

Tim Cunningham

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Postdoctoral Research Fellow in astronomy and astrophysics at the University of Warwick, utilising multi-dimensional radiation-hydrodynamics to study convection in degenerate stars and white dwarf populations. Experienced observer with spectroscopic and photometric expertise. Commitment to leadership roles and contributions to various outreach and teaching opportunities.

Academic Qualifications

University of Warwick

Coventry, UK

Group: *Astronomy and Astrophysics*
Thesis: *Convective overshoot in the atmosphere of white dwarf stars*
Supervisor: *Pier-Emmanuel Tremblay*

Ph.D. in Physics

September 2020

King's College London

London, UK

Reading: *Physics*
Class: *First Class Honors*

MSci in Physics

September 2014

Professional Appointments

University of Warwick

Coventry, UK

Postdoctoral Research Fellow

July 2020 – present

University of California, Santa Barbara

Santa Barbara, CA, US

Research Assistant

Apr – Sept 2013

Publications (with links)

As Lead Author.....

Cunningham, T., Wheatley, P. J., Tremblay, P.-E., et al. 2022 **Nature** 602 219 2022

A White Dwarf Accreting Planetary Material Determined from X-ray Observations

Cunningham, T., Tremblay, P.-E., Bauer, E., et al. 2021 **MNRAS**, 503, 1646 2021

Horizontal Spreading of Planetary Debris Accreted by White Dwarfs

Cunningham, T., Tremblay, P.-E., Gentile Fusillo, N. P., et al. 2020 **MNRAS**, 492, 3540 2020

From Hydrogen to Helium: The Spectral Evolution of White Dwarfs as Evidence for Convective Mixing

Cunningham, T., Tremblay, P.-E., Freytag, B., et al. 2019 **MNRAS**, 488, 2503 2019

Convective Overshoot and Macroscopic Diffusion in Pure-Hydrogen-Atmosphere White Dwarfs

Cunningham T., Wolf W. M. & Bildsten L. 2015 **ApJ**, 803, 76 2015

Photoionization Heating of Nova Ejecta by the Post-Outburst Supersoft Source

As Co-Author.....

- O'Brien, M. W., et al. 2022. Submitted to **MNRAS**. 2022
Gaia white dwarfs within 40 pc III: spectroscopic observations of new candidates in the southern hemisphere
- Elms, A. K., et al. 2022 **MNRAS**. Accepted. 2022
Spectral analysis of ultra-cool white dwarfs polluted by planetary debris
- Raddi, R., et al. 2022 **A&A** 658 A22 2022
Kinematic properties of white dwarfs. Galactic orbital parameters and age-velocity dispersion relation
- Rebassa-Mansergas, A., et al. 2021 **MNRAS** 505 3165 2021
Constraining the solar neighbourhood age-metallicity relation from white dwarf-main sequence binaries
- Veras, D., et al. 2021 **MNRAS** 506 1148 2021
The entry geometry and velocity of planetary debris into the Roche sphere of a white dwarf
- McCleery, J., et al. 2020 **MNRAS** 499 1890 2020
Gaia white dwarfs within 40 pc II: the volume-limited Northern hemisphere sample
- Tremblay, P.-E., et al. 2020 **MNRAS**, 497, 130 2020
Gaia White Dwarfs within 40 pc I: Spectroscopic Observations of New Candidates
- McCleery, J., et al. 2020 **MNRAS**. Accepted. 2020
Gaia White Dwarfs within 40 pc II: The Volume-limited Northern Hemisphere Sample
- Green, M. J., et al. 2020 **MNRAS**, 496, 1243 2020
Spectroscopic and Photometric Periods of Six Ultracompact Accreting Binaries
- Tremblay, P.-E., et al. 2019 **MNRAS**, 482, 5222 2019
Fundamental Parameter Accuracy of DA and DB White Dwarfs in Gaia Data Release 2
- Gentile Fusillo, N. P., et al. 2019 **MNRAS**, 482, 4570 2019
A Gaia Data Release 2 catalogue of white dwarfs and a comparison with SDSS
- Tremblay, P.-E., et al. 2019 **Nature**, 565, 202 2019
Core Crystallization and Pile-up in the Cooling Sequence of Evolving White Dwarfs

Telescope Time Awarded as PI

- Chandra*: Cycle 24 (#24200446) – 35 hours (125 ks) with HRC-I 2022
“Constraining the time-dependent accretion rate of a novel class of X-ray source”
- Chandra*: Cycle 22 (#22200039) – 32 hours (115 ks) with ACIS-S 2020
“First X-rays from white dwarf planet accretion: a definitive test of convective overshoot”

Professional Service

- Journal referee: 2021-

- Astronomy & Astrophysics (A&A)
- Monthly Notices of the Royal Astronomical Society (MNRAS)

Session organiser – National Astronomy Meeting 2022, Warwick, 11–15 July 2022

- 1) *“Know Your Neighbour: White Dwarf Researchers in the UK”*
- 2) *“3D Hydrodynamics and Magnetohydrodynamics: Stars and their Environment”*

Session chair – National Astronomy Meeting 2019, Lancaster, 30 June–4 July 2019

- 1) *“Current Developments in Numerical Astrophysics”*

Contributed Presentations

Talks.....

University of Cambridge <i>Exoplanet Seminar, Cavendish Astrophysics/Institute of Astronomy – [seminar]</i>	Cambridge, UK <i>October 2022</i>
Armagh Observatory & Planetarium <i>Astronomy Group – [seminar]</i>	Armagh, NI <i>September 2022</i>
UKEXOM 2022 <i>UK Exoplanet Community Meeting – [talk]</i>	Edinburgh, UK <i>September 2022</i>
EUROWD22 <i>22nd European Workshop on White Dwarfs – [talk]</i>	Tübingen, Germany <i>August 2022</i>
Ohio State University <i>Exoplanet Group – [seminar]</i>	Ohio, US <i>August 2022</i>
X-ray Astronomy UK <i>X-ray Astronomy Meeting UK – [talk]</i>	Leicester, UK <i>May 2022</i>
AASTCS 9: Exoplanets IV <i>Exoplanets IV – [talk, plenary session]</i>	Las Vegas, US <i>May 2022</i>
Keele University <i>Astrophysics Group Seminar</i>	Keele, UK <i>January 2022</i>
Imperial College London <i>Astrophysics Group Seminar</i>	London, UK <i>December 2021</i>
KITP <i>Transport in Stellar Interiors – [panel discussion on chemical mixing]</i>	California, US <i>November 2021</i>
KITP <i>Probes of Transport in Stars – [talk]</i>	California, US <i>November 2021</i>
O-MESS <i>Online - Meetings on Evolved Stars and Systems</i>	Potsdam, DE <i>June 2021</i>
KITP <i>KITP Online Reunion Conference: Exostar Redux – [talk]</i>	Santa Barbara, California, US <i>August 2020</i>
NORDITA <i>(CANCELLED) The Shifting Paradigm of Stellar Convection: from mixing...</i>	Stockholm, Sweden <i>March 2020</i>

MPIA <i>Bergemann Stars Group Meeting</i>	Heidelberg, Germany <i>November 2019</i>
KITP <i>Bildsten Stellar Group Meeting</i>	Santa Barbara, California, US <i>November 2019</i>
IAUS 357 <i>White dwarfs as probes of fundamental physics and...</i>	Hilo, Hawaii, US <i>October 2019</i>
CCC2019 <i>Compressible Convection Conference</i>	Newcastle, UK <i>September 2019</i>
NAM2019 <i>National Astronomy Meeting</i>	Lancaster, UK <i>July 2019</i>
EuroWD21 <i>21st European White Dwarf Workshop – [talk]</i>	Austin, Texas, US <i>July 2018</i>
EWASS 2018 <i>European Week of Astronomy and Space Science</i>	Liverpool, UK <i>April 2018</i>
Posters	
Los Alamos National Laboratory (Public) <i>Current Challenges in the Physics of White Dwarf Stars</i>	Santa Fe, New Mexico, US <i>June 2017</i>
EuroWD16 <i>20th European White Dwarf Workshop</i>	Warwick, UK <i>July 2016</i>
SDOB7 <i>Seventh Meeting on Hot Subdwarfs and Related Objects</i>	Oxford, UK <i>July 2015</i>

Selected Press Coverage

- *A white dwarf accreting planetary material determined from X-ray observations* (Cunningham et al. 2022)
 - Independent: Final moments of dead planet crashing into a white dwarf seen for the first time
 - Vice: Scientists have finally seen what happens to shredded worlds in deep space
- *Core crystallization and pile-up in the cooling sequence of evolving white dwarfs* (Tremblay et al. 2019)
 - Los Angeles Times: One day our sun will solidify into a giant crystal orb
 - NewScientist: Astronomers have seen dying stars slowly crystallise and turn solid

Awards and Scholarships

Andrewes Prize <i>King's College London</i>	<i>2012</i>
Choral Scholarship <i>King's College London</i>	<i>2010–2012</i>
Jetson University Scholarship <i>Adams' Grammar School</i>	<i>2008-2012</i>

Observational Experience

Spectroscopy.....

IDS **IAC, La Palma**
Isaac Newton Telescope (INT) (5 nights) Jul 2019
Program: *The age-metallicity relation: constraints from white dwarf-main sequence binaries* (PI: Gaensicke)

ISIS **IAC, La Palma**
William Herschel Telescope (WHT) (9 nights) Sep 2018
Program: *The mass ratio distribution of close double white dwarf binary stars* (PI: Marsh)

Photometry.....

ULTRACAM **La Silla, ESO, Chile**
New Technology Telescope (NTT) (6 nights) Jun 2018

ULTRASPEC **TNO, Chang Mai, Thailand**
Thai National Telescope (TNT) (8 nights) Feb 2018

Wide Field Camera **IAC, La Palma**
Isaac Newton Telescope (INT) (6 nights) Feb 2017

Leadership, Outreach and Teaching

Lecturer **University of Warwick**
Undergraduate module: Science and Music 2017–present

Project supervisor **University of Warwick**
Undergraduate module: Science and Music 2017–present

Supervised projects include:

- *Quartet for the end of term: Olivier Messiaen's modes of limited transposition* (2022)
- *Turning sound into colour: Virtual Reality and insights into chromesthesia* (2020)
- *Scriabin's colour wheel: exploring chromesthesia with MIDI piano and C/C++* (2019)
- *Turning colour into sound: developing algorithms to 'hear' images* (2018)

Lab Demonstrator **University of Warwick**
Undergraduate module: First Year Laboratory 2016–2018

Research Lecture **King's College London**
First Year Astrophysics Course February 2018

Astronomy Group Representative **University of Warwick**
Postgraduate Staff-Student Liaison Committee 2016–2018

Athena Swan Diversity Representative **University of Warwick**
Postgraduate Staff-Student Liaison Committee 2016–2018

Outreach Assistant **University of Warwick**
Planterium 2017–2018

Astrophysics demonstrator **University of Warwick**
XMaS Science Gala 2017

Technical Expertise

Programming Languages: Python • IDL • Fortran • C/C++ • C# • bash
High Performance Computing: OpenMP • MPI • slurm • moab
Software (Scientific): C05BOLD • MESA • LaTeX • Unity3D
Software (Accredited): Microsoft Office Specialist Excel 2016 May 2019–present
Software (Audio): Logic Pro X • Ableton Live • Sibelius

Interdisciplinary Accomplishments

Prize Winner **University of Warwick**
Astronomy Meets the Arts 2019

Film: "A Night at the Isaac Newton Telescope"

Composer **British Science Festival, Coventry**
Composition: "Immersed in soundwaves" 2019

A piece for String Quartet, Theremin and Bass Guitar (written for Coull Quartet)

Musicianship Teacher **Morley College, London**
Centre for Young Musicians 2014–present

Workshop Leader **Shrewsbury Folk Festival, UK**
Tuneworks and Refolkus 2018–2019

Composer–Musical Director–Performing Artist **Huddersfield, UK**
Proper Job Theatre Company 2015–2019