

# Marc VAN DER SLUYS

## *Curriculum vitae*

### PERSONAL DATA

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PLACE OF BIRTH:	De Bilt, the Netherlands	DATE OF BIRTH:	15 January 1976
NATIONALITY:	Dutch		
CURRENT ADDRESS:	Utrecht University Institute for Gravitational and Subatomic Physics/Nikhef Princetonplein 1 NL-3584 CC Utrecht The Netherlands	PHONE:	+31 6 4681 2016
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### WORK EXPERIENCE

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CURRENT POSITION (since October 2021)	Scientist in gravitational waves at the Netherlands institute for nuclear and high-energy physics (Nikhef), Amsterdam and Utrecht University, The Netherlands.
MAY 2014 – SEPTEMBER 2021	Senior researcher in sustainable energy at the HAN University of Applied Sciences in Arnhem, The Netherlands.
SEPTEMBER 2010 – FEBRUARY 2014	Postdoctoral researcher in gravitational-wave physics, Radboud University Nijmegen, The Netherlands, working with Prof. Dr. Gijs Nelemans.
SEPTEMBER 2009 – AUGUST 2010:	National Fellow of the <i>Canadian Institute for Theoretical Astrophysics</i> (CITA), at the <i>University of Alberta</i> , Canada.
SEPTEMBER 2006 – AUGUST 2009:	Postdoctoral fellow in gravitational-wave physics at <i>Northwestern University</i> Evanston IL, U.S.A., working with Prof. Dr. Vicky Kalogera.
MARCH 2006 – AUGUST 2006:	Postdoctoral fellow in astrophysics at the <i>Astronomical Institute Utrecht</i> , The Netherlands, working with Prof. Dr. Frank Verbunt.
SEPTEMBER 2001 – DECEMBER 2005:	PhD student/research assistant in astrophysics, <i>Astronomical Institute Utrecht</i> , The Netherlands, working with Prof. Dr. Frank Verbunt.

### EDUCATION

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SEPTEMBER 2001 – FEBRUARY 2006:	Ph.D. research at the <i>Astronomical Institute Utrecht</i> , The Netherlands. <b>Title of Ph.D. thesis:</b> Formation and evolution of compact binaries (2006). <b>Thesis topics:</b> Formation and evolution of ultra-compact X-ray binaries (in globular clusters), formation of double white dwarfs. <b>Supervisors:</b> Prof. Dr. F. Verbunt, Dr. O.R. Pols.
SEPTEMBER 2001:	Undergraduate (MSc) degree in astrophysics at Utrecht University, The Netherlands. <b>Title of MSc thesis:</b> <i>The dynamics of the nebula M1-67 around the run-away Wolf-Rayet star WR 124</i> , 2003 (see publication list). <b>Supervisor:</b> Prof. Dr. H.J.G.L.M. Lamers.
SEPTEMBER 1994 – AUGUST 2001:	Undergraduate (BSc, MSc) studies in physics and astrophysics at Utrecht University, The Netherlands.

### FELLOWSHIPS

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2009–2011:	NATIONAL FELLOW OF THE CANADIAN INSTITUTE FOR THEORETICAL ASTROPHYSICS (CITA NF, \$110,000). I interrupted the fellowship in 2010 to accept a position in Nijmegen.
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## LANGUAGES

DUTCH: Mother tongue  
 ENGLISH: Fluent  
 GERMAN: Fluent

FRENCH: Basic knowledge  
 ITALIAN: Minimal knowledge  
 SPANISH: Minimal knowledge

## INTERESTS AND SKILLS

RESEARCH INTERESTS: Scientific research, scientific modelling, physics, astronomy, (Bayesian) statistics, signal processing, data analysis, CPU-intensive modelling, *Big data*, automation, autonomous (embedded) systems

COMPUTER ENVIRONMENTS: Linux, Unix, Mac OS, Windows

COMPUTING PLATFORMS: Cluster, server, (headless) pc, Raspberry Pi, Arduino, embedded systems

SYSTEM MANAGEMENT: Linux server/client (Gentoo, Arch, Ubuntu, CentOS, Fedora, ...), Beowulf cluster, Mac OS, Windows

PROGRAMMING: Python, ANSI C/C99, Fortran 77/90/95/2003/2008, C++, Perl, IDL, Maxima, MATLAB, Mathematica, R

OTHER COMPUTING: Open-source software, bash (+scripting), tcsh, emacs, vi, sed, awk, git, svn, cvs,  $\LaTeX$ , HTML, PHP, JavaScript, Linux kernel

## SCIENTIFIC INTERESTS AND EXPERIENCE

**Scientific modelling.** Translating (scientific) questions and problems to a (physical) computer model. Experience with CPU-intensive models, such as the detailed evolution of a (binary) star or the simulation of a galaxy in *e.g.* C or Fortran on PCs and clusters.

**Statistics.** Analysis of results from computer models. Monte Carlo-simulations. Bayesian statistics using *Markov chains* for parameter estimation (9–15 dimensions) and *Bayesian model selection* (*Bayes factor*, *odds ratio*, *etc.*).

**Signal processing.** Experience with low- (LIGO-Virgo) and high (LISA) signal-to-noise ratios in signals from gravitational waves: sampling, filtering, Fourier transformations, match between signals, *etc.*

**Data analysis.** Analysis, reduction and (graphical) presentation of results from the processes mentioned above, using *e.g.* matplotlib, PLplot, GNU plot, MATLAB, *etc.* Experience with *Big data*.

**Social interests.** Sustainable generation and efficient use of energy and resources by a growing world population. Climate modelling, especially the feedback of greenhouse gasses, melting ice caps, changing wind and ocean currents, and the consequences for food production. Medical use of scanners, imaging and monitoring (MRI, CT, ultrasound, ECG, EEG, *etc.*) for *e.g.* neurological, cardiovascular or oncological research. Neurology and cognition; modelling and statistics of conscience, behaviour, language, religion, *etc.*

**Popularisation of astronomy and public outreach.** Amongst my activities are:

**Popular talks and courses** (at public observatories, schools, special groups; since 1991)

**Public observing nights** with (amateur) telescopes at Sonnenborgh Observatory, Utrecht (1991–2006)

**Popular-astronomy website** [hemel.waarnemen.com](http://hemel.waarnemen.com), providing *astrocalendars*, sky maps, and more (in Dutch/Flemish, since 2004). I predict events in the night sky which can be observed with simple means by a general public and draw about 5500 unique visitors a day (~2 million in 2020).

## ACADEMIC TEACHING AND OUTREACH

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COMPACT BINARIES	RU Nijmegen, MSc level, 2011, 2020, 2021 (one lecture)
SCENARIO MODELLING	HAN Arnhem, MSc level, 2018–2021 (course)
SOLAR ENERGY	HAN Arnhem, MSc level, 2018–2021 (course)
OPERATING SYSTEMS	HAN Arnhem, BSc level, 2016–2020 (course Linux system programming)
HISTORY OF ASTRONOMY	RU Nijmegen, MSc level, 2019 (lab class, Python)
BINARY EVOLUTION	Universidad de Valparaíso, Chile, MSc level, 2012 (one lecture)
DUTCH ASTRONOMY OLYMPIAD	RU Nijmegen, high-school level, 2011 (organiser + 1 lecture)
OBSERVATIONAL ASTROPHYSICS	RU Nijmegen, BSc level, 2011 (one lecture)
ASTRO 465 (STELLAR ASTROPHYSICS)	University of Alberta, MSc level, 2010 (TA)
NASA SUMMER PROGRAM SEMINAR	Northwestern University, BSc/MSc level, 2009
STELLAR EVOLUTION	Utrecht University, BSc level, 2006 (one lecture)
HIGH-ENERGY ASTROPHYSICS	Utrecht University, MSc level, 2001, 2002 (TA)
OBSERVATIONAL ASTROPHYSICS 1 & 2	Utrecht University, BSc/MSc level, 2002 (TA)
MORGENSTERREN	Utrecht University, three-day astronomy course for high-school students, high-school level, 2002, 2003
THE ROTATION SPEED OF THE SUN	Measuring the rotation of the Sun using the Utrecht observatory spectrograph, high-school level, 1997–2001

## SUPERVISION OF UNDERGRADUATE AND GRADUATE STUDENTS

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SWETA SHAH	<b>GW astronomy</b> ; PhD student at Nijmegen University (2010–present). PhD thesis: November 2014.
CHRIS CHAMBERS	<b>Gravitational waves</b> ; MSc student at Utrecht/Nijmegen University (2011–2012). MSc thesis: Improvements in Determining the Masses of Compact Objects in Binaries using Gravitational Waves (2012).
MAARTEN VAN DE GRIEND	<b>White-dwarf planets</b> ; BSc student at Nijmegen University (2010–2012). BSc thesis: Finding Jovian planets around hot white dwarfs by their $H_{\alpha}$ emission (2012).
TYRONE WOODS	<b>Double white dwarfs</b> ; MSc student at the University of Alberta (2009–2011). MSc thesis: On the Formation of Double White Dwarfs through Stable Mass Transfer and a Common Envelope (Woods et al., 2012).
BEN FARR	<b>Gravitational waves</b> ; PhD student at Northwestern University (2009). PhD thesis: 2014?
ANDREW LOVERIDGE	<b>Binary evolution</b> ; MSc student, Northwestern University (2009–2011). MSc thesis: Analytical Expressions for the Envelope Binding Energy of Giants as a Function of Basic Stellar Parameters (Loveridge et al., 2011).
VIVIEN RAYMOND	<b>Gravitational waves</b> ; MSc, then PhD student at Northwestern University (2007–2009). PhD thesis: Parameter Estimation Using Markov Chain Monte Carlo Methods for Gravitational Waves from Spinning Inspirals of Compact Objects (2012).

## INTERNATIONAL ACTIVITIES

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### Work visits

Feb–Mar 2012	UNIVERSIDAD DE VALPARAÍSO, Chile (Schreiber, Zorotovic)	1 month
Jan–Feb 2011	NORTHWESTERN UNIVERSITY (Politano, Loveridge, Kalogera)	1 week
Jul–Aug 2010	NORTHWESTERN UNIVERSITY (Loveridge, Kalogera, Raymond)	1 week
May 2010	MPA, GARCHING, Germany (Ruiter)	2 days
Mar 2010	CITA, TORONTO, Canada (Murray, Pfeiffer)	1 week
Feb–Mar 2010	MCMASTER UNIVERSITY, Hamilton, Canada (Glebbeek)	1 week
May 2009	UNIVERSITY OF BIRMINGHAM, UK (Vecchio, Veitch)	3 days
Sep 2008	UNIVERSITY OF BIRMINGHAM, UK (Vecchio, Veitch)	1 week
Mar 2008	PENN STATE UNIVERSITY (O’Shaughnessy)	1 week
Oct 2007	UNIVERSITY OF BIRMINGHAM, UK (Vecchio)	1 week

## International collaborations

DOUBLE-WHITE-DWARF FORMATION	Schreiber, Zorotovic (Valparaíso)
ULTRACOMPACT X-RAY BINARIES, AM CVN STARS	in 't Zand (Utrecht), Nelemans (Nijmegen), Yungelson (Moscow), Tout (Cambridge), Portegies Zwart (Leiden)
BINARY EVOLUTION CODE	Eggleton (Los Alamos), Glebbeek (McMaster)
STELLAR MERGERS	Politano (Milwaukee), Taam (Taiwan), Glebbeek (McMaster)
POPULATION SYNTHESIS OF SPINNING BLACK HOLES	Belczynski (Arizona)
GRAVITATIONAL WAVES, BAYESIAN PARAMETER ESTIMATION	Röver, Meyer (Auckland), Vecchio, Veitch (Birmingham, UK), Christensen (Carleton)
LIGO/VIRGO FOLLOW-UP PIPELINE	Gouaty (Louisiana State)

## Memberships

2007–2010	The Laser Interferometer Gravitational-wave Observatory (LIGO)
2007–2009	Cofounder and chair of the Bayesian-analysis group in the LIGO-Virgo collaboration
2011–2014	The Virgo interferometric antenna for gravitational waves
2011–2014	Nikhef: Dutch National Institute for Subatomic Physics
SINCE 2020	NLLGG: Dutch Linux user group
SINCE 2021	The LIGO-Virgo collaboration

## PUBLICATION SUMMARY

REFEREED PUBLICATIONS:	94	ONLINE PUBLICATIONS:	13
NON-REFEREED PUBLICATIONS:	11	SCIENTIFIC SOFTWARE PACKAGES:	17
CITATIONS:	19002	CONTRIBUTIONS TO CONFERENCES:	24
H-INDEX:	58	SEMINAR TALKS AND COLLOQUIA:	20
I10-INDEX:	93	POPULAR TALKS AND LECTURES:	145

## REFEREED PUBLICATIONS

- van der Sluys, M. & van Kan, 2021, P., in preparation: **SolTrack: a free, fast and accurate C/C++, Python and Arduino routine to compute the position of the Sun**
- Catau, R., et al. 2020, Urban and Transit Planning, 415: **High-Concentration Solar Energy Systems for the Built Environment**
- Sonneveld, P., et al., accepted for publication in Acta Horticulturae, 2019: **A concentrated-solar system to reduce greenhouse heat load and generate energy**
- Verbunt, F., & van der Sluys, M. 2019, Journal for the History of Astronomy 50.4, 383: **Why Halley did not discover proper motion and why Cassini did**
- van der Sluys, M., van Kan, P., & Sonneveld, P. 2015, AIPC, 1679, 080003: **CPV in the built environment**
- P. Sonneveld, M. van der Sluys, A. van Rhijn & M. Hebbink, GreenSys 1170, 477, 2015: **Feasibility study of an electricity delivering Fresnel greenhouse**
- van Haften, L. M., Nelemans, G., Voss, R., van der Sluys, M. V., & Toonen, S. 2015, A&A, 579, A33: **Population synthesis of classical low-mass X-ray binaries in the Galactic Bulge**
- Veitch, J., et al. 2015, PhRvD, 91, 042003: **Parameter estimation for compact binaries with ground-based gravitational-wave observations using the LALInference software library**

9. Sidery, T., et al. 2014, PhRvD, 89, 084060: **Reconstructing the sky location of gravitational-wave detected compact binary systems: Methodology for testing and comparison**
10. Shah, S., Nelemans, G., & van der Sluys, M. 2013, A&A, 553, A82: **Using electromagnetic observations to aid gravitational-wave parameter estimation of compact binaries observed with LISA. II. The effect of knowing the sky position**
11. Ratti, E. M., et al. 2013, MNRAS, 431, L10: **IGR J19308+0530: Roche lobe overflow on to a compact object from a donor 1.8 times as massive**
12. van Haften, L. M., Nelemans, G., Voss, R., Toonen, S., Portegies Zwart, S. F., Yungelson, L. R., & van der Sluys, M. V. 2013, A&A, 552, A69: **Population synthesis of ultracompact X-ray binaries in the Galactic bulge**
13. Shah, S., van der Sluys, M., & Nelemans, G. 2012, A&A, 544, A153: **Using electromagnetic observations to aid gravitational-wave parameter estimation of compact binaries observed with LISA**
14. Veitch, J., et al. 2012, PhRvD, 85, 104045: **Estimating parameters of coalescing compact binaries with proposed advanced detector networks**
15. Woods, T. E., Ivanova, N., van der Sluys, M. V., & Chaichenets, S. 2012, ApJ, 744, 12: **On the Formation of Double White Dwarfs through Stable Mass Transfer and a Common Envelope**
16. Loveridge, A. J., van der Sluys, M. V., & Kalogera, V. 2011, ApJ, 743, 49: **Analytical Expressions for the Envelope Binding Energy of Giants as a Function of Basic Stellar Parameters**
17. M. Politano, M.V. van der Sluys, R.E. Taam, and B. Willems, 2010, ApJ 720, 1752: **Population Synthesis of Common Envelope Mergers: I. Giant Stars with Stellar or Substellar Companions**
18. V. Raymond, M.V. van der Sluys, I. Mandel, V. Kalogera, C. Röver, N. Christensen, 2010, CQG 27, 114009: **The effects of LIGO detector noise on a 15-dimensional Markov-chain Monte-Carlo analysis of gravitational-wave signals**
19. G. Nelemans, L.R. Yungelson, M.V. van der Sluys and Christopher A. Tout, 2010, MNRAS 401, 1347: **The chemical composition of donors in AM CVn stars and ultra-compact X-ray binaries: observational tests of their formation**
20. Marc van der Sluys, Ilya Mandel, Vivien Raymond, Vicky Kalogera, Christian Röver and Nelson Christensen, 2009, CQG 26, 204010: **Parameter estimation for signals from compact binary inspirals injected into LIGO data**
21. B. Aylott et al. 2009, CQG 26, 165008: **Testing gravitational-wave searches with numerical relativity waveforms: Results from the first Numerical INjection Analysis (NINJA) project**
22. V. Raymond, M.V. van der Sluys, I. Mandel, V. Kalogera, C. Röver and N. Christensen 2009, CQG 26, 114007: **Degeneracies in Sky Localisation Determination from a Spinning Coalescing Binary through Gravitational Wave Observations: a Markov-Chain Monte-Carlo Analysis for two Detectors**
23. L. Cadonati et al. 2009, CQG 26, 114008: **Status of NINJA: the Numerical INjection Analysis project**
24. M.V. van der Sluys, C. Röver, A. Stroeer, V. Raymond, I. Mandel, N. Christensen, V. Kalogera, R. Meyer and A. Vecchio 2008, ApJ 688, L61: **Gravitational-wave astronomy with inspiral signals of spinning compact-object binaries**
25. M. Politano, R.E. Taam, M.V. van der Sluys, and B. Willems 2008, ApJ 687, L99: **Common Envelope Mergers: A Possible Channel for Forming Single sdB Stars**
26. M.V. van der Sluys, V. Raymond, I. Mandel, C. Röver, N. Christensen, V. Kalogera, R. Meyer and A. Vecchio 2008, CQGra 25, 184011: **Parameter estimation of spinning binary inspirals using Markov-chain Monte Carlo**
27. K. Belczynski, R.E. Taam, E. Rantsiou and M.V. van der Sluys 2008, ApJ 682, 474: **Black-hole spin evolution: implications for short hard gamma-ray bursts and gravitational-wave detection**
28. M.V. van der Sluys, F. Verbunt and O.R. Pols 2006, A&A 460, 209: **Modelling the formation of double white dwarfs**
29. J. in 't Zand, A. Cumming, M. van der Sluys, F. Verbunt and O. Pols 2005, A&A 441, 675: **On the possibility of a helium white dwarf donor in the presumed ultracompact binary 2S 0918-549**

30. M.V. van der Sluys, F. Verbunt and O.R. Pols 2005, *A&A* 440, 973: **Reduced magnetic braking and the magnetic capture model for the formation of ultra-compact binaries**
31. M.V. van der Sluys, F. Verbunt and O.R. Pols 2005, *A&A* 431, 647: **Creating ultra-compact binaries in globular clusters through stable mass transfer**
32. S.-C. Yoon, N. Langer, and M. van der Sluys 2004, *A&A* 425, 207: **On the stability of thermonuclear shell sources in stars**
33. M.V. van der Sluys and H.J.G.L.M. Lamers 2003, *A&A* 398, 181: **The dynamics of the nebula M1-67 around the run-away Wolf-Rayet star WR 124**

### **Refereed LIGO Scientific Collaboration (LSC) publications**

34. Abbott, B. P., et al. 2016, *PhRvX*, 6, 041014: **Improved Analysis of GW150914 Using a Fully Spin-Precessing Waveform Model**
35. Abbott, B. P., et al. 2016, *PhRvL*, 116, 241102: **Properties of the Binary Black Hole Merger GW150914**
36. Aasi, J., et al. 2016, *PhRvD*, 93, 042007: **First low frequency all-sky search for continuous gravitational wave signals**
37. Aasi, J., et al. 2016, *PhRvD*, 93, 042006: **Search of the Orion spur for continuous gravitational waves using a loosely coherent algorithm on data from LIGO interferometers**
38. Abbott, B. P., et al. 2016, *PhRvD*, 93, 042005: **All-sky search for long-duration gravitational wave transients with initial LIGO**
39. Abbott, B. P., et al. 2016, *LRR*, 19, 1: **Prospects for Observing and Localizing Gravitational-Wave Transients with Advanced LIGO and Advanced Virgo**
40. Aasi, J., et al. 2015, *ApJ*, 813, 39: **Searches for Continuous Gravitational Waves from Nine Young Supernova Remnants**
41. Aasi, J., et al. 2015, *CQGra*, 32, 115012: **Characterization of the LIGO detectors during their sixth science run**
42. Acernese, F., et al. 2015, *JPhCS*, 610, 012014: **The Advanced Virgo detector**
43. Accadia, T., et al. 2015, *ppyc.conf*, 261: **Advanced Virgo Interferometer: a Second Generation Detector for Gravitational Waves Observation**
44. Aasi, J., et al. 2015, *PhRvD*, 91, 062008: **Directed search for gravitational waves from Scorpius X-1 with initial LIGO data**
45. Aasi, J., et al. 2015, *PhRvD*, 91, 022004: **Narrow-band search of continuous gravitational-wave signals from Crab and Vela pulsars in Virgo VSR4 data**
46. Aasi, J., et al. 2015, *PhRvD*, 91, 022003: **Searching for stochastic gravitational waves using data from the two colocated LIGO Hanford detectors**
47. Acernese, F., et al. 2015, *CQGra*, 32, 024001: **Advanced Virgo: a second-generation interferometric gravitational wave detector**
48. Aasi, J., et al. 2014, *PhRvL*, 113, 231101: **Improved Upper Limits on the Stochastic Gravitational-Wave Background from 2009-2010 LIGO and Virgo Data**
49. Aartsen, M. G., et al. 2014, *PhRvD*, 90, 102002: **Multimessenger search for sources of gravitational waves and high-energy neutrinos: Initial results for LIGO-Virgo and IceCube**
50. Aasi, J., et al. 2014, *PhRvD*, 90, 062010: **First all-sky search for continuous gravitational waves from unknown sources in binary systems**
51. Accadia, T., et al. 2014, *CQGra*, 31, 165013: **Reconstruction of the gravitational wave signal  $h(t)$  during the Virgo science runs and independent validation with a photon calibrator**
52. Aasi, J., et al. 2014, *PhRvL*, 113, 011102: **Search for Gravitational Waves Associated with  $\gamma$ -ray Bursts Detected by the Interplanetary Network**
53. Aasi, J., et al. 2014, *PhRvD*, 89, 122004: **Methods and results of a search for gravitational waves associated with gamma-ray bursts using the GEO 600, LIGO, and Virgo detectors**

54. Aasi, J., et al. 2014, PhRvD, 89, 122003: **Search for gravitational radiation from intermediate mass black hole binaries in data from the second LIGO-Virgo joint science run**
55. Aasi, J., et al. 2014, CQGra, 31, 115004: **The NINJA-2 project: detecting and characterizing gravitational waveforms modelled using numerical binary black hole simulations**
56. Aasi, J., et al. 2014, PhRvD, 89, 102006: **Search for gravitational wave ringdowns from perturbed intermediate mass black holes in LIGO-Virgo data from 2005-2010**
57. Aasi, J., et al. 2014, PhRvL, 112, 131101: **Constraints on Cosmic Strings from the LIGO-Virgo Gravitational-Wave Detectors**
58. Aasi, J., et al. 2014, CQGra, 31, 085014: **Application of a Hough search for continuous gravitational waves on data from the fifth LIGO science run**
59. Aasi, J., et al. 2014, ApJ, 785, 119: **Gravitational Waves from Known Pulsars: Results from the Initial Detector Era**
60. Aasi, J., et al. 2014, ApJS, 211, 7: **First Searches for Optical Counterparts to Gravitational-wave Candidate Events**
61. Aasi, J., et al. 2013, PhRvD, 88, 102002: **Directed search for continuous gravitational waves from the Galactic center**
62. Aasi, J., et al. 2013, NaPho, 7, 613: **Enhanced sensitivity of the LIGO gravitational wave detector by using squeezed states of light**
63. Abadie, J., et al. 2012, ApJ, 755, 2: **Implications for the Origin of GRB 051103 from LIGO Observations**
64. Abadie, J., et al. 2011, PhRvL, 107, 261102: **Directional Limits on Persistent Gravitational Waves Using LIGO S5 Science Data**
65. Abadie, J., et al. 2011, ApJ, 737, 93: **Beating the Spin-down Limit on Gravitational Wave Emission from the Vela Pulsar**
66. Abadie, J., et al. 2011, PhRvD, 83, 042001: **Search for gravitational waves associated with the August 2006 timing glitch of the Vela pulsar**
67. Abadie, J., et al. 2011, PhRvD, 83, 122005: **Search for gravitational waves from binary black hole inspiral, merger, and ringdown**
68. Abadie, J., et al. 2011, ApJ, 734, L35: **Search for Gravitational Wave Bursts from Six Magnetars**
69. Abadie, J., et al. 2011, PhRvD, 83, 042001: **Search for gravitational waves associated with the August 2006 timing glitch of the Vela pulsar**
70. Abadie, J., et al. 2010, NIMPA, 624, 223: **Calibration of the LIGO gravitational wave detectors in the fifth science run**
71. Abadie, J., et al. 2010, PhRvD, 82, 102001: **Search for gravitational waves from compact binary coalescence in LIGO and Virgo data from S5 and VSR1**
72. Abadie, J., et al. 2010, ApJ, 722, 1504: **First Search for Gravitational Waves from the Youngest Known Neutron Star**
73. Abadie, J., et al. 2010, CQGra, 27, 173001: **TOPICAL REVIEW: Predictions for the rates of compact binary coalescences observable by ground-based gravitational-wave detectors**
74. Abadie, J., et al. 2010, ApJ, 715, 1453: **Search for Gravitational-wave Inspiral Signals Associated with Short Gamma-ray Bursts During LIGO's Fifth and Virgo's First Science Run**
75. Abbott, B. P., et al. 2010, ApJ, 715, 1438: **Search For Gravitational-wave Bursts Associated with Gamma-ray Bursts using Data from LIGO Science Run 5 and Virgo Science Run 1**
76. Abadie, J., et al. 2010, PhRvD, 81, 102001: **All-sky search for gravitational-wave bursts in the first joint LIGO-GEO-Virgo run**
77. Abbott, B. P., et al. 2010, ApJ, 713, 671: **Searches for Gravitational Waves from Known Pulsars with Science Run 5 LIGO Data**
78. Abbott, B. P., et al. 2009, PhRvD, 80, 102002: **Search for high frequency gravitational-wave bursts in the first calendar year of LIGO's fifth science run**

79. Abbott, B. P., et al. 2009, PhRvD, 80, 102001: **Search for gravitational-wave bursts in the first year of the fifth LIGO science run**
80. Abbott, B. P., et al. 2009, PhRvD, 80, 062002: **First LIGO search for gravitational wave bursts from cosmic (super)strings**
81. Abbott, B. P., et al. 2009, PhRvD, 80, 062001: **Search for gravitational wave ringdowns from perturbed black holes in LIGO S4 data**
82. Abbott, B. P., et al. 2009, PhRvD, 80, 047101: **Search for gravitational waves from low mass compact binary coalescence in 186 days of LIGO's fifth science run**
83. Abbott, B. P., et al. 2009, PhRvD, 80, 042003: **Einstein@Home search for periodic gravitational waves in early S5 LIGO data**
84. Abbott, B. P., et al. 2009, Natur, 460, 990: **An upper limit on the stochastic gravitational-wave background of cosmological origin**
85. Abbott, B. P., et al. 2009, ApJ, 701, L68: **Stacked Search for Gravitational Waves from the 2006 SGR 1900+14 Storm**
86. Abbott, B. P., et al. 2009, RPPh, 72, 076901: **LIGO: the Laser Interferometer Gravitational-wave Observatory**
87. Abbott, B., et al. 2009, NJPh, 11, 073032: **Observation of a kilogram-scale oscillator near its quantum ground state**
88. Abbott, B. P., et al. 2009, PhRvD, 79, 122001: **Search for gravitational waves from low mass binary coalescences in the first year of LIGO's S5 data**
89. Abbott, B. P., et al. 2009, PhRvL, 102, 111102: **All-Sky LIGO Search for Periodic Gravitational Waves in the Early Fifth-Science-Run Data**
90. Abbott, B., et al. 2009, PhRvD, 79, 022001: **Einstein@Home search for periodic gravitational waves in LIGO S4 data**
91. Abbott, B., et al. 2008, CQGra, 25, 245008: **First joint search for gravitational-wave bursts in LIGO and GEO 600 data**
92. Abbott, B., et al. 2008, PhRvL, 101, 211102: **Search for Gravitational-wave Bursts from Soft Gamma Repeaters**
93. Abbott, B., et al. 2008, ApJ, 683, L45: **Beating the Spin-Down Limit on Gravitational Wave Emission from the Crab Pulsar**
94. Abbott, B., et al. 2008, CQGra, 25, 114051: **Astrophysically triggered searches for gravitational waves: status and prospects**

## NON-REFEREED PUBLICATIONS

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1. Aasi, J., et al. 2017, yCat, JApJ/785/119: **VizieR Online Data Catalog: Gravitational waves from known pulsars (Aasi+, 2014)**
2. van der Sluys, M. 2011, ASPC, 447, 317: **Gravitational Waves from Compact Binaries**
3. Woods, T. E., Ivanova, N., van der Sluys, M., & Chaichenets, S. 2011, ASPC, 447, 127: **On The Formation of Double White Dwarfs: Reevaluating How We Parametrise the Common Envelope Phase**
4. Woods, T. E., Ivanova, N., van der Sluys, M., & Chaichenets, S. 2010, AIPC, 1314, 24: **The Formation of Low-Mass Double White Dwarfs through an Initial Phase of Stable Non-Conservative Mass Transfer**
5. van der Sluys, M., Politano, M., & Taam, R. E. 2010, AIPC, 1314, 13: **Masses and Envelope Binding Energies of Primary Stars at the Onset of a Common Envelope**
6. The LIGO Scientific Collaboration, et al. 2010, arXiv:1003.2481: **Sensitivity to Gravitational Waves from Compact Binary Coalescences Achieved during LIGO's Fifth and Virgo's First Science Run**
7. Nelemans, G., et al. 2009, astro, 2010, 221: **The astrophysics of ultra-compact binaries**
8. Michael Politano, R.E. Taam, M. van der Sluys and B. Willems, 2009, AAS 21343215: **Mergers During Common Envelope Evolution Involving a Giant Star and a Stellar or Substellar Companion**



9. M.V. van der Sluys, C. Röver, A. Stroeer, N. Christensen, V. Kalogera, R. Meyer, A. Vecchio and I. Mandel 2008, APS APRB10004: **Bayesian inference on spinning compact-binary inspirals with ground-based gravitational-wave laser interferometers**
10. M.V. van der Sluys, A. Stroeer, A. Vecchio and V. Kalogera 2006 AAS 209.7416: **Bayesian Inference and Observations of Massive Black-hole Binaries with LISA**
11. M.V. van der Sluys, F. Verbunt and O.R. Pols 2005, AIPC 797, 627, in *Interacting binaries: accretion, evolution, and outcomes: Creating ultra-compact binaries through stable mass transfer*

## ONLINE PUBLICATIONS

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These documents can be found at [han.vandersluys.nl/pub](http://han.vandersluys.nl/pub), unless specified otherwise.

1. MvdS 2021: **Sunlight and solar energy** (MSc lecture notes)
2. MvdS 2020: **Writing a short scientific paper:  $\LaTeX$  template and instructions**
3. MvdS 2019: **Solar-concentration optics**
4. MvdS 2019: **A brief C tutorial, with code examples**
5. MvdS 2017: **Installing Arch Linux ARM on a Raspberry Pi**
6. MvdS 2017: **Getting started with Emacs**
7. MvdS 2017: **Operating systems and Linux system programming** (BSc Lecture notes)
8. MvdS 2016: **Efficient use of the Linux command line in the Bash shell**
9. MvdS 2015: **Errata NEN 5060 Hygrothermische eigenschappen van gebouwen – Referentieklimaatgegevens** (Errata on Dutch insolation norm)
10. MvdS 2015: **Availability of wind in the Netherlands** (HAN fact sheet)
11. MvdS 2015: **Insolation in the Netherlands** (HAN fact sheet)
12. MvdS 2013: **Celestial mechanics in a nutshell** ([cmians.sf.net](http://cmians.sf.net))
13. MvdS 2003: **Binary evolution in a nutshell** ([www.astro.ru.nl/~sluys/?title=BEiaNS](http://www.astro.ru.nl/~sluys/?title=BEiaNS))

## AUTHORED SCIENTIFIC SOFTWARE PACKAGES

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Most of my free and open-source software (FOSS) has been released under the (L)GPL licence as source code and/or packages and can be found on the following websites:

<b>GitHub</b>	<a href="https://github.com/MarcvdSluys">github.com/MarcvdSluys</a>	Source code
<b>SourceForce</b>	<a href="https://sourceforge.net/u/marcvdsluys">sourceforge.net/u/marcvdsluys</a>	Source code and packages
<b>PyPI</b>	<a href="https://pypi.org/user/MarcvdSluys">pypi.org/user/MarcvdSluys</a>	Python packages

The following list gives a selection of my most relevant, science-related software packages. See [software.vandersluys.nl](http://software.vandersluys.nl) for more open-source projects.

1. LIBSUFR: a library containing Some Useful Fortran Routines, GPL, [libsufr.sf.net](http://libsufr.sf.net) (2002–2021).
2. LIBTHESKY: a library to compute the positions of bodies in **The Sky** (Moon, planets, stars) and events (conjunctions, eclipses), GPL, [libthesky.sf.net](http://libthesky.sf.net); core of the code that generates the popular-astronomy website [hemel.waarnemen.com](http://hemel.waarnemen.com) (2002–2021).
3. SOLTRACK: free, fast and accurate C/C++, Python and Arduino routines to compute the position of the Sun, (L)GPL, [soltrack.sf.net](http://soltrack.sf.net) (2014–2021).
4. SOLARENERGY: a Python package to do simple modelling in the field of solar energy, GPL, [pypi.org/project/solarenergy](https://pypi.org/project/solarenergy) (2020–2021).
5. METEOSERVER: a Python package to obtain and read Dutch weather data from Meteoserver.nl, GPL, [pypi.org/project/meteoserver](https://pypi.org/project/meteoserver) (2020–2021).
6. ASTROTOOL: a Python package for astronomical calculations, GPL, [pypi.org/project/astrotool](https://pypi.org/project/astrotool) (2021).
7. PG2PLPLOT: aids the transition from Fortran code linked against PGPlot to linking it against PLplot, GPL, [pg2plplot.sf.net](http://pg2plplot.sf.net) (2013–2020).

8. HISTASTRO: a Python package for historical-astronomy calculations of Sun, Moon and planets, GPL, [pypi.org/project/histastro](https://pypi.org/project/histastro) (2019–2020).
9. ELP-MPP02: accurate Moon positions using the lunar solution ELP/MPP02 in Python, GPL, [pypi.org/project/elp-mpp02](https://pypi.org/project/elp-mpp02) (2019).
10. ANALYSEMCMC: analyses and presents output from the MCMC codes SPINSPIRAL and LALINFERENCE\_MCMC, GPL, [analysecmcm.sf.net](https://analysecmcm.sf.net) (2006–2017).
11. ASTROTOOLS: assorted command-line tools for astronomy and astrophysics, written in Fortran, GPL, [astrotools.sf.net](https://astrotools.sf.net) (2002–2016).
12. EVTOOLS: tools to reduce, analyse and present output from the binary stellar-evolution code ev, GPL, [evtools.sf.net](https://evtools.sf.net) (2002–2015).
13. GWTOOL: simple command-line tools for working with gravitational waves, GPL, [gwtool.sf.net](https://gwtool.sf.net) (2007–2015).
14. ROCHEPLOT: schematically illustrate the key stages in the evolution of a binary star, several contributions, GPL, [rocheplot.sf.net](https://rocheplot.sf.net) (2012–2015).
15. SPINSPIRAL: a parameter-estimation code to analyse gravitational-wave binary-inspiral signals detected with LIGO/Virgo, including spin effects, GPL, [spinspiral.sf.net](https://spinspiral.sf.net) (2006–2013).
16. EV: also known as STARS, TWIN, or “The Eggleton code”: a detailed binary-stellar evolution code, several contributions, [stars.vandersluys.nl](https://stars.vandersluys.nl) (2005–2011).
17. LALINFERENCE\_MCMC: parameter-estimation code using LAL to analyse GW binary-inspiral signals detected with LIGO/Virgo, several contributions, GPL, [tiny.cc/lal](https://tiny.cc/lal) (2010).

## CONTRIBUTIONS TO CONFERENCES AND WORKSHOPS

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1. April 15, 2013, *Third Bonn workshop on formation and evolution of neutron stars*, Bonn, Germany. Talk: **Measuring neutron-star properties with LIGO and Virgo**
2. August 16, 2012, *EuroWD12*, Krakow, Poland. Talk: **The formation of double white dwarfs**
3. June 25, 2012, *Virgo week 2012*, Pisa, Italy. Talk: **Using astrophysical knowledge in gravitational-wave data analysis of binary inspirals**
4. April 12, 2011, *NOVA Network-3 meeting*, Leiden, The Netherlands. Talk: **Using astrophysical knowledge in gravitational-wave data analysis of binary inspirals**
5. March 11, 2011, *The evolution of compact binaries*, Viña del Mar, Chile. Talk: **Using astrophysical knowledge in gravitational-wave data analysis of binary inspirals**
6. March 9, 2011, *The evolution of compact binaries*, Viña del Mar, Chile. Invited review: **Gravitational waves from compact binaries**
7. January 28, 2011, *GWPAW-15*, Milwaukee, WI, U.S.A. Talk: **Using astrophysical knowledge in gravitational-wave data analysis of binary inspirals**
8. November 5, 2010, *Dutch Physics Society (NvV)*, Lunteren, The Netherlands. Talk: **Using astrophysical knowledge in gravitational-wave data analysis**
9. June 22, 2010, *Binary star evolution: mass loss, accretion and mergers*, Mykonos, Greece. Talk: **Population synthesis of common-envelope mergers on the giant branches**
10. September 29, 2009, *Stellar Mergers workshop*, Leiden, the Netherlands. Talk: **The formation of single sdB stars through common-envelope mergers / Observing BH/NS mergers with LIGO/Virgo**
11. June 4, 2009, *LSC-Virgo meeting*, Orsay, France. Talk (on behalf of the CBC group): **Bayesian inference in the CBC follow-up pipeline**
12. March 17, 2009, *Wild Stars in the Old West II*, Tucson, Az, USA. Talk: **Magnetic capture and the CV formation channel for AM CVn stars**
13. January 19–22, 2009, *GWDaw-13*, San Juan, Puerto Rico. Poster: **Gravitational-wave astronomy using Markov-chain Monte-Carlo parameter estimation for compact binary inspirals with spinning objects**

14. September 20–25, 2008, *LSC-Virgo meeting*, Amsterdam, The Netherlands. Talk: **Dependence of sky-position degeneracies on the detector network and black-hole spin**
15. September 1–5, 2008, *2nd International Workshop on AM CVn stars*, Cape Town, S.A. Talk: **Formation of double white dwarfs and AM CVn stars**
16. June 10, 2008, *LIGO-Virgo meeting*, Orsay, France. Talk: **The effect of spin on the accuracy of parameter estimation of binary black-hole inspirals**
17. April 12, 2008, *American Physical Society Meeting*, St. Louis, Mo, USA. Talk: **Parameter estimation of spinning binary black-hole inspirals using MCMC**
18. March 15–20, 2008, *CBC F2F, LIGO-Virgo meeting*, Caltech, Pasadena, Ca, USA. Talk: **Parameter estimation of spinning binary black-hole inspirals using MCMC on LIGO data**
19. December 13–16, 2007, *GWDAAW 12, MIT*, Boston, Boston, Ma, USA. Poster: **Parameter estimation of spinning binary inspirals using MCMC**
20. October 20–25, 2007, *CBC F2F, LIGO-Virgo meeting*, Hannover, Germany. Talk: **Bayesian follow-up in the CBC pipeline**
21. August 29 – 31, 2005: Workshop: *Modest 6*, Evanston, Il, USA. Poster: **Creating ultra-compact X-ray binaries in globular clusters**
22. July 4 – 8, 2005 *Workshop on AM CVn Stars*, Nijmegen, The Netherlands. Talk: **Modelling the evolution of double white-dwarf systems**
23. December 15 – 17, 2004: Workshop: *Modest 5a*, Edinburgh, Scotland. Talk: **Creating ultra-compact binaries in globular clusters through stable mass transfer**
24. July 4 – 10, 2004: Conference: *Interacting binaries*, Cefalù, Sicily, Italy. Poster: **Creating ultra-compact binaries through stable mass transfer**

#### SELECTED TALKS FOR COLLOQUIA, SEMINARS AND GROUP MEETINGS

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1. March 21, 2012, Centro de Astrofísica, Universidad de Valparaíso, Chile, Astrophysics colloquium: **Compact binaries and gravitational waves**
2. March 20, 2012, ESO Vitacura office, Santiago, Chile, Astrophysics colloquium: **Compact binaries and gravitational waves**
3. May 12, 2010, Astronomical Institute/SRON, Utrecht University, Astrophysics Colloquium: **Gravitational-wave astronomy with LIGO and Virgo**
4. May 11, 2010, Astron, Dwingeloo, the Netherlands, Colloquium: **Population synthesis of common-envelope mergers on the giant branches**
5. May 4, 2010, Max Planck Institute for Astrophysics, Garching, Germany, Astrophysics seminar: **Population synthesis of common-envelope mergers on the giant branches**
6. May 3, 2010, Innsbruck University, Astrophysics colloquium: **Gravitational-wave astronomy with LIGO and Virgo**
7. April 29, 2010, Leiden Observatory, Leiden University, Astrophysics colloquium: **Gravitational-wave astronomy with LIGO and Virgo**
8. April 27, 2010, Department of astrophysics, Radboud Universiteit Nijmegen, Astrophysics seminar: **Gravitational-wave astronomy with LIGO and Virgo**
9. March 11, 2010, Canadian Institute for Theoretical Astrophysics, University of Toronto, CITA seminar: **Gravitational-wave astronomy with LIGO and Virgo**
10. March 3, 2010, Department of physics & astronomy, McMaster University, astrophysics seminar: **Population synthesis of common-envelope mergers on the giant branches**
11. January 11, 2010, Department of physics & astronomy, University of British Columbia, astrophysics colloquium: **Population synthesis of common-envelope mergers on the giant branches / Gravitational-wave astronomy with LIGO and Virgo**
12. March 27, 2008, Center for gravitational-wave physics, Penn State University, seminar: **Parameter estimation of spinning binary black-hole inspirals using MCMC**

13. October 19, 2007, University of Birmingham, Gravity group meeting: **The formation of ultra-compact binaries in globular clusters**
14. October 4, 2007, Northwestern University, Theoretical astrophysics group meeting: **Parameter estimation of spinning binary black-hole inspirals using MCMC**
15. October 19, 2006, Northwestern University, Theoretical astrophysics group meeting: **How the Giant lost its mantle and became a Dwarf**
16. October 7, 2004, Student Seminar, Utrecht University: **How not to create ultra-compact binaries in globular clusters**
17. December 4, 2003, Student Seminar, Utrecht University: **No double white dwarfs from stable mass transfer**
18. December 17, 2002, Astrophysical Seminar, University of Innsbruck: **Backward evolutionary calculations to explain double white dwarf systems**
19. March 27, 2002, Colloquium, University of Innsbruck: **The dynamics of the nebula M1-67 around the run-away Wolf-Rayet star WR 124**
20. August 27, 2001, Graduation Talk, Utrecht University: **A bowshock model for the run-away Wolf-Rayet star WR124**

## EDITOR OF CONFERENCE PROCEEDINGS

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1. **International conference on binaries**, in celebration of Ron Webbink's 65<sup>th</sup> birthday, Mykonos, Greece, 22–25 June 2010. Editors: Vicky Kalogera and Marc van der Sluys. Melville, New York, 2010, AIP Conference Proceedings 1314.

## POPULAR TALKS AND LECTURES SINCE 2009:<sup>1</sup>

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1. 26 March 2021, Public observing night, Radboud University Nijmegen:  
**The night sky this summer**
2. 26 February 2021, Public observing night, Radboud University Nijmegen:  
**The night sky in March**
3. 29 January 2021, Public observing night, Radboud University Nijmegen:  
**The night sky in February**
4. 12 February 2020, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**
5. 17 October 2019, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**
6. 5 October 2019, Space expo Noordwijk, Science week 2019:  
**Lecture: We are made of stardust!**
7. 13 February 2019, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**
8. 11 November 2018, InScience Film Festival 2018, Nijmegen:  
**Short lecture: Cielo, and our connection to the cosmos**
9. 18 October 2018, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**
10. 22 April 2018, Sonnenborgh – museum & observatory, Utrecht:  
**MuseumYouthUniversity: How can you 'hear' black holes?**
11. 22 February 2018, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**
12. 11 October 2017, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**
13. 16 February 2017, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**

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<sup>1</sup>See [hemel.waarnemen.com/lezingen/](http://hemel.waarnemen.com/lezingen/) for a more complete list of my ~ 145 public lectures

14. 12 October 2016, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**
15. 31 March 2016, HAN University of Applied Sciences, Arnhem:  
**Lunch lecture: GW 150914: the first detection of gravitational waves**
16. 1 March 2016, HAN University of Applied Sciences, Arnhem:  
**Lunch lecture: GW 150914: the first detection of gravitational waves**
17. 18 February 2016, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**
18. 18 February 2016, Sonnenborgh – museum & observatory, Utrecht:  
**Short lecture: GW 150914: the first detection of gravitational waves**
19. 15 October 2015, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**
20. 15 March 2015, IMC Weekend school, Nijmegen:  
**Guest lecture: The Sun and sunlight**
21. 18 February 2015, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**
22. 11 January 2015, Sonnenborgh – museum & observatory, Utrecht:  
**Minicourse Astronomy**
23. 28 November 2014, Public observing night, Radboud University Nijmegen:  
**Lecture: Stars, galaxies and gravitational waves**
24. 28 November 2014, Public observing night, Radboud University Nijmegen:  
**Lecture: We are made of stardust!**
25. 28 October 2014, Public observatory, Amsterdam:  
**Lecture: Compact binaries and gravitational waves in our universe**
26. 9 October 2014, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**
27. 13 March 2014, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**
28. 16 October 2013, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**
29. 5 October 2013, Flemish Astronomers Club, Blankenberge, Belgium:  
**Lecture: Compact binaries and gravitational waves in our universe**
30. 22 March 2013, Public observing night, Radboud University Nijmegen:  
**Lecture: Stars, galaxies and gravitational waves**
31. 22 March 2013, Public observing night, Radboud University Nijmegen:  
**Lecture: We are made of stardust!**
32. 26 October 2012, Public observing night, Radboud University Nijmegen:  
**Lecture: Stars, galaxies and gravitational waves**
33. 18 October 2012, Thales, Zwolle:  
**Lecture: Compact binaries and gravitational waves in our universe**
34. 10 October 2012, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**
35. 21 May 2012, Astra Alteria, Putten:  
**Lecture: Compact binaries and gravitational waves in our universe**
36. 28 April 2012, Halley Observatory, Heesch:  
**Lecture: Compact binaries**
37. 30 March 2012, Public observing night, Radboud University Nijmegen:  
**Lecture: The Sun**

38. 16 February 2012, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**
39. 27 January 2012, Public observing night, Radboud University Nijmegen:  
**Lecture: We are made of stardust!**
40. 12 October 2011, Sonnenborgh – museum & observatory, Utrecht:  
**Course: The Sun**
41. 15 June 2011, Dutch Astronomy Olympiad, Radboud University Nijmegen:  
**Lecture: Supernovae and supernova remnants**
42. 8 April 2011, Students association Marie Curie, Radboud University Nijmegen:  
**Lecture: Compact binaries, explosions and gravitational waves in our universe**
43. 12 October 2010 Wessel Knoop, Arnhem:  
**Lecture: Compact binaries and gravitational waves in our universe**
44. 25 July 2009 Adler planetarium, Chicago:  
**Lecture: Gravitational waves with LIGO and Virgo**
45. 16 July 2009 Adler planetarium, Chicago:  
**Lecture: Gravitational waves with LIGO and Virgo**