



Dr. Fred J. Jennings

About

CV

I am a computational astrophysicist interested in tackling a wide-range of problems using massively-parallel computation. Having achieved double first-class honours at the University of Cambridge and recently a PhD in computational astrophysics at the Institute for Astronomy, University of Edinburgh, I have broad expertise in idealised, cosmological, and zoom-in simulations. This is with both SPH and adaptive-mesh codes, applied to a wide range of galaxy formation and gas physics. My work has included analysis focussed on shocks, magnetic fields and anisotropic conduction, radiative cooling, and their effects on thermal and hydrodynamical instabilities, as well as work on black hole feedback and accretion models. In my current research position, my work is focussed on implementing state-of-the-art dust models in the GPU mesh code AthenaPK, which is built on the Parthenon, Kokkos, and CUDA frameworks. I am very interested in applying my expertise to new research areas and collaborating with diverse groups of scientists.

Employment

- 07/2025– **Research Fellow**, *FIM*, Università degli Studi di Modena e Reggio Emilia.
Current Research Fellow in Theoretical and Computational Astrophysics at UNIMORE, Modena, Italy. Working in the ERC-funded “Black Hole Weather” research group with PI Prof. Massimo Gaspari on developing massively-parallel GPU-accelerated MHD simulations of galaxy clusters. Currently I work on adding dust physics, with a self-consistently modelled and evolved dust grain-size distribution.

Education

- 09/21–08/25 **PhD in Astrophysics**, *Institute for Astronomy*, University of Edinburgh.
PhD student in theoretical astrophysics at the ROE in Edinburgh under Prof. Romeel Davé. I used the SIMBA large-scale cosmological simulations to probe galaxy groups and clusters. This included work on the statistical properties of large numbers of X-ray halos with realistic mock observations, and work on the heating of halo baryons and the triggering of precipitation via X-ray cavities in high-resolution zoom simulations.
- 2020–2021 : **MSci, Astrophysics**, *University of Cambridge*, UK.
Included a published research project focusing on the evolution of small cold clouds dynamically interacting with the hot ICM, supervised by Dr R.S. Beckmann and Prof. D. Sijacki.
- Grade : 1st Class (hons)
- 2017–2020 : **BA, Natural Sciences (Astrophysics)**, *University of Cambridge*, UK.
Grade : 1st Class (hons)

Students Advised

- 2024 : **Sophia Tonelli, MSci Student**, *Summer Project: Investigating the effect of sub-grid feedback parameters on the observed morphology distribution and thermodynamic evolution of X-ray cavities in galaxy groups and clusters.*

Contributed Talks

- 12/2025 **Black Hole Weather – Toward a Unified Theory of Feeding and Feedback**, Sesto, Italy.
- 11/2025 **Modelling of Multiphase Astrophysical Media**, Ringberg, Bavaria, Germany.
- 12/2024 **CIERA Group Meeting**, Northwestern University, Chicago, USA.
- 08/2024 **Lurking Lions: Hidden Challenges to Galaxy Formation**, Kruger National Park, South Africa.
- 04/2024 **Institute for Astronomy Colloquium**, Edinburgh, UK.
- 05/2023 **Simba Group Meeting**, CCA, Simons Foundation, New York City, USA.
- 10/2022 **The Ecosystem of Massive Halos Across Cosmic Time**, Edinburgh, UK.
- 07/2022 **The Physical Properties of the Groups of Galaxies**, Ce.U.B., Bertinoro, Italy.
- 09/2021 **IoA Galaxies Group Meeting**, Cambridge, UK.

Press Releases

2023 : [Athena X-ray Observatory](#).

Research Experience

11/2022 **Visitor at the CCA, New York City, New York.**

Worked with Dr D. Rennehan on analyzing the FIRE simulations of galaxy clusters with MOXHA.

07/21-09/21 **8-week Summer Research intern (paid) at the Institute for Astronomy, Cambridge, UK..**

Continuing masters work on simulations of cold clouds in the multiphase ICM.

Computing Awards

09/2025 10,000 GPU (80,000 CPU) hours on TIER-0 Leonardo Booster as PI of Iskra-C MACMULT Project

Academic Achievements & Recognitions

2021-2025 **STFC PhD Scholarship:** £80,000

2024 **UOE SOPA Career Development Summer Student Scholarship:** £2,500

08/2021 **Summer Research Internship, Newnham College Cambridge, UK:** £1700

07/2021 **Summer Research Internship, IoA Cambridge, UK:** £800

2021 **Foundation Scholarship:** *Awarded for Academic Excellence.* Queens' College, University of Cambridge

Computer skills

Kokkos, Python, C/C++, Unix, MPI, AthenaPK, Gadget/Gizmo, Ramses, yT-Project, PyVista

Positions of Responsibility

2025- **Astronomy & Astrophysics (A&A),** Reviewer.

2024- **Monthly Notices of the Royal Astronomical Society (MNRAS),** Reviewer.

2021-24 **Line Emission Mapper (LEM),** CGM Working Group Member.

10/2022 **Ecosystems of Massive Halos Across Cosmic Time,** Edinburgh, UK, LOC.

2019-2021 **Student Representative to the Teaching Committee (Part II & III),** IoA, Cambridge.

Teaching

As a Postgraduate I have acted as a Teaching Assistant for the following courses in the Dept.:

2023-2024 : **Fourier Analysis PHYS09055, Statistical Mechanics PHYS09061, Computational Astrophysics PHYS11037,** UoE, UK.

2022-2023 : **Programming and Data Analysis PHYS08049, Observational Astronomy PHYS09059, Computational Astrophysics PHYS11037,** UoE, UK.

2021-2022 : **Modern Physics PHYS08044 (Quantum Mechanics & Special Relativity), Experimental Physics PHYS09049 (Python & Data Analysis), Computer Simulation PHYS08026 Modelling and Visualization in Physics,** UoE, UK.

References

- Romeel Davé, *Professor and Chair of Physics, University of Edinburgh, UK, Romeel.Dave@ed.ac.uk*
- Arif Babul, *Distinguished Professor, University of Victoria, Canada, babul@uwic.ca*
- Ricarda Beckmann, *Future Leaders Fellow, University of Edinburgh, UK, ricarda.beckmann@roe.ac.uk*
- Debora Sijacki, *Professor of Astrophysics and Cosmology, University of Cambridge, UK, deboras@ast.cam.ac.uk*

- Jennings, F., A. Babul, R. Davé, W. Cui, and D. Rennehan** (Jan. 2025). “ [HYENAS: X-ray bubbles and cavities in the intragroup medium](#)”. In: *MNRAS* 536.1, pp. 145–165. DOI: 10.1093/mnras/stae2592. arXiv: 2407.14415 [astro-ph.GA]. #citations = **9**.
- Koss, M., N. Aftab ..., F. Jennings ..., and R. Maiolino** (Oct. 2025). “The Advanced X-ray Imaging Satellite Community Science Book”. In: *arXiv e-prints*, arXiv:2511.00253, arXiv:2511.00253. DOI: 10.48550/arXiv.2511.00253. arXiv: 2511.00253 [astro-ph.HE]. #citations = **1**.
- Cui, W., F. Jennings, ..., R. Dave, A. Babul, and G. Gozaliasl** (Oct. 2024). “The HYENAS project: a prediction for the X-ray undetected galaxy groups”. In: *MNRAS* 534.2, pp. 1247–1256. DOI: 10.1093/mnras/stae2115. arXiv: 2406.17012. #citations = **9**
- *I performed the X-ray Analysis.*
- Kraft, R., Á. Bogdán, F. Jennings, ..., and I. Zhuravleva** (Aug. 2024). “The Line Emission Mapper (LEM) probe mission concept”. In: *Space Telescopes and Instrumentation 2024: Ultraviolet to Gamma Ray*. Ed. by J.-W. A. den Herder, S. Nikzad, and K. Nakazawa. Vol. 13093. Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series, 1309327, p. 1309327. DOI: 10.1117/12.3019969. #citations = **5**.
- Schellenberger, G., Á. Bogdán, J. A. ZuHone ..., F. Jennings, ..., and I. Zhuravleva** (July 2024). “Mapping the Imprints of Stellar and Active Galactic Nucleus Feedback in the Circumgalactic Medium with X-Ray Microcalorimeters ”. In: *ApJ* 969.2, 85, p. 85. DOI: 10.3847/1538-4357/ad4548. arXiv: 2307.01259 [astro-ph.GA]. #citations = **20**
- *I Provided Simba X-ray Mocks.*
- Jennings, F., R. S. Beckmann, D. Sijacki, and Y. Dubois** (Feb. 2023). “ [Shattering and growth of cold clouds in galaxy clusters: the role of radiative cooling, magnetic fields, and thermal conduction](#)”. In: *Monthly Notices of the Royal Astronomical Society* 518.4, pp. 5215–5235. DOI: 10.1093/mnras/stac3426. arXiv: 2211.09183 [astro-ph.GA]. #citations = **17**.
- Jennings, F. and R. Davé** (Nov. 2023). “ [Halo Scaling relations and hydrostatic mass bias in the SIMBA simulation from realistic mock X-ray catalogues](#)”. In: *Monthly Notices of the Royal Astronomical Society* 526.1, pp. 1367–1387. DOI: 10.1093/mnras/stad2666. arXiv: 2306.01397 [astro-ph.GA]. #citations = **11**.
- Kraft, R., M. Markevitch..., F. Jennings ..., and J. ZuHone** (Nov. 2022). “Line Emission Mapper (LEM): Probing the physics of cosmic ecosystems”. In: *arXiv e-prints*, arXiv:2211.09827, arXiv:2211.09827. DOI: 10.48550/arXiv.2211.09827. arXiv: 2211.09827 [astro-ph.IM]. #citations = **105**
- *I Provided Simba X-ray Mocks.*