

Tim Cunningham

NASA Hubble Fellow

Harvard University

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NASA Hubble Fellow at Harvard & Smithsonian Center for Astrophysics, utilizing multi-dimensional radiation-hydrodynamic simulations and multi-wavelength observational strategies to study convection in degenerate stars and white dwarf populations. Experienced observer with spectroscopic and photometric expertise. Commitment to leadership roles, mentoring, outreach and teaching.

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

Harvard University

Cambridge, MA, US

NASA Hubble Fellow

Sept 2023–present

University of Warwick

Coventry, UK

Postdoctoral Research Fellow

July 2020 – Sept 2023

University of California, Santa Barbara

Santa Barbara, CA, US

Research Assistant

Apr – Sept 2013

Publications (with links)

Metrics: h-index=17 on 23 abstracts with 1,200+ citations ([Google Scholar](#))

As Lead Author.....

8. **Cunningham, T.**, Tremblay, P.-E., O'Brien, M., et al. 2024, **MNRAS**, submitted. 2024
The dearth of high-mass hydrogen-atmosphere metal-polluted white dwarfs within 40 pc
7. **Cunningham, T.**, Caiazzo, I., Prusinski, N., et al. 2024, **ApJL**, 975, L7 2024
Expansion properties of the young supernova type Ia remnant Pa 30 revealed
6. **Cunningham, T.**, Tremblay, P.-E., O'Brien, M. 2024, **MNRAS**, 527, 3602 2024
Initial-final mass relation from white dwarfs within 40 pc
5. **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

4. **Cunningham, T.**, Tremblay, P.-E., Bauer, E., et al. 2021 **MNRAS**, 503, 1646 2021
Horizontal Spreading of Planetary Debris Accreted by White Dwarfs
3. **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
2. **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
1. **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.....

17. Williams, J. T., et al. 2024 **MNRAS**. Accepted. 2024
PEWDD: A database of white dwarfs enriched by exo-planetary material
16. Elms, A. et al. 2024 **MNRAS**, 534, 2758 2024
A network of cooler white dwarfs as infrared standards for flux calibration
15. Munday, J. et al. 2024 **MNRAS**, 532, 2534 2024
The DBL Survey I: discovery of 34 double-lined double white dwarf binaries
14. O'Brien, M. W., et al. 2023 **MNRAS**, 527, 8687 2024
The 40 parsec sample of white dwarfs from Gaia
13. Corrales, L., et al. 2023 (AXIS white paper) 2023
The life cycle of stars and their planets from the high energy perspective
12. Rebassa-Mansergas, A., et al. 2023 **MNRAS**, 526, 4787 2023
Main-sequence companions to white dwarfs – II. The age–activity–rotation relation from a sample of Gaia common proper motion pairs
11. O'Brien, M. W., et al. 2023 **MNRAS**, 518, 3055 2023
Gaia white dwarfs within 40 pc III: spectroscopic observations of new candidates in the southern hemisphere
10. Elms, A. K., et al. 2022 **MNRAS**, 517, 4557 2022
Spectral analysis of ultra-cool white dwarfs polluted by planetary debris
9. Raddi, R., et al. 2022 **A&A**, 658, A22 2022
Kinematic properties of white dwarfs. Galactic orbital parameters and age-velocity dispersion relation
8. Rebassa-Mansergas, A., et al. 2021 **MNRAS**, 505, 3165 2021
Constraining the solar neighbourhood age-metallicity relation from white dwarf-main sequence binaries
7. 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
6. McCleery, J., et al. 2020 **MNRAS**, 499, 1890 2020
Gaia white dwarfs within 40 pc II: the volume-limited Northern hemisphere sample
5. Tremblay, P.-E., et al. 2020 **MNRAS**, 497, 130 2020
Gaia White Dwarfs within 40 pc I: Spectroscopic Observations of New Candidates

4. Green, M. J., et al. 2020 MNRAS , 496, 1243	2020
<i>Spectroscopic and Photometric Periods of Six Ultracompact Accreting Binaries</i>	
3. Tremblay, P.-E., et al. 2019 MNRAS , 482, 5222	2019
<i>Fundamental Parameter Accuracy of DA and DB White Dwarfs in Gaia Data Release 2</i>	
2. Gentile Fusillo, N. P., et al. 2019 MNRAS , 482, 4570	2019
<i>A Gaia Data Release 2 catalogue of white dwarfs and a comparison with SDSS</i>	
1. Tremblay, P.-E., et al. 2019 Nature , 565, 202	2019
<i>Core Crystallization and Pile-up in the Cooling Sequence of Evolving White Dwarfs</i>	

Telescope Time Awarded as PI

Metrics: 774 ks (215 hours) of *Chandra/XMM-Newton* time, and 13 nights of 6.5m ground-based spectroscopy and photometry awarded as PI:

MMT: Semester 2024B – 1 nights with Binospec	2024
<i>“White dwarf gaseous disks discovered in SDSS-V”</i>	
MMT: Semester 2024B – 1 nights with Binospec	2024
<i>“Extreme white dwarfs in the Solar neighbourhood”</i>	
MMT: Semester 2024B – 1 nights with MMIRS	2024
<i>“Confirming the first strongly asynchronous polar”</i>	
MMT: Semester 2024B – 2 nights with Binospec	2024
<i>“Novel isolated white dwarf X-ray sources from XMM-Newton”</i>	
Magellan: Semester 2024B – 4 nights with FourStar/FIRE/MagE	2024
<i>“Novel isolated white dwarf X-ray sources from XMM-Newton”</i>	
Magellan: Semester 2024A – 1 night with FourStar	2024
<i>“Infrared time-series of the oldest accreting magnetic white”</i>	
Magellan: Semester 2024A – 2 nights with MagE	2024
<i>“Novel isolated white dwarf X-ray sources from XMM-Newton”</i>	
XMM-Newton: AO 23 (#09418801) – 34 hours (124 ks)	2023
<i>“Metal-polluted white dwarfs as novel X-ray sources”</i>	
Chandra: Cycle 25 (#25200153) – 104 hours (375 ks) with HRC-I	2023
<i>“Constraining the time-dependent accretion rate of a novel class of X-ray source”</i>	
Chandra: Cycle 25 (#25200459) – 10 hours (35 ks) with ACIS-S	2023
<i>“Earliest X-rays from a possible late thermal pulse?”</i>	
Chandra: Cycle 24 (#24200446) – 35 hours (125 ks) with HRC-I	2022
<i>“Constraining the time-dependent accretion rate of a novel class of X-ray source”</i>	
Chandra: Cycle 22 (#22200039) – 32 hours (115 ks) with ACIS-S	2020
<i>“First X-rays from white dwarf planet accretion: a definitive test of convective overshoot”</i>	

Grants awarded

Metrics:

- \$1,345,000 in fellowship grants offered.
- \$284,000 of observing grants awarded for *Chandra/HST* PI/Co-PI time.

Grants offered for independent fellowships:

NASA Hubble Fellowship (STSci), Harvard University [current position] Awarded grant value: \$400,000	Sept 2023–
51 Pegasi b Fellowship (Heising-Simons), The Ohio State University [declined] Awarded grant value: \$450,000	2023
Stephen Hawking Fellowship (EPSRC), University of Cambridge [declined] Awarded grant value: £385,000 (\$495,000)	2024

Grants awarded for *HST* Co-PI time:

<i>HST</i> : Cycle 32 (HST-GO-17720) – \$69,000 Science PI: Caiazzo, Co-PI: Cunningham , Administrative PI: Charbonneau	2024
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Grants awarded for *Chandra* PI time:

<i>Chandra</i> : Cycle 25 (#25200153) – \$120,000 Science PI: Cunningham , Administrative PI: Charbonneau	2023
<i>Chandra</i> : Cycle 25 (#25200459) – \$60,000 Science PI: Cunningham , Administrative PI: Charbonneau	2023
<i>Chandra</i> : Cycle 24 (#24200446) – \$35,000 Science PI: Cunningham , Administrative PI: Corrales	2022

Professional Service

Collaborations: <ul style="list-style-type: none">- AXIS - NASA Probe Mission Concept:<ul style="list-style-type: none">· Team Member· Stars and Exoplanets Science Working Group· (selected for Phase A funding in October 2024)- Zwicky Transient Facility:<ul style="list-style-type: none">· External collaborator - Stars Group- 4MOST:<ul style="list-style-type: none">· Member of the White Dwarf Binary (WDB) Survey (PI: Toloza)- SDSS-V:<ul style="list-style-type: none">· Membership through current institution	2022–
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Journal referee: <ul style="list-style-type: none">- Astronomy & Astrophysics (A&A)- Monthly Notices of the Royal Astronomical Society (MNRAS)- Astrophysical Journal Letters (ApJL)	2021–
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Peer Review & Time Allocation Committee Panels:	2023–
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- *Hubble Space Telescope*
- *Chandra X-ray Observatory:*
 - Deputy Chair
- **NASA Keck**
 - Panel chair
- **FINESST:**
 - External Reviewer
- **NASA ROSES:**
 - Astrophysics Theory Program (ATP)
 - *ULTRASAT* – Ultraviolet Transient Astronomy Satellite Participating Scientist

- Session organiser** – National Astronomy Meeting 2023, Cardiff, 3–7 July 2023
 - *“Open questions in stellar (radiation-) fluid dynamics: from dwarfs to giants”*
- Session organiser** – National Astronomy Meeting 2022, Warwick, 11–15 July 2022
 - *“Know Your Neighbour: White Dwarf Researchers in the UK”*
 - *“3D Hydrodynamics and Magnetohydrodynamics: Stars and their Environment”*
- Scientific Organising Committee (SOC)** – Physics Days at Warwick, Warwick, 5/6 July 2021
 - *“Summer workshop on white dwarfs and related objects”*
- Session chair** – National Astronomy Meeting 2019, Lancaster, 30 June–4 July 2019
 - *“Current Developments in Numerical Astrophysics”*

Contributed Presentations

Talks.....

AXIS Seminar <i>AXIS Science Team Seminar – [talk]</i>	Online Seminar <i>October 2024</i>
NHFP Symposium - Caltech <i>NASA Hubble Fellowship Program Symposium – [talk]</i>	Pasadena, CA, US <i>September 2024</i>
TANDEM Seminar Series <i>Harvard & Smithsonian Center for Astrophysics – [talk]</i>	Cambridge, MA, US <i>August 2024</i>
EuroWD24 <i>23rd European workshop on white dwarfs – [talk]</i>	Barcelona, ES <i>July 2024</i>
Institute for Science and Technology Austria (ISTA) <i>Astrophysics seminar – [seminar]</i>	Vienna, AT <i>June 2024</i>
Exo V <i>Exoplanets V – [talk, plenary session]</i>	Leiden, NL <i>June 2024</i>
NORDITA <i>Physics and Astrophysics seminar – [seminar]</i>	Stockholm, SE <i>June 2024</i>
ESAC/XMM-Newton <i>The X-ray mysteries of neutron stars and white dwarfs – [talk]</i>	ESAC, Madrid, ES <i>June 2024</i>

Caltech <i>Astronomy and Astrophysics colloquium – [colloquium]</i>	Pasadena, CA, US <i>April 2024</i>
ExSS V <i>Extreme Solar Systems V – [talk]</i>	Christchurch, NZ <i>March 2024</i>
Tufts University <i>Astronomy and Physics – [colloquium]</i>	Cambridge, MA, US <i>March 2024</i>
CfA/Harvard <i>ITC Luncheon – [talk]</i>	Cambridge, MA, US <i>February 2024</i>
UCLA <i>Astrophysics seminar – [seminar]</i>	Los Angeles, CA, US <i>February 2024</i>
NHFP Symposium - Harvard University <i>NASA Hubble Fellowship Program Symposium – [talk]</i>	Cambridge, MA, US <i>September 2024</i>
University of Exeter <i>Astrophysics Group – [seminar]</i>	Exeter, UK <i>June 2023</i>
Aspen Center for Physics <i>Conference on late-stage planetary systems – [talk]</i>	Aspen, CO <i>April 2023</i>
KITP <i>White Dwarfs as Probes of the Evolution of Planets, Stars...Universe – [talk]</i>	California, US <i>December 2022</i>
CfA/Harvard <i>High Energy Seminars, Centre for Astrophysics/Harvard & Smithsonian – [seminar]</i>	Boston, US <i>October 2022</i>
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>	Columbus, OH, 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, NV, 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>	Santa Barbara, CA, US <i>November 2021</i>
KITP <i>Probes of Transport in Stars – [talk]</i>	Santa Barbara, CA, 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, CA, 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, CA, 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, TX, 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

- [Expansion properties of the young supernova type Ia remnant Pa 30 revealed \(Cunningham et al. 2024\)](#)
 - CNN: A supernova first seen in 1181 is releasing glowing filaments
 - Scientific American: Scientists Spy a ‘Dandelion’ Supernova around a ‘Zombie’ Star
- [Spectral analysis of ultra-cool white dwarfs polluted by planetary debris \(Elms et al. 2022\)](#)
 - NewScientist: Planets around graveyard star were consumed before Earth was even born
 - Independent: New star system discovery may be oldest in our galaxy, scientists say

- *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

Observational Experience

Spectroscopy.....

KCWI Keck Program: <i>Observations of the type Ia supernova remnant Pa30</i>	Mauna Kea Observatory (3 nights) 2023- (PI: Fuller/Polin)
MagE Magellan/Baade Program: <i>Novel isolated white dwarf X-ray sources from XMM-Newton</i>	Las Campanas Observatory (2 nights) 2023- (PI: Cunningham)
FIRE Magellan/Baade Program: <i>Novel isolated white dwarf X-ray sources from XMM-Newton</i>	Las Campanas Observatory (1 night) 2024 (PI: Cunningham)
IDS Isaac Newton Telescope (INT) Program: <i>The age-metallicity relation: constraints from white dwarf-main sequence binaries</i>	IAC, La Palma (5 nights) Jul 2019 (PI: Gaensicke)
ISIS William Herschel Telescope (WHT) Program: <i>The mass ratio distribution of close double white dwarf binary stars</i>	IAC, La Palma (9 nights) Sep 2018 (PI: Marsh)

Photometry.....

FourStar Magellan/Baade	Las Campanas Observatory, Chile (1 night) Nov 2023
ULTRACAM New Technology Telescope (NTT)	La Silla, ESO, Chile (6 nights) Jun 2018
ULTRASPEC Thai National Telescope (TNT)	TNO, Chang Mai, Thailand (8 nights) Feb 2018
Wide Field Camera Isaac Newton Telescope (INT)	IAC, La Palma (6 nights) Feb 2017

Leadership, Outreach and Teaching

Current Students

Will Brennom – post-Bachelors at the Harvard–Smithsonian Center for Astrophysics (2024).
– Project: *Spectroscopic observations of wide white dwarf companions to Hot Jupiter hosts*

Sumit Maheshwari – Master’s student in Physics at University of Hamburg (2024).

– Project: *Near-infrared time-series photometric and spectroscopic studies of magnetic accreting white dwarfs*

Former Students

Gracjan Sienkiewicz – second year undergraduate in Physics (2023).

- Undergraduate Research Support Scheme, University of Warwick
- Project: *Development of Accretion Models for White Dwarfs at Low Accretion Rates*

Klemen Keršič – second year undergraduate in Physics (2021).

- Undergraduate Research Support Scheme, University of Warwick
- Project: *Modeling Accretion of Planetary Debris on White Dwarfs (2021)*
- Now MSci student at ETH, Zürich.

Lecturer

Undergraduate module: *Science and Music*

University of Warwick
2017–2023

Project supervisor

Undergraduate module: *Science and Music*

University of Warwick
2017–2023

Supervised projects include:

- *Data-to-sound: algorithmic sonification of images and data* (2023)
- *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

Undergraduate module: *First Year Laboratory*

University of Warwick
2016–2018

Research Lecture

First Year Astrophysics Course

King's College London
February 2018

Astronomy Group Representative

Postgraduate Staff-Student Liaison Committee

University of Warwick
2016–2018

Athena Swan Diversity Representative

Postgraduate Staff-Student Liaison Committee

University of Warwick
2016–2018

Outreach Assistant

Planterium

University of Warwick
2017–2018

Astrophysics demonstrator

XMaS Science Gala

University of Warwick
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 (X-ray): SAS • CIAO • XSPEC • BXA

Software (Accredited): [Microsoft Office Specialist Excel 2016](#) May 2019–present

Software (Audio): Logic Pro X • Ableton Live • Sibelius

Interdisciplinary Accomplishments

Prize Winner

Astronomy Meets the Arts

Film: "A Night at the Isaac Newton Telescope"

University of Warwick

2019

Composer

Composition: "Immersed in soundwaves"

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

British Science Festival, Coventry

2019

Musicianship Teacher

Centre for Young Musicians

Morley College, London

2014–2023

Workshop Leader

Tuneworks and Refolkus

Shrewsbury Folk Festival, UK

2018–2019

Composer–Musical Director–Performing Artist

Proper Job Theatre Company

Huddersfield, UK

2015–2019