


Michael S. Petersen

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POSITION

UKRI Stephen Hawking Fellow

April 2022-present

Institute for Astronomy, Royal Observatory Edinburgh, UK
Award value: £436,513.

Postdoctoral Research Associate

September 2021-March 2022

Institut d'Astrophysique de Paris, France

Postdoctoral Research Associate

May 2019-August 2021

Institute for Astronomy, Royal Observatory Edinburgh, UK

EDUCATION

Doctor of Philosophy, Astronomy

February 2019

University of Massachusetts at Amherst, Amherst, Massachusetts, USA

The non-linear dynamics of barred galaxy evolution in Λ CDM

Advisors: Martin D. Weinberg, Neal Katz

PUBLICATIONS

12 first-author publications, 7 student first-author publications. 11 additional co-authorships. **30 total refereed publications.** *h*-index: 14.

First-author publications

12. **Petersen, M. S.** and Weinberg, M. D. *exp: a Python/C++ package for basis function expansion methods in galactic dynamics*, In review with JOSS.
11. **Petersen, M. S.**, Roule, M., Fouvry, J.-B., Pichon, C. and Tep, K. *Predicting the linear response of self-gravitating stellar spheres and discs with LinearResponse.jl*, 2024, MNRAS, 531:733.
10. **Petersen, M. S.**, Weinberg, M. D., and Katz, N. *Measuring the dynamical length of galactic bars*, 2024, MNRAS, 530:4378.
9. **Petersen, M. S.**, Peñarrubia, J., and Jones, E. *Tidally stripped halo stars from the Large Magellanic Cloud in the Galactic North*, 2022, MNRAS, 514:2166
8. **Petersen, M. S.**, Weinberg, M. D., and Katz, N. *exp: N-body integration using basis function expansions*, 2022, MNRAS, 510:6201.
7. **Petersen, M. S.** & Peñarrubia, J. *Detection of the Milky Way reflex motion induced by the Large Magellanic Cloud infall*, 2021, Nature Astronomy, 5, 251. See summary of press coverage here.
6. **Petersen, M. S.**, Weinberg, M. D., and Katz, N. *Using commensurabilities and orbit structure to understand barred galaxy evolution*, 2021, MNRAS, 500:838.
5. **Petersen, M. S.** & Peñarrubia, J. *Reflex motion in the Milky Way stellar halo resulting from the Large Magellanic Cloud infall*, 2020, MNRAS, 494:11.
4. **Petersen, M. S.**, Weinberg, M. D., and Katz, N. *Using torque to understand barred galaxy models*, 2019, MNRAS, 490:3616.
3. **Petersen, M. S.**, Gutermuth, R.A., Nagel, E., Wilson, G.W., Lane, J. *Early science with the Large Millimetre Telescope: new mm-wave detections of circumstellar discs in IC 348 from LMT/AzTEC*, 2019, MNRAS, 488:1462.
2. **Petersen, M. S.**, Katz, N., & Weinberg, M.D. *The Dynamical Response of Dark Matter*

to *Galaxy Evolution Affects Direct-Detection Experiments*, Phys Rev D, 2016. Figure 4 was featured as part of the journal's 'Kaleidoscope'.

1. **Petersen, M. S.**, Weinberg, M. D., and Katz, N. *Dark matter trapping by stellar bars: the shadow bar*, 2016, MNRAS, 463:1952–1967.

Student-led publications

7. Ganapathy, A., **Petersen, M. S.**, Yaaqib, R., Filion, C. *Disc asymmetry characterisation in JWST galaxies at $1 < z < 4$* , in MNRAS review. Vacation Project.

7. Sarkar, S. & **Petersen, M. S.** *commensurability: a Python package for classifying astronomical orbits based on their toroid volume*, in JOSS review. MPhys student.

6. Yaaqib, R., **Petersen, M. S.**, and Peñarrubia, J. *The radial variation of the LMC-induced reflex motion of the Milky Way disc observed in the stellar halo*, 2024, MNRAS, 531:2534. PhD student.

5. Johnson, A.C., **Petersen, M. S.**, Johnston, K.V., and Weinberg, M.D. *Dynamical Data Mining Captures Disc-Halo Couplings that Structure Galaxies*, 2023, MNRAS, 521, 1757. Columbia University Bridge Postgraduate Program.

4. Lilleengen, S., **Petersen, M. S.**, Erkal, D. and others. *The effect of the deforming dark matter haloes of the Milky Way and the Large Magellanic Cloud on the Orphan-Chenab stream*, 2023, MNRAS, 518:774. PhD student.

3. Donaldson, K., **Petersen, M. S.**, and Peñarrubia, J.. *Effects on the local dark matter distribution due to the Large Magellanic Cloud*, 2022, MNRASL 513:L48. Senior Honours/Vacation project.

2. Reddish, J., Kraljic, K, **Petersen, M. S.**, and others. *The NewHorizon Simulation – To Bar Or Not To Bar*, 2022, MNRAS 512:160. Senior Honours/Vacation Project.

Significant co-authored publications

5. Naik, A. & **Petersen, M. S.** *lintsampler: easy python sampling*, Journal of Open Source Software, 9, 102, 6906

4. Horta, D., **Petersen, M. S.** & Peñarrubia, J. *Disentangling the Galaxy's Gordian knot: evidence from APOGEE-Gaia for a knotted and slower bar in the Milky Way*, in MNRAS review.

3. Peñarrubia, J. & **Petersen, M. S.** *Identification of Sagittarius stream members in Angular Momentum space with Gaussian mixture techniques*, 2021, MNRASL 508:L26.

2. Weinberg, M. D. & **Petersen, M. S.** *Using Multichannel Singular Spectrum Analysis to Study Galaxy Dynamics*, 2021, MNRAS 501:5408.

1. Bary, Jeffrey S. & **Petersen, M. S.** *Anomalous Accretion Activity and the Spotted Nature of the DQ Tau Binary System*, 2014, ApJ, 792:64.

Collaborative publications

6. Brooks, R., and others including **Petersen, M. S.** *Action and energy clustering of stellar streams in deforming Milky Way dark matter haloes*, 2024, MNRAS, 532:2657.

5. Lucey, M., and others including **Petersen, M. S.** *Constraining the length and pattern speed of the Milky Way bar from direct orbit integration of APOGEE and Gaia data*, 2023, MNRAS, 520:4779.

4. Pérez Paolino, F., and others including **Petersen, M. S.** *Correlating Changes in Spot Filling Factors with Stellar Rotation: The Case of LkCa 4*, 2023, ApJ, 946:10.

3. Eckner, C., and others including **Petersen, M. S.** *How do the dynamics of the Milky*

Way - Large Magellanic Cloud system affect gamma-ray constraints on particle dark matter?, 2023, MNRAS, 518:4138.

2. Chamberlain, K., and others including **Petersen, M. S.** *Implications of the Milky Way travel velocity for dynamical mass estimates of the Local Group*, 2023, ApJ, 942:18.

1. Elmegreen, Debra M., and others including **Petersen, M. S.** *Clumpy Galaxies in Goods and Gems: Massive Analogs of Local Dwarf Irregulars* 2009, ApJ, 701:306.

**SCIENTIFIC
COLLABORATIONS**

Basis Function Expansion Collaboration

Co-PI of a Center for Computational Astrophysics (NYC)-funded collaboration.

Secular Evolution in Galaxies (SEGAL) Collaboration

Kinetic theory of barred galaxies with the SEGAL collaboration (IAP [Paris]).

**RECENT INVITED
SCIENCE TALKS**

New Methods in Milky Way Dynamics

July 2024

Basis function expansions for disequilibrium galactic dynamics

Kinetics 2024 Workshop, KITP

June 2024

Advances in linear response theory for stellar systems

ORGANISED MEETINGS

Secular evolution of self-gravitating systems

April 2023

Designed, proposed, and organised a weeklong Higgs Centre-funded workshop.

RECENT PROPOSALS

PI DiRAC, Tursa GPU cluster

2024

Reaching the collisionless limit in models for barred galaxy evolution

Co-I DiRAC, Tursa GPU cluster

2023

Extreme-resolution simulation and dynamical analysis of the MW-LMC interaction

TEACHING & ADVISING

University of Edinburgh Research Advisor

2019-present

Designed and advised four year-long MPhys projects. Designed, successfully sought funding for, and advised five summer research projects for advanced undergraduate students at the University of Edinburgh. Designed and advised ten semester-long Senior Honours over eight semesters.

Columbia University Post-Baccalaureate Bridge Advisor

2020-2022

Assisted advising, providing project guidance and numerical training, to a post-baccalaureate student at Columbia University, New York.

RECENT SERVICE

Peer Reviewer

Monthly Notices of the Royal Astronomical Society (MNRAS), The Astrophysical Journal (ApJ), Astronomy and Astrophysics (A&A), The Journal of Cosmology and Astroparticle Physics (JCAP), the Journal of Open Source Software (JOSS), and Science Advances.

IfA Equality, Diversity and Inclusion Team Organiser

2020-present

Initiated a team to promote issues of equality, diversity and inclusion at the Institute for Astronomy. Includes proposing for SoPA funding and advising summer internships (Summers 2023, 2024). Intern themes: Widening participation, BAME support, Best-practice PhD recruitment, Curriculum decolonisation recommendations.

	IfA Theory Lunch Organiser	2023-present
	IfA Computing Advisory Committee	2023-present
RECENT PUBLIC ENGAGEMENT TALKS	Royal Observatory Edinburgh Astronomy for All Talk <i>Galaxies in Technicolor</i>	October 2024
	Royal Observatory Edinburgh Open Days <i>Sonification of Galaxies</i>	September 2024
	Pint of Science Edinburgh <i>A year in the life of the Galaxy</i>	May 2023
	Royal Observatory Edinburgh Astronomy for All Talk <i>A billion years of stargazing</i>	March 2023