projection with `feh -FZ` which enables zoom-in with the mouse during a talk (depress the wheel and shift horizontally).

Browser. I retrieved my Firefox profile and bookmarks from my Ubuntu 9.04 backup with `sudo rsync -vau /media/usb0/backup0904/home/username/.mozilla ~/.` Google Chrome now installed properly (not in my Ubuntu 9.04) and appears to be a nice fast browser. However, it does not play my .avi and .mov DOT movies and does not use my mime defaults. No remedies found so far.

Second monitor / projector. I followed [Jon Dowland's Portégé recipe](#) by getting to the BIOS (press ESC at startup), go to second page (Page Down), change setting "Power on display" to "LCD + Analog RGB". I use alias `alias vga-beamer 'xrandr --output LVDS1 --mode 1024x768 --output VGA1 --mode 1024x768 --same-as LVDS1'` to start a talk projection, and alias `alias vga-auto 'xrandr --output LVDS1 --auto --output VGA1 --auto'` otherwise. Another option is to use `disper`.

Remaining bug: a flat background (not wallpaper) becomes black and remains black.

Printing. Selecting EN-US as language apparently sets the printing to letter size. I use `cups` at `http://localhost:631/` to manage printing: ∷ Adding Printers and Classes ∷ Add Printer. Then ∷ Manage Printers, click on the printer name, ∷ Administration ∷ Set Default Options ∷ media size A4 small margins, etc. I wake up `cups` with `sudo service cups restart` which seems to replace the former `sudo /etc/init.d/cups restart`, and I define the desired printer by specifying its name in `~/cups/lpoptions`. This way even the simple command `lpr file` works.

Update manager. For some obscure reason the Ubuntu update notifier minimizes itself immediately on the workspace I happen to be on when it appears. I added the window selector applet to the panel and click on it to find where it went and to reopen it.

Auto login / How to revive Ubuntu. Because the Ubuntu updater often requires computer restart I tried to enable password-free automatic login so that I can do something else while it takes minutes to shut down and then again minutes to boot up and execute [my desktop startup script](#), instead of having to pay attention and type my password halfway this lengthy procedure. Oops: this became a nightmare. My first try was sudo-editing `/etc/lightdm/lightdm.conf` as [specified here](#). It didn't work. I then tried the GUI recipe: Applications ∷

System Settings ↵ User Accounts, unlock the lock at the top and slide the Automatic Login slider so that ON appears. I relocked the lock. Disaster: restarting my laptop gave a dark screen without any information or response. Nothing, not even the grub booter. I tried power-on pressing ESC, no success. Deep-panic googling with my wife's Mac eventually gave me [this excellent recipe](#). Press SHIFT during power-on, select and boot the recovery-mode entry, cursor down to get the root shell prompt, type `mount -o rw,remount /` and you can do at least something. I cleaned `/etc/lightdm/lightdm.conf` which didn't help. Normal reboot then got stuck displaying text messages like "stopping system V runlevel compatibility". Pressing CNTRL+ALT+F1 gave a command-line login. Logging in to my user account and typing `startx` gave a Unity version of my Gnome startup script, with my aliases working but my scripts not working and with a weird low-resolution screen format. Clicking on the gearwheel+spanner icon opened the settings GUI but the User Accounts GUI was locked and could not be unlocked. I then went back to the recovery-mode boot and root command line, defined a root password with `passwd -u root` and `passwd root`, restarted with CNTRL+ALT+F1 login to the root account with the new root password. Typing `startx` now gave a fresh default Unity opener screen. The User Accounts GUI now had no lock. Selecting my user account and shifting the Automatic Login slider back to the OFF position restored my laptop functionality. Phew! (In retrospect: typing `sudo startx` in the CNTRL+ALT+F1 user login might have worked without need for defining a root password which Ubuntu advises against. I subsequently removed that and relocked the root account with `sudo passwd -dl root on this advice`).

Remaining bug: I guess I better live with having to type a password halfway the lengthy reboot.

13.7 Ubuntu 14.04 on a Toshiba Portégé Z930

In April 2014 I forgot to take my faithful Toshiba Portégé R600 from a plane. I got it back only months later because the border police doesn't know solar physics including Ellerman features. In the meantime I had bought a Toshiba Portégé Z930 and installed Ubuntu 14.04, again lured by its LTS (long-term support) promise of five-year-no-muck. Warning: these notes remain a snapshot anno spring 2014.

Hardware comparison. The older Toshiba Portégé R600 and the newer Toshiba Portégé Z930 are similar computers. Of course the newer model runs faster but I haven't really noticed the difference. The newer model has no DVD drive but I used the one in the R600 only rarely and can live without one. I like the larger memory (8G versus 3G). The most important improvement is the absence of fan and disk noise in normal operation. However, the high-pitched vacuum-cleaner-like noise produced by the fan when you make the laptop work seriously is quickly unbearable. I also found I need to kill IDL sessions to make the noise stop even after these have completed their job.

The Z930 solid-state disk is noticeably faster than the R600 spinner, especially in close/open = hibernate/resume and when untarring large data sets. Presumably it is also more reliable. However, it furnishes significantly less storage (227G versus 286G at my disposal).

I regard the 1366x768 pixel screen an unhappy setback from the former 1280x800 one. The wide cover strip below the screen screams out it could and should be pixels instead. Also, the cone of best visibility became even narrower than it was before, so that one now has to continually adjust one's posture and/or the screen tilt for optimally studying images and movies (my daily work). Showing such to a colleague requires a second screen, but that brings two major problems. First, the 1366x768 size is not supported by any monitor that I have seen so far, requiring irritating fall-back to the more ubiquitous 1024x768 VGA size. Second, after Ubuntu suspend with the external screen still connected it becomes the primary screen even when non-connected: you end up with a black laptop screen. Arrggghh...

The keyboard now lights up at low light, which is useful in darkened conference rooms but distractive elsewhere. I find typing on the Z930 less pleasant and more error-prone than on the R600. The move of the ENTER key away from the righthand side is disastrous. In the R600 this was large and placed flush-right as usual (even on Macs); now it is not only smaller but shifted one column left so that one instead hits PageUp or PageDown.

The physical form of the Z930 is a setback also beyond being just larger (a bad idea, I pay for laptop smallness and lightness). The exceedingly sharp corners and front edge of the palmrest areas cut badly into one's hands, so

much so that I fear that RSI from continuous irritation lurks as dark threat around them. The connection sockets are placed less conveniently than before, not along the laptop sides but mostly at its back. The SD-card reader is now hard to access while it was perfectly placed in the older model.

The sound quality is improved and is now good enough for Skype but remains too poor for music.

Ubuntu installation. Once again I had major problems. Pressing F12 during power-up didn't give me a boot choice to the USB stick with the downloaded iso, but instead produced unfathomable error messages and eventually MS Windows. I ended up installing that and not getting out of it anymore. My mistakes were that one really has to logout from Windows, not just power-down, and that one should hit F12 repetitively as a machine gun. Eventually I so got to the Ubuntu installer and could wipe MS Windows off the disk (a satisfying action except for regretting its paid-for cost). Gnome Classic (no special effects) is now called Gnome-Fallback-Metacity and needs `sudo apt-get install gnome-session-flashback`. Some websites suggested that Ubuntu doesn't really want to continue Gnome offering, so I am glad it still did in this LTS release. I hope to be free from computer setup problems for five years!

Setup and packages. Most of the setup recipes that I gave above under [Ubuntu 12.04](#) still worked. Most packages listed there got installed without problem. Acroread was nasty in requiring 32-bit libraries but a week later Ubuntu furnished those properly (I installed 14.04 an hour after its release, which may have been unwise early).

Workspace shifting. Problematic because the Applications menu didn't furnish the former Keyboard & Shortcuts & Navigation anymore. Luckily the answer how to redefine keys to focus on another workspace came quickly from [AskUbuntu](#): install `sudo apt-get install dconf-tools`, then click Applications & System Tools & dconf-editor, click the appropriate little triangles open to descend into `org.gnome.desktop.wm.keybindings`, and define your choice of hotkeys as, e.g., `move-to-workspace-right [']&Control;&Alt;&Right'`. I again have 12 workspaces selectable with the 12 function keys. My [desktop startup script](#) again puts two terminals in each of them and opens some specific emacs sessions, a browser, and special mail windows for mutt.

Theme selection. The Applications menu also did not furnish the former Preferences & Advanced Settings anymore. Google advised to install `sudo apt-get install gnome-tweak-tool` and then entering `gnome-tweak-tool` in a terminal retrieves that menu. I selected Metabox (window), Radiance-Graphite (GTK+; I like this less than my former pale mint but it is acceptably non-loud), Ubuntu-Mon-Light (icons), DMZ-White (cursor). Once again I hide the panel bars out of sight and have a smooth lightgreen background.

Screen brightness control. Disfunctional in a Toshiba laptop after suspend. Repaired followed [this recipe](#).

Touchpad off when mouse present. This is good to have in order to avoid sudden erratic cursor jumps in your editor window when your hands brush unintentionally over the touchpad. Activated at minute cadence with a crontab-called script following [this recipe](#). Hitting the BREAK key gives me momentary touchpad override through setting Applications & System Tools & Preferences & Keyboard & Text Entry (at bottom left) & Keyboard Settings (at bottom right) & Custom Shortcuts and defining "touchpad toggle" as Pause, executing [the bonus script given here](#).

Notifications. I switched off the pop-up notifications informing me, e.g., that my laptop gets connected or disconnected because I don't need them while they disturb me and even more my audience during presentations. I followed [the recipe given here](#).

Emacs. Again trouble, as always with this fancy program. This time I got a superfluous GTK error message at every start of an emacs session. The remedy was to not use a `--geometry` option in my emacs start-up alias but to define the window size and location within my [~/.emacs file](#). This upsets my habit of defining specific geometries for specific purposes with an alias, but so be it. The next problem was that emacs didn't recognize compose-key sequences to type umlauts etc. Solved by starting it as: `env XMODIFIERS="@im=none" emacs`. An old bug remains: emacs still flashes intermediate windows elsewhere on the screen before it opens the requested one, an unnerving and irritating habit.

Latex. To my dismay, my `\citeads` macros to turn citations in pdf files into openers of NASA's ADS literature server, a trick [recommended by the astronomy journal A&A](#), didn't work anymore with latex (they still do for pdflatex), stopping latex on non-sensical and non-fatal error messages. Apparently they came in soon after the

ancient 2009 texlive of Ubuntu 12.04 that I used sofar. This problem remains an open question at [stackexchange](#) but since 2019 a trick from Linus Stonys avoids it.

13.8 Ubuntu 18.04 on a Toshiba Portégé X30

In September 2018 a burglar stole my Portégé Z930. I bought a Portégé X30-D-15D and installed Ubuntu 18.04 LTS, again hoping for five years of no-muck science productivity. Again it took weeks of frantic and frustrating googling to cope with Ubuntu's evolution and to fine-tune it to my ancient way of work (no icon clicking but X-window terminals for typing commands, aliases, bin scripts). Warning: these notes remain a snapshot anno September 2018.

Hardware comparison. The Portégé X30-D-15D is similar to the Portégé Z930. Doubled memory, doubled SSD, slightly faster, but 30% higher cost. Keyboard: the Enter key went back to flush-right where it belongs. The layout now replicates that of my 10-years old Portégé R600 but that still types better. Also, the Z930's black key paint had flaked off so badly that their backlighting made characters illegible; I hope this ones fare better. There is now a central knob aspiring to be a pointing device but useless (my past-millennium Atari ST-Book had a better pressure pad). The frontside frame corners are now slightly less sharp. The sound quality again improved, becoming acceptable for a clavichord but not much else.

The 1920x1080 screen is too much of an improvement over the Z930's 1366x768: too many horizontal pixels so that the icons in the Ubuntu top bar, Chrome, Skype and many other windows are too small and need scale-up to regain legibility; the result of doing that by font scale factor is simply that the icons and characters are sharper. In older programs as xv, xfig and IDL widgets this scaleup doesn't work making clickers too small. If the pixels must be this small I prefer 4/3 size 1440x1080 in a two-inches less wide laptop, as was the R600 which even contained a DVD/CD-rom station. The R600 was thicker while thin is the fashion, but that is the dimension I care least about whereas weight, height and width define portability and aircraft-table fit.

The power supply became smaller again but now (in Europe) has a three-prong inlet needing a ground plug instead of the previous small fit-all Europlug, unwieldy and requiring a far less common earthed power socket, therefore requiring specific converters. The power button got too-bright illumination. I miss the former indicator lights for power-on, charging, battery status, disk activity (months later I found there are still two but on the bottom; you see them only when you lift the laptop). The connectivity became bad so that you must now buy and bring extra gadgets in unfortunate aping of Apple's nasty approach to milk its customers. No Ethernet jack anymore, no VGA connection anymore, micro-SD instead of the former versatile one. Only one standard USB, on the wrong side for the mouse. Two USB-C connectors of which one is taken by the charger since there is no charging socket anymore. Both are on the right side so that the required extension gadgets obstruct mouse movement. I bought an expensive Toshiba Travel Adapter to add ethernet that failed for speeds above 100 Mbps and had to be replaced by an equally expensive Goobay Multiport adapter, an USB-C to multiple USB-3 port replicator to connect my mouse, printer, and data disks, an SD-to-USB converter for my photographs, a conversion cable unsplitting the now combined microphone and speaker jacks, and a VGA to HDMI converter for projection. I so join my poor Mac colleagues in toting a gadget bag and hoping I did not forget an essential implement.

Ubuntu installation. Problematic once again. I downloaded 18.04, at first confused that I needed the AMD version for my Intel chip. I found an Ubuntu Startup Disk Creator in Ubuntu 12.04 on my old Portégé R600 and tried to produce a 18.04 boot stick, but the process stuck endlessly at the erase question. Remedy: wipe the stick with `sudo rm -rf *`, remove it, re-enter, try again. Starting up the X30 of course got me into Windows; remedy is to push power-off a long time, then back on while hammering F12 continuously to get into the boot choice. From there the installer worked fine. I chose English (USA) and Australia as environment, the latter antipodal preference to combine metric units, decimal points instead of commas, dates in English, A4 sheet size.

However, the first glance at and trials with the initial desktop were terrible. I had read that Ubuntu discarded Unity and went back to Gnome, very much to my liking, but I hadn't expected that the trend to make computers behave as smartphones would have taken over Gnome's sensible layout so badly. A dock with icons to click on as if I had a Mac. No panels anymore but a top bar with tiny icons without hide buttons and without the non-iconized

applications and places drop-down menus of before. An ugly vertical column of workspaces without a mechanism to get my desired row of 12 named workspaces under the function keys. Oops... A webpost suggested I should switch to Xubuntu for proper workspaces. I didn't thanks to the below.

Workspaces. A panicky question on Askubuntu delivered instructions from a most helpful Vanadium. Install the "Gnome Shell Integration" add-on for your browser. Install the host connector with `sudo apt install chrome-gnome-shell`. (In 2018 one uses `sudo apt` rather than `sudo apt-get`). Find and install Gnome extensions from their website reached with the new Gnome clicker icon in your browser by simply switching them on and clicking Install. I needed Dash to panel, Hide top bar, Workspace grid, Workspace indicator, Window navigator, Steal my focus. They are switched on already after the install from the browser (open a new terminal to see their effect) but some you have to find in `gnome-tweaks` ; Extensions to select appropriate options. I made the top bar contain the dock and auto-hide and adjusted the workspaces to 12 in a row, named with `gsettings set org.gnome.desktop.wm.preferences workspace-names "['EML', 'WWW', ...]"`, installed `dconf-editor` and set shortcut keys by descending to `org.gnome.desktop.wm.keybindings` and setting the 12 function keys to get to the 12 workspaces as I have had for decades. Login again populates my workspaces with script initworkspaces with terminals and particular emacs sessions (to-do, diary), email windows, google-chrome. The workspace indicator in the top bar is adequate but I liked the non-drop-down row of small named and clickable icons in the former panel far better, and also the former shifter since the new one is ugly large and doesn't map the window layout in each workspace thumbnail as the old one did.

Packages. I made a list of all packages I thought to need from my notes on my previous Ubuntu installations, nearly a hundred, and installed them by first running `cat packagelist.txt | xargs sudo apt -s` where `-s` checks on errors, then with `-y` to get them all jumping questions. One package containing Microsoft stuff gave trouble in opening an awkward permission query, solved by rerunning from shell `sh` instead of my default `tesh`.

Themes and fonts. `Gnome-tweaks-tool` is still package `gnome-tweak-tool` but is now started by typing `gnome-tweaks`. Under fonts I first reset the scaling factor to 1.3 to enlarge the tiny icons, then played with font sizes choosing themes Adwaita, DMZ-white, Adwaita and theme font Ubuntu Regular 11. The terminal fonts got set by rightclicking in a terminal body to get to Preferences; I eventually selected Monospace Bold 11 for the terminals (24 of them in my workspace layout) and DejaVu Sans Mono Book 11 for mutt in my two special mail windows (side-by-side for reading and answering in parallel). Similarly DejaVu Sans Mono height 110 in the font specifier in `.emacs` (see my Linux pages) and in my to-do and diary session scripts. The eventual result is that this new Toshiba presents nearly identical desktops as my previous one, the finer pixels just giving enhanced sharpness.

Missing libraries. Some of my long-established daily workhorses needed 32-bit libraries no longer served by `sudo apt install package`.

IDL: my IDL 6.4 wanted `libxp6` found here. To make IDL run with Hyper-c under IDLWAVE required undoing the "show overview" (Activities in Ubuntese) (de)faultly coupled to that key (the Windows flag; note also that in Ubuntese Super means Control) with `gsettings set org.gnome.mutter overlay-key 'Alt+F1'`.

xv: this ancient but highly effective image viewer wanted old libraries I couldn't locate; fortunately I found the brilliant recipe to get it elsewhere. Download the `xv rpm` from SuSE Leap 15 here which needed to delve into google-chrome Extra options to get permission to do so, install `alien`, run `sudo alien xv-3.10a...rpm` and `sudo dpkg -i xv_3.10...deb`.

GTK warnings: Emacs, Acroread and other applications spewed endless most-irritating GTK warnings on their calling terminal. Google taught me to get rid of them by installing: `gnome-themes-standard`, `gtk2-engines-pixbuf`, `gtk2-engines-pixbuf:i386`, `gnome-themes-extra`, `gnome-themes-extra:i386`, `murrine-themes`, `libcanberra-gtk-module`, `libcanberra-gtk-module:i386`, `libatk-adaptor:i386`.

Emacs. Emacs still irritatingly flashes fake windows on my screen before opening the desired one. I also found that if you have used a second monitor and switched it off but left the connector, emacs opens sessions on that non-existent screen unless you switch that off explicitly with `xrandr`.

Printer. For my simple HP Deskjet printer I installed `cups` and went through the lengthy procedures given here.

13.9 Ubuntu update disasters

Ubuntu has announced that its 18.04 edition will live ten years to corner the Internet of Things. The disastrous update failures described below do not give confidence. Within half a year the first killed my laptop usage for two days, the second for a full month.

Update failure 1: login stuck in loop. In January 2019 the Ubuntu software updater put me into a nasty endless login loop. The recipe then is to hit CNTRL + ALT + F3 (or F1 or F2) to start a terminal-like login screen; this worked, be it haphazardly needing multiple reboots. When that screen appeared it was better to install and switch to the lightdm display manager which opens this CNTRL + ALT + F3 screen reliably. The standard recipes are then to check the ownership of .Xauthority, the permissions of /tmp, and to muck with the nvidia driver, but in my case the culprit was the workspace grid Gnome extension in `~/.local/share/gnome-shell/extensions`. Its removal made Ubuntu finally start up; renewal from the [extension page](#) revived my workspace layout. This update failure cost me two days of frantic googling until I found [the answer](#).

Update failure 2: CPU frequency lowered. In April 2019 the Ubuntu software updater again acted disastrously: after the mandatory restart my Portégé X30 became terribly slow. It took three weeks to find the cause and remedy [given here](#) while the culprit remains unidentified. I had already tried a complete Ubuntu 18.04 re-install; repeating [all its fine tuning](#) took another week. Thanks, Ubuntu!

14 Recipes for IDL

IDL, Interactive Data Language, is a 1970s programming language for image analysis. It remains expensive and gets replaced by Python. Traditionally, IDL was popular in astronomy and medical imaging. In solar physics the large [SolarSoft library](#) requires IDL until portage to Python is complete.

If you want to use IDL programs from my libraries download the [zip collection](#), unzip, and include rridl in your IDL search path.

[Simple IDL instruction](#) for astronomy students: [\[.txt\]](#) [\[.pdf\]](#) [\[.html\]](#)

[My IDL software for datacube analysis](#) with an [instruction](#) for [DOT students](#): [\[.txt\]](#) [\[.pdf\]](#) [\[.html\]](#)
[\[zip of all files\]](#)

[My IDL software for image and image sequence manipulation and analysis](#)

[My IDL software for image sequences in fits files](#)

[My IDL software to process DOT image sequences](#) (DOT = [Dutch Open Telescope](#))

[My IDL software to process SST image sequences](#) (SST = [Swedish 1-m Solar Telescope](#))

[My IDL software to get and co-align SDO image sequences](#) (SDO = [Solar Dynamics Observatory](#), [manual](#): [\[.txt\]](#) [\[.pdf\]](#) [\[.html\]](#) [hands-on demo](#): [\[.txt\]](#) [\[.pdf\]](#) [\[.html\]](#))

[My IDL software to process NISP Halpha image sequences](#) (NISP = [NSO Integrated Synoptic Program](#) = [GONG & SOLIS/FDP](#))

[My IDL software for RH input and output processing](#) (RH = [H. Uitenbroek's spectrum synthesis program](#))

[My IDL software for LTE line formation](#) (LTE = [Local Thermodynamic Equilibrium](#))

[My IDL library tree](#): [collected in a zip file](#) [link to the top](#) [link to explanations](#)

[My IDLWAVE setup in .emacs](#)

[Why IDL counts fingers from zero](#) [more Edsger Dijkstra wisdom](#)

15 Dutch Open Telescope

16 Solar file archive

Solar spectrum atlases, line lists, plane-parallel standard models, spectroheliograms, and more. Mostly dating back to the 1980s. Restored from archive magnetic tapes to re-offer these ancients while writing *Lingezicht Astrophysics Report 2* = Compendium solar spectrum formation. Details in README.

[Link to archive content](#)

17 Photos

17.1 Rob's astronomer shots

Mostly thumbnails only to thwart Google and misuse.
I may honor bona fide requests for full-size copies.
I will honor bona fide requests for removal.

Weihai, Shandong Univ. course SSF, October 2018: [thumbnail album](#) [group](#) [content](#)

Vienna, IAU General Assembly, August 2018: [thumbnail album](#)

Palo Alto, LMSAL course SSF, May 2018: [thumbnail album](#) [group](#) [content](#)

Sunspot, Sac Peak Farewell, August 2017: [thumbnail album](#) [group](#) [LOC ladies](#) [last run at NSO/DST](#)

Bern, ISSI meeting, March 2017: [thumbnail album](#) [group](#)

Lanzarote, Solarnet IV, January 2017: [thumbnail album](#) [solar ladies](#)

Newcastle, Northumbria Univ. course SSF, November 2016: [thumbnail album](#) [group](#) [content](#)

Cartagena, IAU Symposium 327, October 2016: [thumbnail album](#) [organizers](#)

Stockholm, IRIS 6, June 2016: [thumbnail album](#)

Mitaka, NAOJ course SSF, May 2016: [thumbnail album](#)

Bern, ISSI meeting, January 2016: [thumbnail album](#) [group](#)

Belfast, Hinode 9, September 2015: [thumbnail album](#)

Freiburg, KIS course SSF, August 2015: [thumbnail album](#)

Pune, Conference on Coupling and Dynamics of the Solar Atmosphere, November 2014: [thumbnail album](#)

Dublin, 14th European Solar Physics Meeting, September 2014: [thumbnail album](#)

La Laguna, IAC course SSF, March 2014: [thumbnail album](#)

Palm Cove, GONG-2012/LWS/SDO-5/SOHO-27 meeting, November 2012: [thumbnail album](#)

Oslo, Solaire summer school, June 2010: [thumbnail album](#)

Sunspot & White Sands, 25th NSO Summer Workshop, September 2009: [thumbnail album](#)

Dwingeloo, USO School "Solar Magnetism", June-July 2009: [thumbnail album](#)

Freiburg, 12th European Solar Physics Meeting, September 2008: [thumbnail album](#)

Dublin, Hinode workshop, August 2007: [thumbnail album](#)

Melbourne, SOHO/GONG workshop, July 2007: [thumbnail album](#)

Oslo, USO summer school, June 2007: [thumbnail album](#)

Utrecht, course IART, spring 2007: [thumbnail album](#)
 Utrecht, course RTSA, winter 2006-2007: [thumbnail album](#)
 Coimbra, CSPM, October 2006: [thumbnail album](#)
 Malta & Libya, spring 2006: [thumbnail album](#)
 Utrecht, course SOL, spring 2006: [thumbnail album](#)
 Utrecht, course IART, winter 2005-2006: [thumbnail album](#)
 Sunspot, NSO workshop, July 2005: [thumbnail album](#)
 Potsdam, Staude colloquium, April 2005: [thumbnail album](#)
 Utrecht, course RTSA, spring 2005: [thumbnail album](#)
 Leiden, Goedbloed workshop, March 2005: [thumbnail album](#)
 Utrecht, course IART, winter 2004-2005: [thumbnail album](#)
 Utrecht, new year party, 2005: [thumbnail album](#)
 Tatranska Lomnica, ESMN School, November 2004: [thumbnail album](#) [everybody in ESMN attire](#)
 Kiev, MAO-60 conference, July 2004: [thumbnail album](#)
 StPetersburg, IAU Symposium 223, June 2004: [thumbnail album](#)
 Leiden, Akademiegebouw, April 6, 2004: [thumbnail album](#)
 Utrecht, course IART, winter 2003-2004: [thumbnail album](#)
 Oslo, ESMN summer school, June 2003: [thumbnail album](#)
 Boulder, course RTSA, April 2003: [thumbnail album](#)
 Stockholm, SST Workshop, April 3-4, 2003: [thumbnail album](#)
 Nijmegen, NOVA AC March 31 - April 1 2003: [thumbnail album](#)
 Utrecht, February 2003, AFYC class: [thumbnail album](#)
 Utrecht, November 2002: [thumbnail album](#)
 Utrecht, November 2000, taken by Marco Kouwenhoven: [thumbnail album](#)
 Santa Cruz, Tenerife, October 1-2, 2000: [thumbnail album](#)
 White Sands, September 13, 2000: [thumbnail album](#)
 Capodimonte, April 5, 2000: [thumbnail album](#)
 Kiev, MAO: [thumbnail album](#)
 Peter Brandt shots: [thumbnail album](#)
 Sterrewacht Sonnenborgh, December 5, 1968: [thumbnail album](#)
 Jaap Houtgast as Sint Nicolaas Kees de Jager with Sint Nicolaas Marcel Minnaert at the organ
[Minnaert being quizzed](#) [Minnaert being complimented](#) [Minnaert relieved](#) [Anne Underhill quizzed](#)
[Underhill & Zwarte Piet](#) [Thijs de Graauw & Zwarte Piet](#)
 Sterrewacht Sonnenborgh, 1966-1968: [thumbnail album](#)
[Ed van den Heuvel](#) [Max Kuperus](#) [Walter van Rensbergen](#) [Kees Zwaan & Hans Rosenberg](#)
[John Heise, Rob Rutten, Vincent Icke, Marijke Burger](#)
 Nederlandse Astronomenconferentie, Dalfsen, May 1967: [thumbnail album](#)
[G.B. van Albada](#) [Marijke Burger](#) [Elly Dekker](#) [Tom de Groot](#)
[Wim van Rijsbergen, René van Helden, Wim Diemel, Renzo Sancisi](#) [Jaap Houtgast](#) [Henk van de Hulst](#)
[Pater de Kort](#) [Osamu Namba](#) [Jaap van Nieuwkoop](#) [Jaap Tinbergen](#) [Christ Titulaer](#)

Bilderberg International Study Week, April 1967: [thumbnail album](#) [group](#) [group idents](#)
[Grant Athay & John Jefferies](#) [Jacques Blamont](#) [Roger Bonnet](#) [Owen Gingerich](#) [Nicolas Grevesse](#)
[Hans Hubenet](#) [Kees de Jager](#) [John Jefferies](#) [Jean-Claude Pecker](#) [Marcel Minnaert](#) [Edith Müller](#)
[Paul Mutschlecner](#) [Bob Noyes](#) [Pierre Souffrin](#)

17.2 Rob's eclipse shots

June 10 2011, Lingezicht Astrophysics, The Netherlands [thumbnail album](#)

July 2 2019, Bellavista, San Juan province, Argentina [thumbnail album](#)
[Andes mountains](#) [Official madhouse](#) [Search quiet](#) [Happy at quiet and blue](#)
[Scheduled start \(Toos van Stralen\)](#) [Bespectacled spectators](#) [Crescent projection](#) [Second contact \(Toos\)](#)
[Second-contact chromosphere \(Toos\)](#) [Mid-eclipse corona \(Toos\)](#) [Third contact chromosphere \(Toos\)](#)
[Third contact \(Toos\)](#) [Crescent projection](#) [Eclipse by moon and earth \(Toos\)](#)
[Mountains on moon and earth \(Toos\)](#)

August 21 2017, Traughber Road, Swan Valley, Idaho, USA [thumbnail album](#)
[Peter at site selection](#) [Selected foreground](#) [Spectator setup](#) [Photography setup](#) [Sequence image start](#)
[Excellent prospects](#) [Inspection and projection](#) [Crescent projection setup](#) [Crescent projection result](#)
[Totality](#) [Composite mimicking visual view \(Peter\)](#) [Marijke Burger measuring temperature drop](#)
[Sequence image completion](#) [Sequence with foreground \(Peter\)](#) [Site next day](#)
[Memorial site marker expressing the shadowy fleetingness of time](#)

March 9 2016, Pulau Kadidi, Togian Islands, Sulawesi, Indonesia [thumbnail album](#)
[Equator passage day before](#) [Normal eclipse day before](#) [First contact](#) [Cloudy prospects](#)
[Cloud-dodge boat](#) [Projection setup](#) [Projection result](#) [Second contact](#) [Totality](#) [Chromosphere](#)
[Third contact](#) [Smiley projection](#) [Normal eclipse and me day after](#)

March 20, 2015, M/V Norröna, Tórshavn, Faroer [thumbnail album](#)
[Gloomy prospects](#) [Wet blue](#) [Eclipsed start](#) [Clearing too late](#) [Bitter aftertaste](#) [Projection setup](#)
[Projection result](#) [Projection result](#) [Explanation of what we didn't see \(content\)](#)

November 14 2012, Ellis Beach, Australia [thumbnail album](#)
[Cloudy sunrise \(by Anik de Groof\)](#) [Yet cloudier prospects \(Anik\)](#) [Thinner cloud towards totality \(Anik\)](#)
[Clear at second contact \(Rietje\)](#) [Totality \(Anik\)](#) [Corona \(Anik\)](#) [Crescent projection setup 1 \(Anik\)](#)
[Crescent projection result 1 \(Anik\)](#) [Crescent projection setup 2 \(Rietje\)](#) [Crescent projection result 2](#)
[Bespectacled viewer](#)

July 22 2009, Shengshi Island, China [thumbnail album](#)
[Peter on foggy beach](#) [Deliberation after first contact \(Rietje\)](#) [Chromosphere \(Peter\)](#)
[Foggy noisy corona \(Rietje\)](#) [Foggy noisy corona](#) [Cloudy crescent](#) [Bespectacled viewers](#)
[Crescent preparation](#) [Crescent consumption \(Rietje\)](#)

August 1 2008, Gobi Altai, Mongolia [thumbnail album](#)
[Peter with late arrival](#) [After first contact \(Rietje\)](#) [Bespectacled viewers](#) [Finger pinhole imaging \(Rietje\)](#)
[Sunhat pinhole imaging \(Rietje\)](#) [Totality wide \(Rietje\)](#) [Totality composite \(Peter\)](#)
[Crescent projection setup](#) [Crescent projection result](#) [Wide-view sequence \(Peter\)](#)

March 29 2006, Sahara beyond Waw-an-Namus, Libya [thumbnail album](#)
[Flatter than Holland](#) [Martijn and Peter at 2nd contact](#) [Peter and Joke plus unwelcome visitors](#)
[Crescent projection setup](#) [Crescent projection result \(Martijn\)](#) [Sharp shadows and bright crescents](#)
[Printed and real imagery](#) [White light corona](#) [Composite corona \(Peter\)](#)

October 3 2005, SST building, La Palma, Spain: [thumbnail album](#)
[Crescent projection with crescents](#) [Anna Önehag watching outside](#)
[Sara Martin photographing outside](#) [Pit Sütterlin at DOT control](#)
[Excellent DOT seeing during eclipse](#) [Luc Rouppe van der Voort & Mats Löfdahl at SST control](#)

Crescent on monitor Sara Martin, Yong Lin, Rietje Rutten & Kostas Tziotzou observing observers
Luc Rouppe van der Voort, Mats Löfdahl, Michiel van Noort, Klaartje Schure & Yong Lin observing partiality
Eric Stempels observing TV Annular eclipse over Madrid

June 21 2001, Kagushi Dam, Zambia: thumbnail album
Eclipse site Explanation by Peter Group setting up Marijke Burger projecting crescents
Crescent projection setup Crescent projection result Short-exposure corona Long-exposure corona

August 11 1999, Vajta, Hungary:

Eclipse site Utrecht student team Crescent projection setup Crescent projection result

July 11 1991, Salina Cruz, Mexico:

Crescent projection setup Crescent projection result

March 7 1970, Miahuatlan, Mexico:

Jo van den Broek and Jaap Houtgast mounting the coelostat mirror Osamu Namba cleaning the Steinheil doublet
Camera electronics and Jacques van Amerongen Short-wave radio and Thijs de Graauw's multiplexer electronics
Osamu Namba and Jo van den Broek at the spectrograph slit, with lunar limb chart
Osamu Namba with slit assembly - reflecting slit for 2nd contact, curved slot for 3rd contact, ciné slit-jaw camera with filters, slitjaw viewer, image shifter

November 12 1966, Bagé, Brazil:

mounting sun shade switching aperture stops Jaap Houtgast at the spectrograph slit

May 20 1966, Saronis, Greece:

NVWS expedition setup NVWS member Dr. Keuskamp - who put my leg in plaster after I busted my ankle escaping from an NVWS-started bush fire Tom de Groot at his setup Our setup - coelostat, telescope objective with Jo van den Broek, spectrograph slit and cabin with Jaap Houtgast and Osamu Namba Jaap Houtgast and Rob Rutten (taken by Tom de Groot) Jaap Houtgast sunbathing
After-eclipse gathering

17.3 **Hans Nieuwenhuijzen's 1956–2012 Utrecht astronomy photos**

Album Sterrewacht Sonnenborgh in 1956–1957

Album Symposium "The Solar Spectrum" held at Utrecht in 1963 at the retirement of Marcel G.J. Minnaert

Album Utrecht astronomers 1961–1965

Album meeting Nederlandse Astronomenclub 1968

Album Utrecht astronomy 1968–1969

Album Herman van de Stadt in 1969 and 1999

Album farewell Sterrekundig Instituut Utrecht 2012-04-04

17.4 **M.G. Rutten's 1936–1939 Indonesia photos**

17.5 **Rob's travel albums**

Manicouagan Reservoir, Quebec

White River, Colorado

Grand Canyon, Arizona

Olkhon Island, Lake Baikal

17.6 Rob shots

- [Rob's orchard 7](#) - spring with diamonds, April 2022.
- [Rob's orchard 6](#) - pear tree finally blown over, February 2022.
- [Rob's kayak 18](#) - Ilha de Cabanas, Portugal, September 2021.
- [Rob's kayak 17](#) - Tortuguero, Costa Rica, February 2020.
- [Rob's telescope 2](#) - 70-year old Minnaert telescope pointed at the daily buzzard - October 2019.
- [Rob's kayak 16](#) - with Rietje, Embalse Potrerillos the day after the eclipse, Argentina, July 2019.
- [Rob's canoe 2](#) - high-flood loading by Rietje, upper Missouri, June 2018.
- [Rob's kayak 15](#) - with Rietje, rounding Satellite Island with Canada on the horizon, August 2017.
- [Rob's buddies 2](#) - which from Mars? Roswell, August 2017.
- [Rob's kayak 14](#) - towards the daily eclipse the day after a total one, Sulawesi, March 2016.
- [Rob's show-and-tell 2](#) - part of talk at community center Deil, November 2016.
- [Rob's kingship](#) - in nearby orchard, De Gelderlander, July 2016.
- [Rob's hairdo](#) - not patented by the patent officer, Bern, January 2016.
- [Rob's kayak 13](#) - Sun Kosi, Nepal, October 2015.
- [Rob's kayak 12](#) - the center one, Grand Canyon, June 2015.
- [Rob's kayak 11](#) - with Rietje, at sunset over Barretta where the DOT was born, Portugal, September 2014.
- [Rob's show-and-tell 1](#) - talk about the solar chromosphere, IAC La Laguna, Tenerife, February 2014.
- [Rob's kayak 10](#) - with Rietje, before Vivaldi's church at the start of the 39th Vogalonga, Venice, May 2013.
- [Rob's kayak 9](#) - assembly, river Sejm, Ukraine, June 2012.
- [Rob's last stance](#) - final Utrecht astronomy talk at a Nederlandse Astronomen Conferentie, Ameland, May 2012.
- [Rob's teacher 2](#) - Kees de Jager at the burial of Utrecht astronomy, April 2012.
- [Rob's orchard 5](#) - a few pears (left) but many apples (right), July 2011.
- [Rob's kayak 8](#) - the non-empty one, once again in President Harding Rapid, Grand Canyon, July 2011.
- [Rob's orchard 4](#) - our remaining pear tree partially blossoming, April 2011.
- [Rob's kayak 7](#) - with Rietje, paddling four weeks along South-West Turkey, May 2010.
- [Rob's flute 3](#) - 209 Mile Canyon, Grand Canyon, September 2009.
- [Rob's kayak 6c](#) - on a quiet stretch, Grand Canyon, September 2009.
- [Rob's kayak 6b](#) - in President Harding Rapid, Grand Canyon, September 2009.
- [Rob's kayak 6a](#) - in Badger Creek Rapid, Grand Canyon, September 2009.
- [Rob's school 3](#) - USO School, Westerbork, July 2009.
- [Rob's flute 2c](#) - bowing out, Teatro Chico, Santa Cruz de La Palma, October 2008.
- [Rob's flute 2b](#) - as *Une flûte invisible* (Saint-Saëns), Teatro Chico, Santa Cruz de La Palma, October 2008.
- [Rob's flute 2a](#) - posted, Teatro Chico, Santa Cruz de La Palma, October 2008.
- [Rob's band 2](#) - *Nu Sus Dan So* in rehearsal, Casino, Los Llanos de Aridane, La Palma, October 2008.
- [Rob's kayak 5](#) - near foggy Olkhon Island, Lake Baikal, Siberia, August 2008.
- [Rob's beard](#) - as unusual phenomenon, Mongolia, July 2008.
- [Rob's kayak 4c](#) - in Class IV Hermit Rapid, Grand Canyon, May 2007.
- [Rob's kayak 4b](#) - in Class III Boucher Rapid, Grand Canyon, May 2007.
- [Rob's kayak 4a](#) - in Class II chute, Sûre, Luxemburg, April 2007.
- [Rob's speech](#) - at mandatory retirement, Museum Sterrenwacht Sonnenborgh, April 2007.
- [Rob's knife](#) - on impact-molten glacier-polished breccia, [Eye of Quebec](#), Canada, August 2006.
- [Rob's chair](#) - on impact-molten glacier-polished breccia, [Eye of Quebec](#), Canada, August 2006.
- [Rob's rainbow 3](#) - doubled, [Eye of Quebec](#), Canada, August 2006.
- [Rob's rainbow 2](#) - white underneath from drop impacts, [Eye of Quebec](#), Canada, August 2006.
- [Rob's kayak 3](#) - with Rietje, [Eye of Quebec](#), Canada, August 2006.
- [Rob's camp](#) - in the [Eye of Quebec](#), Canada, August 2006.
- [Rob's telescope 1](#) - guess which, Roque de los Muchachos, La Palma, July 2006.
- [Rob's bike](#) - guess which, Hoya Grande, La Palma, July 2005.
- [Rob's kayak 2b](#) - as icebreaker, Ammassalik Fjord, Greenland, April 2005.
- [Rob's kayak 2a](#) - as icebreaker, Ammassalik Fjord, Greenland, April 2005.

Rob's way - as Einzelgänger, Tasilaq, Greenland, April 2005.
Rob's class - ESMN School, Tatranska Lomnica, Slovakia, November 2004.
Rob's school 2 - ESMN School, Tatranska Lomnica, Slovakia, November 2004.
Rob's orchestra 2 - *Betuws Symfonie Orkest* before performing, Duras, France, July 2004.
Rob's pose 5 - as ladies' man, with Natasha Shchukina and Valya Kollyukh, Kiev, July 2004.
Rob's pose 4 - as kayaker, with Rietje, river Sejm, June 2004.
Rob's pose 3 - as canoeist, with Rietje, river Sieg, May 2004.
Rob's pose 2 - as astrophysicist, in the library of Museum Sterrenwacht Sonnenborgh, May 2004.
Rob's pose 1 - as astronomer, at the Merz telescope of Museum Sterrenwacht Sonnenborgh, May 2004.
Rob's bull's eye - the Manicouagan impact lake as enticing kayak target on the very far horizon, above Quebec, April 2004.
Rob's orchard 3 - our remaining pear trees in blossom, April 2004.
Rob's food 3 - cake celebrating 40 years at Utrecht University, February 2004.
Rob's food 2 - family at lunch, Bachleiden, Luxemburg, December 31, 2003.
Rob's white - White Sands, New Mexico, October 2003.
Rob's food 1 - calliopes at dinner, Bozeman, Montana, July 2003.
Rob's orchard 2 - our neighbour's, ice-coated for blossom protection, April 2003.
Rob's orchard 1 - our own, seen from *Lingezicht*, one pear tree dying, April 2003.
Rob's computer 5 - multifunctional laptop, also for toasting, SIU office, May 2004.
Rob's computer 4 - light laptop, learning Linux from Alfred, Minnaert building, Utrecht, January 2003.
Rob's computer 3 - heavy Schlepptopf, 10th European Solar Physics Meeting, Prague, September 2002.
Rob's computer 2 - immobile X-terminal, SIU office, Utrecht, November 2002.
Rob's mansion - *Lingezicht* on the first image from a new astronomer shooter, Deil, November 2002.
Rob's orchestra 1 - *Betuws Symfonie Orkest* before performing, Lauzerte, France, August 2002.
Rob's coffee - Dwingeloo, April 2002.
Rob's school 1 - ESMN-PLATON Spring School, Westerbork, April 2002.
Rob's brother - Kees & Rob as lookalikes, *Avontuur 2*, Waddenzee, September 2001.
Rob's mouth - illuminating exhaustive groundbased endeavor, Kariba, Zimbabwe, June 2001.
Rob's shadow - with solar crescents, Kagushi Dam, Zambia, June 21, 2001.
Rob's optics - second lens implant and new glasses, Lusaka, Zambia, June 2001.
Rob's feet - up in the air above Africa, June 2001.
Rob's canoe - on its 12th descent of the Semois, with Rietje, Belgium, April 2001.
Rob's wife - reading in the wilderness, White River, Utah, May 2000.
Rob's joy - rollercoasting the Green River in Split Mountain Canyon, Utah, May 2000.
Rob's hat - shadowed sharply with crescent decoration, Vajta, Hungary, August 11 1999.
Rob's break - with a view towards Akamas, Troödos Mountains, Cyprus, December 1998.
Rob's flag - hoisted at Lysmark, Östersjön, Swedish Baltic, June 1997.
Rob's fate - the *Dutch Open Telescope* being erected on La Palma, July 1996.
Rob's wife - non-shipshape before crossing from the Lofoten to the Vesterålen, July 1995.
Rob's wife - shipshape with the famous Trollfjord in the background, Lofoten, July 1995.
Rob's band 1 - *Nu Sus Dan So* ready for its 10th anniversary concert: with Teuni Trouwborst, Corry Oomen, Ina Entrop, Lianne Lugtigheid, Arie Atema, Paul Smit, Marijke Rensink, Erichem, January 1995.
Rob's kayak 1 - on the way to distant Normandy beyond Mont St. Michel, with Martijn, Couesnon, December 1993.
Rob's teacher 1 - PhD adviser, colleague, and friend Kees Zwaan, Utrecht University portrait, summer 1993.
Rob's beaut - shining after the NSO directorship contest won by Jacques Beckers, Arizona, May 1993.
Rob's high - soaring with the NSO director, Arizona, May 1993.
Rob's institution - the Buijs Ballotbajes when astronomy still had most of the top floor, Utrecht, March 1993.
Rob's flute 1 - 1993 Utrecht University calendar.
Rob's rainbow 1 - as Anton Pannekoek quote, drawn by Roeland, 1991.
Rob's toes - as published in *Zenit*, July 1992, page 284. Which other astronomer has ever had his/her toes published full-color in an astronomy journal? Salina Cruz, Mexico, July 11, 1991.

Rob's colleagues - Max Kuperus, Hollis Johnson, Aert Schadee, Jan Kuijpers, Brian Murphy, Tony Hearn, Kees Zwaan, Hans Nieuwenhuijzen, Rob, Hans Heintze, with Marcel Minnaert supervising, student almanac photograph, spring 1991.

Rob's village - Deil from above, with *Lingezicht* at top center, summer 1989.

Rob's windmill - *De Vlinder* along the Linge 3 km downstream from *Lingezicht*, autumn 1986.

Rob's river - the Linge 2 km downstream from *Lingezicht*, Appeldijk, autumn 1986.

Rob's family - on a three-week Tara-Drina expedition, Montenegro, then Yugoslavia, summer 1986.

Rob's computer 1 - telephone connector to the university computer, around 1980.

Rob's sun - as a most befitting aureole, Planetenpad Westerbork, spring 1976.

Rob's buddies 1 - budding astronomers John Heise, Rob, Vincent Icke and Marijke Burger, 1968, by Hans Nieuwenhuijzen.

Rob's buddy - with electronics engineer Jacques van Amerongen, 1968, by Hans Nieuwenhuijzen.

Rob's timing - guardedly changing aperture stops towards 2nd contact, Bagé, Brasil, November 12 1966, by Jo van den Broek.

Rob's instruction - in spectrogram inspection, Saronis, Greece, May 1966, by Tom de Groot.

Rob's first namesake - Rob Hammerschlag with his telescope, La Palma, November 1997.

Rob's second namesake - René G.M. Rutten, formerly next door at Utrecht and later next door on La Palma. Please add my second initial when citing or acknowledging me! Portrait 1998 taken from the [ING staff site](#).

18 Travel notes and albums

List of boated rivers and coasts

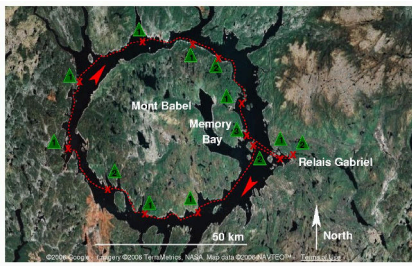
18.1 Nostalgic Nederlands Indië 1936-1939

This album from Java and Sumatra contains photographs by my father Martin G. Rutten. He collected them in print albums now residing with my brother Kees W. Rutten, who scanned them using the captions as file names. The original higher-resolution scans can be requested from him (jslokkert apestaart-symbol xs4all.nl) or from me.

My father ([biography in Dutch](#), [inaugurele rede](#)) was a geologist, as was his father Louis M.R. Rutten ([biography in Dutch](#)) before him and is Kees after him. He was born in Indonesia, then called the Dutch East Indies, returned there as oil-company geologist during the late 1930s, and then took these photographs.

One of the photographs shows my mother, Titia W. Rutten-Kooistra, close to the summit of the Semeru, the highest volcano on Java. Much later she wrote a short essay "[Een hemels gerecht](#)" about this expedition. This essay and similar ones became part of a biographic novel "[Zuurkool met spek](#)" by my sister Wietske S. Rutten (wietske apestaart-symbol ns.sympatico.ca). Rietje and I tried to climb Semeru in 2000 but were not allowed on the summit cone beyond Ranu Kumbolo. That lake remains as beautiful as it appears on my father's photographs. My photograph of it became the [cover of "Zuurkool met spek"](#).

18.2 Kayak Manicouagan Reservoir 2006



The giant annular lake Manicouagan in Quebec is the combined result of one of the largest identified asteroid or comet impacts on Earth, the recent ice ages, and one of the largest retention dams on Earth. The near-circular central island and the annular reservoir together appear on photographs from space as the "Eye of Quebec", the most striking and beautiful impact structure on Earth.

Rietje and I kayaked the full circuit during three weeks in August 2006, a splendid wilderness expedition (second kayak circuit ever).

[Manicouagan Reservoir kayak expedition picture album](#)

[Manicouagan Reservoir kayak expedition report](#)

[Reisverslag Manicouagan Reservoir per kano](#)

["Per kano een meteorinslag rond" \(PeddelPraat nr. 207, november 2006\)](#)

["Als ramptoerist de mooiste inslag rond" \(Zenit mei 2007\)](#)

The bolide impact was 215.6 (+/-0.1) million years ago, during the Mesozoic Triassic, a warm era in which therapsids including pre-mammals thrived, halfway the previous and present cold episodes. It caused a fireball as far as present-day New York, a melting pot mixing the Panagaeon target area containing billion-year Grenville Precambrian rock over 48 km extent and 9 km depth, a crater wall of 100 km diameter. Ejecta have been found as far as Britain and Japan. Surprisingly, the massive species extinction at the Triassic-Jurassic transition, starting the age of the dinosaurs and as bad as the K-T extinction (Chicxulub impact) ending it, is dated 13 My after the impact (the even worse Permian-Triassic "great dying" transition was 37 My before it). Why no mass extinctions from the Manicouagan impact? I speculate that the hard Triassic rock and harder underlying Grenville gabbro absorbed the shock as fluidizing waves without pulverizing and liftoff, while the soft sulphur- and feldspar-rich Yucatan limestone went up into the atmosphere globally causing acid rain, re-entry firestorms and long winter.

During the last million years the glaciations of the present cold episode removed a kilometer of Triassic rock down to the Precambrian Canadian shield, including the outer crater wall. The melt was harder and survived, at 1 km thickness, as a lonesome 2000 square km Triassic hump, the largest impactite mountain on Earth. Its nearly 1000 m high non-brecchiated peaks (Mont de Babel, Maskelynite Peak) represent terrestrial examples of planetary impact uplifts. The bedrock beyond the melt was shattered in the impact; the fragments were scooped up by the ice leaving a deep annular moat around the uplifted melt.

The dam ("Manic-5" or "Daniel-Johnson") is located about 60 km south of the excavated annulus, rising 214 meters atop a canyon of the former Manicouagan river along the (only) road to Labrador. During the 1960s this was the largest construction site in North America, taking 13000 workers and 2.2 million cubic meters of concrete

to inundate an area of 2000 square km including the excavated impact annulus. The central molten impactite mountain emerged as "Isle René Levasseur" to become the second-largest lake island and the largest man-made island on Earth. The annular reservoir symbolizes that the Earth's water may have come from comets, replenishing outgassed hydrogen from the Big Bang.

Levasseur island was covered by pristine mature boreal forest but the Southern part has been devastated by the infamous Kruger company, scandalously permitted to convert much of the forest into toilet paper. Kruger probably also caused the immense 2005 forest burns seen on the ISS images below and with [Google-Earth/maps satellite view](#).

Weblinks concerning Manicouagan topography, geology, hydrology:

Manicouagan impact bibliography	concise summary	Manicouagan impact cartoons
Wikipedia: Manicouagan Reservoir	Earth impact database	Charles O'Dale crater pages
Triassic Europe mass extinctions	Manicouagan faulting	Manicouagan ejecta discovery
Trias Jura extinctions	Manicouagan extinction?	Manicouagan ejecta proof no feldspar extinction?
crackpot interpretation	Wikipedia: Isle René Levasseur	indigenous Nitassinan Innu
1962 map	impact melt map	1950s map
cloudless reservoir	fogged reservoir	Google Maps clicker
reservoir plus aurora	reservoir plus aurora	stereo & anaglyph radar images with StLawrence
reservoir level graph	reservoir level rise?	reservoir fact sheet
	Pessamit action	Doc Searls 2009 photos from plane
		Pourvoirie Boreal drowned

Weblinks concerning the devastation of Isle René Levasseur by the Kruger company:

Reserve Louis Babel	SOS Levasseur video	Kruger logging map	Kruger guilty of death at landing
Kruger Levasseur devastation from the air			Kruger Levasseur devastation from ISS-14
Kruger Levasseur devastation from ISS-15			Kruger Levasseur devastation from ISS-17
Kruger Levasseur landings from ISS-18	winter view ISS-30	winter view ISS-34	

Weblinks concerning kayaking/canoeing/sailing the Manicouagan reservoir:

Manicouagan kayak information	Manicouagan canoe information	driving there
where camp on impactite	Station Uapishka	splendid April Fools hoax
1895 Mouchalagane exploration	Andrew Nuquist 1994 kayak circuit and 1998 return	
sail trips 2000 and 2005	Charles O'Dale aerial and 2004 paddle investigations	smooth 2006 sailing
2006 canoe crossing	our 2006 circuit report	our 2006 circuit album
fast 2007 kayak circuit	2007 Levasseur interior canoe expedition,	2009 manic paddlers circuit album
2010 solo circuit report,	album	2011 Mouchalagane canoe expedition
2011 mokai circuit	2011 second thoughts	
2012 kayak circuit	2012 sail circuit	2013 Mouchalagane canoe expedition
2013 Chad's return, album	2013 kayak crossing	2018 solo circuit per inflatable
2018 fast solo circuit+return 2020	2019 two kayak circuit	2019 four kayak circuit

18.3 Canoe White River 2000, 2004, 2008, 2015

Beautiful lonesome desert canyon canoeing in the USA. Ken and Shirley Parsons' excellent guidebook is locally for sale and [also downloadable here](#).

We did the 120-mile stretch from Rangely (Colorado) to the Sandwash ranger station (Utah) on the Green River four times, the first three using our bring-per-plane Ally folding canoe (the first time by Greyhound bus from Denver), the fourth with a locally rented canoe. The put-ins and take-outs were efficiently and pleasantly arranged by River Runners' Transport in Vernal. We leisurely took about two weeks each time, always in May, but with the end of May 2000 too hot and insectuous, the beginning of May 2008 too cold and cottonwood-bare, much of May 2015 braving daily thunderstorms.

In 2004 and 2008 we started at the picnic site below the Taylor Draw Dam of the Kenney Reservoir. That location and the first few miles have excellent bird watching. However, the stretch from there to, through, and below Rangely has been irrevocably spoiled by the bulldozing of numerous previously beautiful wild river banks with undercut cottonwoods into treeless dumps of concrete waste, plus a hundred or so car wrecks. So much for local appreciation of nature. It is now better to start at the Big Trujillo Wash BLM access site.

From there, the White River remains largely unspoiled (fortunately the White River Dam did not materialize). The current is pleasantly fast, the few ripples are trivial. The canyon scenery is superb. One's isolation is splendid, except for nightly inspection and slap-warning by the beaver at every campsite, once a wild-horse stampede along the Green River, and frequent but distant booming by the off-river oil industry.

Album May 2008

Album May 2015

18.4 Paddle Grand Canyon 1978, 2007, 2009, 2011, 2015

Glenn Canyon dam. The good thing about it may be that, presently, the Grand Canyon is virtually insect-free all summer - the deep-lake flow feeding the Colorado is too regular, cold, alkaline. But I hope that the dam collapses soon. When it does, how fast and high will the flash flood run? Can a warning ranger outpace it per speedboat from Lee's Ferry, or must downstream parties be told per helicopter to climb up? How fast, how high must they climb? What flora and fauna will populate the ex-Lake Powell silt flats? Meadows and cows? How long will the river take to re-carve out Glenn Canyon? Will the flash flood smooth out the present Grand Canyon rapids? How long before the NPS permits canoe trips through Glenn and Grand Canyons? How long until Page is a ghost town? How long before the bureaucrats decide to rebuild the dam?

Our more recent trips with the highly recommended CanX company:

May 2007:	<u>album CanX "hikers special"</u>	
September 2009:	<u>album CanX "hikers special"</u>	<u>movie rafting Lava Falls</u>
June 2011:	<u>album sea-kayak Lake Powell</u>	<u>album CanX "string quartet special"</u>
July 2015:	<u>album CanX "string quartet special"</u>	

18.5 Olkhon Island 2008

Beautiful Olkhon Island in Lake Baikal (Siberia) is a popular summer resort.

Album Olkhon coast

Album foggy Olkhon coast - seen from a kayak.

Album "Beautiful Olkhon island" - the impact of trashy tourism.

19 Utrechts zonnestelsel

In 1992 bestond de Utrechtse sterrenkunde 350 jaar. Bij de viering van dit heugelijke feit rees het idee de stad Utrecht blijvend te versieren met een model van het zonnestelsel op schaal 1 op de miljard, het "Utrechts zonnestelsel". Op deze schaal krijgt de zon de menselijke maat van bijna anderhalve meter terwijl de planeten nog net binnen Utrecht vallen. Met zowel de diameters als de afstanden met dezelfde factor verkleind. In andere schaalmodellen zijn de modelplaneten vaak veel te groot vergeleken bij hun afstanden.

In uitvoerig overleg met de gemeente Utrecht maakte ik in 1993 een gedetailleerd plan voor het Utrechts zonnestelsel met officieel goedgekeurde lokaties. De zon op het Domplein naar een suggestie van Aert Schadee. De aarde op de Vismarkt, tegenover de kippenboerin, op deze schaal slechts 13 mm groot! Pluto kon nog net bij jeugdherberg Rhijnauwen (een Utrechtse enclave) door zijn perihelium in de ecliptica te poten. Niet netjes, maar Pluto een planeet noemen was ook toen al overdreven.

Als modelfoton zou je dan in acht minuten van de zon naar de aarde lopen. Alle planeten af door van het Centraal Station naar Rhijnauwen te wandelen, rustig-aan want de meegeschaalde lichtsnelheid is maar 1,08 km/uur en harder mag niet van Einstein.

Voor nog verder fotonwandelen schaalde ik ook de afstanden van objecten verderop in het heelal naar deze

maat. De eerstvolgende ster is maar 40,000 km verder lopen, juist de omtrek van de aarde (1/10e van de maansafstand). Voor rondom-de-aarde fotonwandelen heb je dan ruim vier jaar de tijd (gemiddeld 26 km/dag, doorlopen met slaapwandelen?).

Nog in 1993 besloot de Utrechtse universiteit met de zon te beginnen, als Sol Iustitiae, "zonne der gerechtigheid", het universiteitssymbool als bronzen bol op het Domplein pal voor het Akademiegebouw. Die werd in mijn opdracht gemaakt door beeldend-kunstenaar echtpaar Theo van der Hoeven en Inez de Heer Kloots en in april 1994 door Prinses Margriet onthuld. Sindsdien dient de Solbol als erepodium voor afstudeerders.

Helaas was toentertijd daarmee het geld op. Sindsdien wachtte het "Utrechts zonnestelsel" op voltooiing met de planeten (toen nog negen, nu nog acht) tot het idee in 2018 werd overgenomen en gerealiseerd door Louk Röell.

In 2012 bestond de Utrechtse sterrenkunde 370 jaar. Maar niet heus: het kortzichtige bestuur van de Utrechtse universiteit besloot in 2011 het Sterrekundig Instituut Utrecht op te heffen. Begin 2012 was de Utrechtse sterrenkunde verdwenen, 370 jaar na de start in het geboortjaar van Newton, niet lang nadat Galileï met zonnevlek-waarnemingen de zonnephysica startte en meer in het algemeen astrofysica als wetenschap tegenover astrologie en ander bijgeloof. Als *Sol iustitiae* symboliseerde de zon haar onderzoek als bestaansrecht voor een universiteit. Hoogst toepasselijk was het Utrechtse zonsonderzoek de laatste honderd jaar wereldberoemd. Nu is het beëindigd. J.H. Oort vond dat een universiteit waar het heelal niet wordt bestudeerd niet universiteit mag heten – de Domplein-Sol kan beter weg en de zinspreuk gewijzigd in *Sol scientiae est fabula*.

19.0.1 Zonnestelsel

Zon

Een relatief kleine en koele ster aan de buitenkant van de Melkweg, bijna vijf miljard jaar oud en met nog eens vijf miljard jaar voor de boeg. Dan wordt de zon eerst zo groot als de huidige aardbaan en schrompelt vervolgens in één tot een witte dwerg, even klein als de aarde.

Mercurius

De kleinste planeet, niet veel groter dan de maan en net als de maan zonder dampkring en overdekt met inslagkraters uit de beginperiode van het zonnestelsel, toen de planeten veel vaker werden getroffen dan nu.

Venus

De naaste buur van de aarde. Venus heeft ook een dampkring, maar veel dichter dan de onze. Hij bestaat vooral uit koolstofdioxide, met bovenaan ondoorzichtige wolken zwavelzuur. Het broeikaseffect levert een temperatuur van 475 graden Celsius op het zwaar vulkanische oppervlak.

Aarde en Maan

De aarde is de enige planeet waarvan de naam niet komt uit de klassieke Grieks-Romeinse mythologie. De aarde is blauw: het is ook de enige planeet die grotendeels is bedekt met water. De ontdekkingsgreizigers van weleer bevoeren de aardse oceanen; in onze tijd vormen ruimtemissies naar de andere planeten het equivalent.

Mars

Mars is rood van de woestijnen die het oppervlak bedekken. Ooit is er veel water geweest, maar of zich daarin leven heeft ontwikkeld is een open vraag. Het is er nu erg droog en koud; de dunne atmosfeer houdt geen warmte vast.

Jupiter

De grootste planeet, driehonderd maal zo zwaar als de aarde. Een gasreus, vooral bestaand uit waterstof- en heliumgas. Galileï ontdekte de vier grootste manen (Io, Europa, Ganymede, Callisto) in 1610 en stelde vast dat ze om Jupiter draaien – niet om de aarde!

Saturnus

De planeet met de mooiste ringen in het zonnestelsel. Galilei zag al in 1610 dat er iets aan Saturnus uitsteekt maar pas in 1656 stelde de Nederlander Christiaan Huygens vast dat het om ringen gaat. Ze bestaan vooral uit ijskristallen die in eigen banen rond Saturnus draaien, net zoals de planeten om de zon.

Uranus

De eerste planeet die per telescoop is ontdekt, door William Herschel in 1781, omdat hij niet met het blote oog waarneembaar is. De draaiingsas van Uranus staat bijna haaks op het baanvlak zodat dagen en nachten bij de polen tientallen jaren duren.

Neptunus

Ontdekt in 1846 nabij de plaats waar hij door Adams en LeVerrier was voorspeld op grond van onregelmatigheden in de baan van Uranus; sindsdien legde Neptunus pas één rondje om de zon af. Neptunus en Uranus zijn gasreuzen die qua samenstelling lijken op de kernen van Jupiter en Saturnus.

[Pluto]

Pluto, ontdekt in 1930, gold lang als de negende planeet maar werd in 2006 gedegradeerd tot dwergplaneet: planetoïde nummer 134340. Een van de vele kleinere objecten die om de zon draaien, en niet eens het grootste (dat is Ceres). Planetoïde 12695 heet Utrecht. Enkele honderden zijn naar Nederlanders vernoemd, meest sterrenkundigen.

20 Exsociate astronomy links

Worthwhile astronomy information from ex-associates at the ex-Sterrekundig Instituut Utrecht:

Rob van Gent: historical astronomy and calendars

Karel Schrijver: solar link collection TRACE images & movies

Louis Strous: astronomy answers astronomie antwoorden

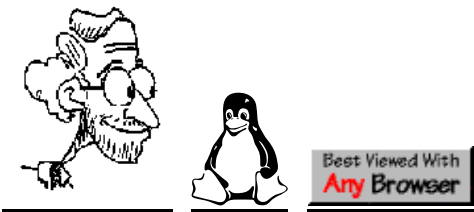
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