

Thomas G. Wilson

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Education

University College London, UK
Ph.D. Physics & Astronomy, 2019
Thesis Title: *On the Formation, Evolution, and Destruction of Minor Planetary Bodies*
Supervisors: Jonathan M. C. Rawlings, Jay Farihi, Bruce M. Swinyard

International Space University, France
M.Sc. Space Studies, 2013
Supervisor: Chris Welch

Cardiff University, UK
M.Phys Astrophysics, 2012
Supervisor: Edward Gomez

Areas of Interest

Exoplanetary systems, Solar System comets and asteroids, planetary debris disks, white dwarfs

Research Experience

Research Fellow, University of St Andrews, U.K., 2019-present

Working on the detection and characterisation of exoplanets with a focus on Earth-like planets using *TESS*, *HARPS-N*, and the upcoming *CHEOPS* telescopes and instruments.

Post-Graduate Student Researcher, University College London, U.K., 2014–2019

Performed analysis, including aperture, PSF, and synthetic photometry, SED fitting, and infrared excess calculations, on *Spitzer* IRAC observations of 236 white dwarfs in order to determine the frequency of debris disks. *Gaia* astrometric data has been used to search for binary companions to the white dwarf sample (Wilson, Farihi, Gänsicke, & Swan, 2019, *MNRAS*, vol. 487, p. 133).

Determined long- and short-term infrared flux and colour variations of circumstellar debris disks around white dwarfs on the 0.1 percent level using *Spitzer* and *WISE* observations by querying the large *WISE* IRSA database. Differential photometry was conducted on 40 white dwarfs using automated PSF photometry of all field stars in the images (Swan, Farihi, & Wilson, 2019, *MNRAS*, vol. 484, p. 109; Farihi et al., 2018, *MNRAS*, vol. 481, p.2601; Xu et al. 2018, *ApJ*, vol. 866).

Developed and utilised the CRETE radiative transfer model (de Val-Borro & Wilson, 2016, *Astrophysics Source Code Library*, record ascl:1612.009) to analyse the astrophysical and astrochemical water environments of four cometary comae observed with *Herschel* SPIRE (Wilson, Rawlings, & Swinyard, 2017, *MNRAS*, vol. 466, p. 1954).

Reduced and performed quality assurance analysis on VLT UVES spectra of 24 carbon-dominated white dwarf stars, and select other, so-far unpublished, polluted white dwarfs.

Analysed the O₂ to H₂O ratio in comet 67P/Churyumov-Gerasimenko, as determined by *Rosetta*, using astrochemical models simulating comet formation conditions (Rawlings, Wilson, & Williams, 2019, *MNRAS*, vol. 486, p. 10).

Conducted 32 nights of photometric and spectroscopic observations at the VLT, Keck, WHT, INT, and Mercator telescopes primarily for radial velocity variation and lightcurve analysis studies.

Isaac Newton Telescope Student Support Astronomer, Isaac Newton Group, Spain, 2017–2018

Helped develop the NEARBY moving source detection platform via live, on-sky testing in order to detect asteroids, with three new NEAs discovered (Vaduvescu, Popescu, Wilson, & Davison, MPEC, 2018, 2018-V09; Vaduvescu, Popescu, Wilson, & Davison, MPEC, 2018, 2018-V45; Vaduvescu et al. submitted)

Conducted high-cadence photometric observations on 18 nights to discovery and characterise physical characteristics of Near-Earth Asteroids using the INT and Mercator telescopes, with analysis of the lightcurves currently ongoing (Aznar, Vaduvescu, Wilson, & Zegmott, CBET, 2018, #4523).

Leading a team to observe and characterise the target of a potential future JAXA space mission; asteroid 2005UD, using TNG NICS, and INT IDS and WFC.

Conducted ~50 support and service nights at the INT in which I gained a lot of knowledge about telescope maintenance and problem solving, and observation planning.

ESAC Trainee Researcher, European Space Astronomy Centre, Spain, 2013–2014

Developed the boloSource code (Wilson & Vavrek, 2013, ESA Herschel Science Archive) for the removal of embedded sources in *Herschel* PACS images in order to provide a tool to the community to study the observed diffuse background. Aspects of the code included source identification, removal, and background interpolation to preserve the statistical properties of the background.

Visiting Researcher, NASA Goddard Space Flight Center, U.S.A, 2013

Interferometrically determined the optical imaging properties of off-axis parabolic mirrors in an instrumentational hardware simulation in order to demonstrate feasibility for inclusion in the Visible Nulling Coronagraph Testbed.

Graduate Student Researcher, International Space University, France, 2012-2013

Undertook radio observations in order to determine the thermal response of the lunar regolith in relation to the lunar phase.

Undergraduate Student Researcher, Cardiff University, U.K, 2008-2012

Performed aperture and differential photometry on high-cadence observations of exoplanet systems, using the GAIA image analysis tools, in order to detect additional planets via transit timing variation. Observations taken at the Las Cumbres Observatory were fitted with transit models.

Visiting Undergraduate Student Researcher, Universiteit Gent, Belgium, 2011

Conducted computational fluid dynamics simulations using the GAMBIT and Fluent codes in order to study the effect of plasma temperature on the morphology of air bubbles in a water medium.

Observing Experience

80 nights observing experience (32 as the observer, 48 as a support astronomer)

Observer

Spectroscopic Follow-Up of Metal-Poor Star Candidates from Pristine

- Intermediate Dispersion Spectrograph (IDS), Isaac Newton Telescope
2018B, 3 nights, PI: Eline Tolstoy

Testing the EURONEAR Automated Moving Source Detection Pipeline

- Wide Field Camera (WFC), Isaac Newton Telescope
2018B, 2 nights, PI: Ovidiu Vaduvescu

INT Global Observing Campaign of JAXA Target 2005UD; Spectroscopy

- Intermediate Dispersion Spectrograph (IDS), Isaac Newton Telescope
2018B, 0.5 nights, PI: Thomas Wilson

Constraining Orbital Periods of Carbon-Rich Dwarf Stars

- Intermediate dispersion Spectrograph and Imaging System (ISIS), William Herschel Telescope
2018B, 3 nights, PI: Thomas Wilson

Continuing the EURONEAR Lightcurve Survey of Near Earth Asteroids

- Wide Field Camera (WFC), Isaac Newton Telescope & Mercator Advanced Imager for Asteroseismology (MAIA), Mercator Telescope
2018A, 2018B, 16 nights, PI: Ovidiu Vaduvescu

Follow-Up Observations Probing SDSS ELM Candidates

- Intermediate Dispersion Spectrograph (IDS), Isaac Newton Telescope
2018A, 2018B, 1 night, PI: Thomas Wilson

An Exploratory Search for Further Disintegrating Asteroids Around White Dwarfs

- Wide Field Camera (WFC), Isaac Newton Telescope
2018A, 2018B, 0.5 nights, PI: Thomas Wilson

Optical Observations of PG1132+471 to Determine White Dwarf Infrared Flux

- Wide Field Camera (WFC), Isaac Newton Telescope
2018A, 0.5 nights, PI: Thomas Wilson

The Origin of Dwarf Carbon Stars: Orbital Periods and Mass Transfer

- Intermediate dispersion Spectrograph and Imaging System (ISIS), William Herschel Telescope
2017B, 2 nights, PI: Jay Farihi

The History of Star and Planet Formation: A Search for Substellar Companions to Cool Subdwarfs

- Spectro-Polarimetric High-contrast Exoplanet REsearch (SPHERE), Very Large Telescope
97A, 2.5 nights, PI: Carolina Bergfors

A Chemical Inventory of Planetary Debris in the First Known Polluted White Dwarf with a Circumbinary Disk

- HIgh Resolution Echelle Spectrometer (HIRES), Keck Telescope
2016A, 1 night, PI: Seth Redfield

The following are a list of the programs I am PI or Co-I of, but did not observe on:*Targeting the Low-End of the NEA Brightness Distribution: the INT 1000 Square Degrees Survey*

- Wide Field Camera (WFC), Isaac Newton Telescope
2019B, PI: Ovidiu Vaduvescu

Dust Recycling over the 2 hour Period of a White Dwarf Planetesimal

- InfraRed Array Camera (IRAC), Spitzer Space Telescope
Cycle 14 - DDT, PI: Thomas Wilson

The Second Life of Planetary Systems: Youthful Variability in White Dwarf Debris Disks

- InfraRed Array Camera (IRAC), Spitzer Space Telescope
Cycle 14 - DDT, PI: Jay Farihi

Differentiating Mass Transfer Mechanisms in Carbon-Rich Dwarf Stars

- Intermediate dispersion Spectrograph and Imaging System (ISIS), William Herschel Telescope
2019A, PI: Thomas Wilson

INT Global Observing Campaign of JAXA Target 2005UD; Photometric Lightcurve

- Wide Field Camera (WFC), Isaac Newton Telescope
2018B, PI: Thomas Wilson

INT Global Observing Campaign of JAXA Target 2005UD; Photometric Colours

- Wide Field Camera (WFC), Isaac Newton Telescope

2018B, PI: Thomas Wilson

A Changing Legacy for Dead Rock Stars

- InfraRed Array Camera (IRAC), Spitzer Space Telescope

Cycle 13 - DDT, PI: Jay Farihi

Support astronomer

Multiple programmes

- Long-slit Intermediate Resolution Infrared Spectrograph (LIRIS), William Herschel Telescope

2018A, 0.5 nights

Multiple programmes

- Auxiliary-port CAMera (ACAM), William Herschel Telescope

2018A, 0.5 nights

Multiple programmes

- Intermediate Dispersion Spectrograph (IDS), Isaac Newton Telescope

2017B, 2018A, 2018B, 30 nights

Multiple programmes

- Wide Field Camera (WFC), Isaac Newton Telescope

2017B, 2018A, 2018B, 17 nights

Publications

First author

Wilson, T. G., Farihi, J., Gänsicke, B. T., & Swan. A. *The unbiased frequency of planetary signatures around single and binary white dwarfs using Spitzer and Hubble*, MNRAS, 2019, Volume 487, Issue 1, Page 133

Wilson, T. G., Rawlings, J. M. C., & Swinyard, B. M. *Herschel/SPIRE Observations of Water Production Rates and Ortho-to-Para Ratios in Comets*, MNRAS, 2017, Volume 466, Issue 2, Page 1954

Co-author

Aguado, D. S., Youakim, K., González Hernández, J. I., Allende Prieto, C., Starkenburg, E., Martin, N., Bonifacio, P., Arentsen, A., Caffau, E., Peralta de Arriba, L., Sestito, F., Garcia-Diaz, R., Fantin, N., Hill, V., Jablonca, P., Jahandar, F., KIELTY, C., Longeard, N., Lucchesi, R., Sánchez-Janssen, R., Osorio, Y., Palicio, P. A., Tolstoy, E., **Wilson, T. G.**, Côté, P., Kordopatis, G., Lardo, C., Navarro, J. F., Thomas, G. F., Venn, K. *The Pristine Survey – VII. The First Three Years of Medium Resolution Follow-Up Spectroscopy of Pristine EMP Star Candidates*, accepted

Vaduvescu, O., Gorgan, D., Copandean, D., Bacu, V., Stefanut, T., Sabou, A., Nandra, C., Boldea, C., Pinter, V., Popescu, M., Petrescu, E., Bertesteanu, D., Davison, T., Pérez Toledo, F. M., Boldea, A., Predatu, M., Zegmott, T., **Wilson, T. G.**, Hudin, L., Stanescu, M., Stanica, A., Buhulea, A., Stoica, A., Timpea, A., Anghel, S., Ciobanu, D., Toma, R., Casanova, V., Stecklum, B., Choque-Challapa, N., Short, P., & Tudorica, A. *Ready for EURONEAR NEA Surveys using the NEARBY Moving Source Detection Platform*, submitted

Rawlings, J. M. C., **Wilson, T. G.**, & Williams, D. A. *A Gas-Phase Primordial Origin of O₂ in Comet 67P/Churyumov-Gerasimenko*, MNRAS, 2019, Volume 486, Issue 1, Page 10

Swan, A., Farihi, J., & **Wilson, T. G.** *Most White Dwarfs with Detectable Dust Discs show Infrared Variability*, MNRAS, 2019, Volume 484, Issue 1, Page 109

- Vaduvescu, O., Popescu, M., **Wilson, T. G.**, & Davison, T. *2018 VQ1*, MPEC, 2018, 2018-V45
- Vaduvescu, O., Popescu, M., **Wilson, T. G.**, & Davison, T. *2018 VE*, MPEC, 2018, 2018-V09
- Farihi, J., van Lieshout, R., Cauley, P. W., Dennihy E., Su, K. Y. L., Kenyon, S. J., **Wilson, T. G.**, Toloza, O., Gänsicke, B. T., von Hippel, T., Redfield, S., Debes, J. H., Xu, S., Rogers, L., Bonsor, A., Swan, A., Pala, A. F., & Reach, W. T. *Dust Production and Depletion in Evolved Planetary Systems*, MNRAS, 2018, Volume 481, Issue 2, Page 2601
- Xu, S., Su, K. Y. L., Rogers, L., Bonsor, A., Olofsson, J., Veras, D., van Lieshout, R., Dufour, P., Green, E. M., Schlawin, E., Farihi, J., **Wilson, T. G.**, Wilson, D. J., & Gänsicke, B. T. *Infrared Variability of Two Dusty White Dwarfs*, ApJ, 2018, Volume 866, Issue 2
- Whitehouse, L. J., Farihi, J., Green, P., **Wilson, T. G.**, & Subasavage, J. P. *Dwarf Carbon Stars are Likely Metal-Poor Binaries and Unlikely Hosts to Carbon Planets*, MNRAS, 2018, Volume 479, Issue 3, Page 3873
- Aznar, A., Vaduvescu, O., **Wilson, T. G.**, & Zegmott, T. (15745) *Yuliya*, CBET, 2018, #4523
- Hussein, A. A., Silva-Martinez, J., & **Wilson, T. G.** *From Project Management to Planetary Defense: Implementation of a Systems Engineering Approach Using Integrated Product and Process Development (IPPD)*, IEEE AERO EL SYS MAG, 2018, Volume 33, Issue 1, Page 6
- Chubb, K., Hood, R., **Wilson, T. G.**, Holdship, J., & Hutton, S. *Discovering New Variable Stars at Key Stage 3*, PHYS. EDUC., 2017, Volume 52, Issue 3

Grants Awarded

- Isaac Newton Group Studentship
- To complete the Isaac Newton Group Studentship in La Palma, Spain.
- Royal Astronomical Society Grant - £ 960
- To attend and present at Asteroids, Comets, Meteors 2017 conference in Montevideo, Uruguay.
- University College London - Postgraduate Training Committee Travel Grant - £ 250
- To attend and present at Asteroids, Comets, Meteors 2017 conference in Montevideo, Uruguay.
- University College London - Postgraduate Training Committee Travel Grant - £ 250
- To observe at the European Southern Observatory's Very Large Telescope.
- Science and Technology Facilities Council Ph.D Scholarship
- To complete a Ph.D in Physics and Astronomy at University College London.
- European Space Agency Traineeship
- To undertake a traineeship at the European Space Astronomy Centre in Madrid, Spain.

Presentations

- "The Life of a Planetary System"*, Berlin Astronomy Outreach Seminar, Berlin Astronomy and Astrophotography, Germany, 2019
- "On the Formation, Evolution, and Destruction of Minor Planetary Bodies"*, Isaac Newton Group Seminar, Isaac Newton Group, Spain, 2018
- "Planetary Debris Disk Frequencies & Herschel Observations of Non-Typical Cometary Water Ortho-to-Para Ratios"*, Centre for Planetary Science Summer Meeting, University College London, U.K, 2017
- "Herschel/SPIRE Observations of Water Production Rates and Ortho-to-Para Ratios in Comets"*, Origins of Solar Systems - Gordon Research Conference, Mount Holyoke College, U.S.A, 2017
- "Herschel/SPIRE Observations of Water Production Rates and Ortho-to-Para Ratios in Comets"*, Asteroids, Comets, Meteors 2017, Universidad de la República, Uruguay, 2017

"An Extended Unbiased Survey to Determine the Frequency of White Dwarf Debris Disks", Planetary Systems Beyond The Main Sequence II, Technion – Israel Institute of Technology, Israel, 2017

"Herschel/SPIRE Observations of Water Production Rates and Ortho-to-Para Ratios in Comets", Scottish Planetary Research Network (SPERO), The University of Edinburgh, U.K, 2017

"Herschel/SPIRE Observations of Water Production Rates and Ortho-to-Para Ratios in Comets", UK Planetary Forum, The University of Manchester, U.K, 2017

"Water Production Rates of the Oort Cloud and Jupiter Family Comets Observed by Herschel/SPIRE", National Astronomy Meeting, The University of Nottingham, U.K, 2016

"Water Production Rates Of Long- And Short-Period Comets Observed by Herschel/SPIRE", Water in the Universe, European Space Research and Technology Centre, The Netherlands, 2016

"Determining the Imaging Properties of Off Axis Parabolas for Use in the Visible Nulling Coronagraph Testbed", 2013 Summer Intern Session, NASA Goddard Space Flight Center, U.S.A, 2013

"Phobos Next: Human Exploration of Mars from Martian Orbit", Humans 2 Mars Summit, George Washington University Space Policy Institute, U.S.A, 2013

Teaching

Students Co-Supervised

Sheila Long, M.Sc in Astrophysics, University College London, U.K 2016-2017

Giuseppe Ussia, visiting summer intern, University College London, U.K 2017

Lectures Given

"Understanding Alien Worlds", International Space University Space Studies Program 2017, Cork Institute of Technology, Ireland, 2017

"Understanding Alien Worlds", International Space University Space Studies Program 2015, Ohio University, U.S.A, 2015

Teaching Positions Held

Lab Demonstrator for the PHAS1240 course - Computing, University College London, U.K, 2015-2017

Lab Demonstrator for the PHAS1130 course - Practical Astronomy, University College London, U.K, 2015-2017

Teaching Associate for the Planetary Defence Team Project, Ohio University, U.S.A, 2015

Teaching Associate for the Exoplanets Team Project, École de Technologie Supérieure (ÉTS), Canada, 2014

Telescope Training

Trained five graduate students on the Isaac Newton Telescope using the IDS instrument, Spain, 2018

Public Outreach

Conducted multiple tours of the Isaac Newton Telescope to general public and local students, Spain, 2017-2018

Provided tours of the University College London Observatory as part of the Centre for Planetary Science Summer Meeting, U.K, 2017

Organised and ran 10-week long practical astronomy course to teach 10/11 year old high school students basic astronomy, and asteroid and variable star detection methods. In collaboration and funded by the Mayor's Fund for London, U.K, 2015-2017

Services

Departmental Services

Graduate Student Representative, 2014-2017

Events Organized

Journal Club Organiser, University College London, 2015-2016

Meet-the-Speaker Coordinator, University College London, 2015-2017

Ph.D Interview Student Help Coordinator, University College London, 2015-2016

Skills

Data Analysis

Large astronomical datasets (*Gaia*DR2, IRSA)

Photometric and spectroscopic data reduction (HIPE, Reflex, Gasgano, IRAF, MOPEX, and SExtractor)

Mutli-wavelength data reduction and analysis (optical, infrared, and sub-millimetre)

Radiative transfer modeling

SED fitting and infrared excess determination

Aperture, PSF, synthetic and differential photometry

High-cadence photometric observations and lightcurve analysis

Programming

Expert: Python, Latex, Shell scripting

Intermediate: Fortran77/90, C++, JavaScript, HTML/CSS, SQL/ADQL, Jython, Git

Infrequent use: C#, IDL, Java

Project Management

PI of one *Spitzer*, two WHT programs, and six INT proposals.

Leading two separate teams to study the physical and orbital properties of asteroids and comets.

Team project management of two 30+ people teams for Exoplanet and Planetary Defense projects.

Languages

English — expert (native)

Spanish — intermediate

French — beginner

References

Prof. Jonathan M. C. Rawlings, University College London, U.K

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Dr. Ovidiu Vaduvescu, Isaac Newton Group, Spain

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Prof. Ian Howarth, University College London, U.K

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