Dr. Tim D. Pearce

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Research: Debris discs • Exoplanets • Planet-disc interactions • Hot exozodis • Dynamics & simulations

Employment

2024–present **Stephen Hawking Fellow**, University of Warwick, UK
Independent research fellowship funded by EPSRC/UKRI, worth £0.5 million over 3 years.

2023–2024 **Prize Fellow**, University of Warwick, UK
3-year independent research fellowship. Paused in Spring 2024 to undertake Stephen Hawking fellowship.

2019–2023 **Postdoctoral Researcher**, Friedrich-Schiller-Universität, Jena, Germany
Full-time research, supervision and teaching in the Theory Group.

2018–2019 **Lead Mathematical Developer**, JCT Consultancy Ltd., Lincoln, UK
Responsible for all maths and research in an industry-leading traffic-modelling company.

2016–2018 **Weapon Engineer Officer (Submariner)**, Royal Navy
Underwent extensive management, leadership, communication, administration and engineering training before joining a *Vanguard*-class submarine as an engineering officer.

2011 **Visiting Researcher**, Institute of Astronomy, University of Cambridge, UK
Summer job in the X-ray astrophysics group, characterising gas structures in galaxies.

Education

2012–2016 **PhD in Theoretical Astrophysics**, Institute of Astronomy, University of Cambridge, UK
Title: *Planetary Orbits and Interactions with Debris*
Supervisors: Mark Wyatt & Grant Kennedy
Awarded with no corrections.

2008–2012 **MPhys in Physics and Astronomy (1st class, Hons.)**, Durham University, UK
Masters thesis: *Modelling Hypervelocity Stars*

Student Supervision

Masters projects

2021–2022 **Tyson Costa**, primary supervisor
Title: *Projectile stirring of a debris disc by planetesimals scattered by a planet*
Publication: Costa, Pearce & Krivov (2024)

2020–2021 **Robert Ostermann**, primary supervisor
Title: *Constraints on unseen planets in ISPY debris-disk systems*
Publication: Pearce, Launhardt, Ostermann et al. (2022)

Bachelors projects

2022 **Laura Schulze**, primary supervisor
Title: *Constraining the orbit of Fomalhaut b through mean-motion resonances*

2021 **Marc Friebe**, primary supervisor
Title: *Gaps in debris discs - the importance of planet migration*
Publication: Friebe, Pearce & Löhne (2022)

Summer projects

2024 (upcoming) **Noah Sims**, primary supervisor
Title: *Explaining the intermediate debris ring around Fomalhaut*

Masters mini-projects

2022 **Marc Friebe & Richard Bernecker**, primary supervisor
Title: *Constraining planets around ϵ Eri from clumps in the debris disc*

Teaching

Friedrich-Schiller-Universität, Jena

2020-2021 **Example classes**, 4th-year *Celestial Mechanics* course
Group of 10 students. Official student feedback very positive, placing my teaching quality and engagement well above Physics-department averages in all assessment criteria.

Institute of Astronomy, University of Cambridge

2014-2016 **Example classes**, 4th-year *Planetary System Dynamics* course
Groups of 6-12 students. Taught for 2 years.

2014-2016 **Tutorials**, 3rd-year *Problems in Astrophysics* course
Supervised 3 pairs of students.

Formal Collaborations

2022-present **VLTI-NOTT** Exozodi Science-Team member (exozodi science-verification for NOTT)
2022-present **ALMA-ARKS** Science-Team member (large-programme legacy survey of debris discs)
2022-present **ExoPAG SAG 23** Science-Team member (impact of exozodis on exoplanet imaging)
2020-present **NaCo-ISPY** Science-Team member (direct-imaging survey for planets)
2019-2023 **FOR 2285** Research-Unit member (DFG-funded, multi-institution collaboration)

Conference Organisation

Scientific Organising Committee (SOC) member

2024 *Dust Devils - Debris Disks in the Sonoran Desert*, Arizona, USA
2023 *ExoPAG SAG 23 symposium*, Baltimore, USA

Session chair & Organisation Panel member

2018, 2019 *JCT Traffic Signal Symposium and Exhibition*, Nottingham, UK
The primary UK conference on traffic modelling and junction design (2 instances)

Local Organising Committee (LOC) member

2024 (upcoming) *UKI Discs Meeting*, Warwick, UK
2022 *Debris discs: At Home and Abroad*, Jena, Germany
2014 *Characterizing Planetary Systems Across the HR Diagram*, Cambridge, UK

Session-organisation member

2024 (upcoming) *Europlanet Science Congress (EPSC)*, Berlin, Germany
Session: *The impact of planets and flybys on debris disks*

Publicly Available Science Codes

Six programs and numerical tools available on my `website` and `GitHub`, including:

- `SculptingPlanet` - Constrain the mass and orbit of an unseen planet sculpting a debris disc.
- `GetDebrisStirringLevelInReboundSim` - Measure the level of debris-disc stirring in a Rebound simulation.
- `MinSelfStirringDiscMass` - Calculate the absolute minimum mass a debris disc requires to self-stir.
- `PlanetMassToCarveDebrisGap` - Calculate the gap carved by a planet embedded in a massive debris disc.

Observations

JWST

Cycle 3 *Finding the great sculptors: a renaissance in planet disk dynamics* (48hrs, PI: Millar-Blanchaer)

Cycle 2 *Using planets to dynamically weigh a debris disc for the first time* (8hrs, PI: **Pearce**)

Cycle 2 DDT: *Establishing the Formation of AF Lep b with NIRCam: The Lowest-Mass Imaged Exoplanet with a Dynamical Mass* (5hrs, PI: Franson)

Cycle 1 *Using JWST to search for Planetary Sculptors in an ALMA-Selected Sample of Debris Disks* (24hrs, PI: Hinkley)

Cycle 1 *Searching for low mass planets in debris disk gaps* (11hrs, PI: Marino)

VLTI-MATISSE

2023 *Investigating the variability and morphology of hot exozodiacal dust around κ Tuc* (6hrs, PI: Stuber)

2022 *Disc or spherical shell? The architecture of hot exozodiacal dust systems observed with MATISSE* (9hrs, PI: Kirchschlager)

2021 *Mid-infrared emission of six hot exozodis* (9hrs, PI: Kirchschlager)

ALMA

2023 *Vertical structure and planetary system dynamics* (52 hrs, PI: Hughes)

2016 *Double-ring debris disks at 10s of au: probing how far out planets can form* (10 hrs, PI: Marino)

2016 *What lies beyond Exo-Jupiter planets?* (2 hrs, PI: Wyatt)

VLT-SPHERE

2023 *DDT: Enabling breakthrough science with the JWST* (3 hrs, PI: Ginski)

Other Skills and Experience

Scientific services: Referee for AJ, A&A and the Open Journal of Astrophysics. Also reviewer of observing proposals for several telescopes.

Computing: *Python*, *C#*, *C++*, *LaTeX*, *Linux*, *Windows*. Highly experienced with n-body integrator *Rebound*.

Management: Level 5 Diploma in Management and Leadership, Chartered Management Institute, 2016.

German language: Intermediate 1 (CEFR level B1), Jena Sprachenzentrum, 2020 (awarded grade 1.7).

English language: Fluent (native speaker).

Academic Conferences and Talks

Invited review talks

2022 *(Exo)Planet Diversity, Formation and Evolution*, Berlin, Germany
Title: *Debris Discs as Probes of Planetary Systems*

Discussion-session chair

2024 *Dust Devils - Debris Disks in the Sonoran Desert*, Arizona, USA
Session: *Exozodis*

2022 *Debris Discs at Home and Abroad*, Jena, Germany
Session: *Hot exozodis*

Contributed talks

2024 *Dust Devils - Debris Disks in the Sonoran Desert*, Arizona, USA
2023 *STScI: Planetary Systems and the Origins of Life in the Era of JWST*, Baltimore, USA
2023 *PERC International Symposium on Dust & Parent Bodies 2023*, Tokyo, Japan
2022 *Debris Discs at Home and Abroad*, Jena, Germany
2022 *In the Spirit of Lyot*, Leiden, Netherlands
2022 *PERC International Symposium on Dust & Parent Bodies 2022*, Japan (Virtual)
2021 *European Astronomical Society Annual Meeting*, Leiden, Netherlands (Virtual)
2020 *Five years after HL Tau: a new era in planet formation*, Chile (Virtual)

(Outside academia April 2016 - December 2019)

2015 *Exoplanet Community Meeting*, Warwick, UK

Seminars

2023 *Astrophysical Colloquium*, Jena, Germany
2023 *NOTT exozodi workshop*, Leuven, Belgium
2023 *STScI High-Contrast Imaging Seminar Series*, Baltimore, USA
2023 *Planet- & Star-Formation Seminar Series*, Heidelberg, Germany
2022 *Cambridge Exoplanet Seminar Series*, Cambridge, UK
2022 *Astronomy Group Seminar Series*, Warwick, UK
2021 *TLS Institute's Colloquium*, Tautenburg, Germany (Virtual)
2021 *Mark Wyatt's Group Seminar Series*, Cambridge, UK (Virtual)
2020 - 2023 *FOR 2285 Research Unit Seminar Series*, various locations, Germany (7 talks over 3.5 years)
2020 - 2023 *AIU Seminar Series*, Jena, Germany (4 talks over 3.5 years)

(Outside academia April 2016 - December 2019)

2016 *Astrophysics Seminar Series*, Exeter, UK
2014 *Institute of Astronomy Seminar Series*, Cambridge, UK

Posters

2022 *Debris Discs at Home and Abroad*, Jena, Germany
2021 *Distorted Astrophysical Discs*, Cambridge, UK (Virtual)
2021 *Sagan Summer Workshop - Circumstellar Disks and Young Planets*, USA (Virtual)
2021 *Towards the Comprehensive Characterization of Exoplanets*, STScI, USA (Virtual)

(Outside academia April 2016 - December 2019)

2015 *In the Spirit of Lyot*, Montreal, Canada
2014 *Characterizing Planetary Systems Across the HR Diagram*, Cambridge, UK
2013 *Protostars and Planets VI*, Heidelberg, Germany

Publications

Invited review chapters

- Debris disks around main-sequence stars
  Pearce, 2024, to be published in *Encyclopedia of Astrophysics*, 1st Edition, Elsevier (arXiv: 2403.11804)

First author

- The effect of sculpting planets on debris-disc inner edges
  Pearce, Krivov, Sefilian et al., 2024, MNRAS, 527, 3876
- Hot exozodis: cometary supply without trapping is unlikely to be the mechanism
  Pearce, Kirchschlager, Rouillé et al., 2022, MNRAS, 517, 1436
- Planet populations inferred from debris discs: insights from 178 debris systems in the ISPY, LEECH and LIStEN planet-hunting surveys
  Pearce, Launhardt, Ostermann et al., 2022, A&A, 659, A135
- Fomalhaut b could be massive and sculpting the narrow, eccentric debris disc, if in mean-motion resonance with it
  Pearce, Beust, Faramaz et al., 2021, MNRAS, 503, 4767
- Gas trapping of hot dust around main-sequence stars
  Pearce, Krivov & Booth, 2020, MNRAS, 498, 2798

(Outside academia April 2016 - December 2019)

- Double-ringed debris discs could be the work of eccentric planets: explaining the strange morphology of HD 107146
  Pearce & Wyatt, 2015, MNRAS, 453, 3329
- Constraining the orbits of sub-stellar companions imaged over short orbital arcs
  Pearce, Wyatt & Kennedy, 2015, MNRAS, 448, 3679
- Dynamical evolution of an eccentric planet and a less massive debris disc
  Pearce & Wyatt, 2014, MNRAS, 443, 2541
- Imaged substellar companions: not as eccentric as they appear? The effect of an unseen inner mass on derived orbits
  Pearce, Wyatt & Kennedy, 2014, MNRAS, 437, 2686

Second author

- Increasing planet-stirring efficiency of debris disks by "projectile stirring" or "resonant stirring"
  Costa, Pearce & Krivov, 2024, MNRAS, 527, 7317
- The clumpy structure of ϵ Eridani's debris disc revisited by ALMA
  Booth, Pearce, Krivov et al., 2023, MNRAS, 521, 6180
- ISPY-NACO Imaging Survey for Planets around Young stars. The demographics of forming planets embedded in protoplanetary disks
  Cugno, Pearce, Launhardt et al., 2023, A&A, 669, A145
- Gap carving by a migrating planet embedded in a massive debris disc
  Friebe, Pearce & Löhne, 2022, MNRAS, 512, 4441

Other co-author

- How much large dust could be present in hot exozodiacal dust systems?
  Stuber, Kirchschlager, Pearce et al., 2023, A&A, 678, A121
- Debris-disc mass strongly changes the outcomes of interactions with inclined planets
  Poblete, Löhne, Pearce et al., 2023, MNRAS, 526, 2017
- Astrometric Accelerations as Dynamical Beacons: A Giant Planet Imaged Inside the Debris Disk of the Young Star AF Lep
  Franson, Bowler, Zhou, Pearce et al., 2023, ApJL, 950, L19

- High resolution ALMA and HST images of q1 Eri: an asymmetric debris disc with an eccentric Jupiter
  Lovell, Marino, Wyatt et al., 2021, MNRAS, 506, 1978
- LIStEN: L' band Imaging Survey for Exoplanets in the North
  Musso Barcucci, Launhardt, Müller et al., 2021, A&A, 645, A88
- Resolving the outer ring of HD 38206 using ALMA and constraining limits on planets in the system
  Booth, Schulz, Krivov et al., 2021, MNRAS, 500, 1604

(Outside academia April 2016 - December 2019)

- An M-dwarf star in the transition disk of Herbig HD 142527
  Lacour, Biller, Cheetham et al., 2016, A&A, 590, A90