Michael S. Petersen

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Research	What is dark matter? How does it influence whof baryonic matter? I design, implement, executive merical models to understand dark matter dyna and their halo environs. I then use these results Milky Way galaxy big data sets.	nat we observe in the dynamics cute, and analyse precision nu- imical evolution in disc galaxies is to identify dynamical effects in
Position	Stephen Hawking Fellow Institute for Astronomy, Royal Observatory	April 2022-present Edinburgh, UK
	Postdoctoral Research Associate Institut d'Astrophysique de Paris, France	September 2021-March 2022
	Postdoctoral Research Associate Institute for Astronomy, Royal Observatory	May 2019-August 2021 Cedinburgh, UK
Education	Doctor of Philosophy , Astronomy University of Massachusetts at Amherst, A The non-linear dynamics of barred galaxy	February 2019 mherst, Massachusetts, USA evolution in ΛCDM
Publications	 first-author publications, 4 student first-author publications. <i>h</i>-index: 14. <i>First-author publications</i> (Citations as of August 2023) Petersen, M. S., Weinberg, M. D., and Katz, N. <i>Measuring the dynamical length of galactic bars</i>, MNRAS submitted. (0 citations) Petersen, M. S., Peñarrubia, J., and Jones, E. <i>Tidally stripped halo stars from the Large Magellanic Cloud in the Galactic North</i>, 2022, MNRAS, 514:2166 (5 citations) Petersen, M. S., Weinberg, M. D., and Katz, N. exp: <i>N-body integration using basis function expansions</i>, 2022, MNRAS, 510:6201. (13 citations) Petersen, M. S. & Peñarrubia, J. <i>Detection of the Milky Way reflex motion induced by the Large Magellanic Cloud infall</i>, 2021, Nature Astronomy, 5, 251. See summary of press coverage here. (58 citations) Petersen, M. S., Weinberg, M. D., and Katz, N. <i>Using commensurabilities and orbit structure to understand barred galaxy evolution</i>, 2021, MNRAS, 500:838. (18 citations) Petersen, M. S. & Peñarrubia, J. <i>Reflex motion in the Milky Way stellar halo resulting from the Large Magellanic Cloud infall</i>, 2020, MNRASL, 494:11. (49 citations) Petersen, M. S., Weinberg, M. D., and Katz, N. <i>Using torque to understand barred galaxy models</i>, 2019, MNRAS, 490:3616. (18 citations) Petersen, M. S., Gutermuth, R.A., Nagel, E., Wilson, G.W., Lane, J. <i>Early</i> 	

science with the Large Millimetre Telescope: new mm-wave detections of circumstellar discs in IC 348 from LMT/AzTEC, 2019, MNRAS, 488:1462. (3 citations)

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'. (9 citations)

1. **Petersen, M. S.**, Weinberg, M. D., and Katz, N. *Dark matter trapping by stellar bars: the shadow bar*, 2016, MNRAS, 463:1952–1967. (22 citations)

Student-led publications

4. 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. (1 citation)

3. 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 (20 citations)

2. 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. (4 citations)

1. Reddish, J., Kraljic, K, Petersen, M. S., and others. *The NewHorizon Simulation – To Bar Or Not To Bar*, 2022, MNRAS 512:160. (19 citations)

Significant co-authored publications

3. Peñarrubia, J. & **Petersen, M. S.** *Identification of Sagittarius stream members in Angular Momentum space with Gaussian mixture techniques*, 2021, MNRASL 508:L26. (11 citations)

2. Weinberg, M. D. & Petersen, M. S. Using Multichannel Singular Spectrum Analysis to Study Galaxy Dynamics, 2021, MNRAS 501:5408. (4 citations)

1. Bary, Jeffrey S. & Petersen, M. S. Anomalous Accretion Activity and the Spotted Nature of the DQ Tau Binary System, 2014, ApJ, 792:64. (17 citations)

Collaborative publications

3. 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. (7 citations)

2. 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. (1 citation)

1. 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. (8 citations)

Organised Meetings	Secular evolution of self-gravitating systems	April 2023
	Designed, proposed, and organised a weeklong Higgs Cer	ntre-funded work-

shop for thirty internal and external scientists.

Collaborations **Beyond Basis Function Expansion (B-BFE) Collaboration** Co-leader of a Center for Computational Astrophysics (NYC)-led collaboration. The group is working to develop a holistic approach to galaxy evolution using basis function expansions. I am directly responsible for coordinating software development.

Secular Evolution in Galaxies (SEGAL) Collaboration

Analysing barred galaxies in the New Horizon cosmological simulation within the SEGAL collaboration (Institut d'Astrophysique de Paris). The collaboration is developing a new kinetic theory-based picture of galactic dynamics, and focuses on secular evolution. I am responsible for mathematical development pertaining to isolated stellar systems and supplying a novel kinematic method to detect barred galaxies with unprecedented sensitivity.

Service Peer Reviewer

Serving as a peer reviewer for Monthly Notices of the Royal Astronomical Society (MNRAS), The Astrophysical Journal (ApJ), Astronomy and Astrophysics (A&A), and The Journal of Cosmology and Astroparticle Physics (JCAP).

ROE Equality, Diversity and Inclusion Team Organiser 2020-2023 Initiated a team to promote issues of equality, diversity and inclusion at the Institute for Astronomy. Includes proposing for funding and advising summer internships.

ROE Seminar Organiser

Responsible for selection of speakers and organising delivery of talks for the Royal Observatory. Includes remote organisation and hosting during workfrom-home period.

ROE Local Universe Reading Group Organiser

Responsible for programming and hosting a dozen-person reading group covering multiple research teams at the ROE. Includes remote organisation and hosting during work-from-home period.

Teaching & Advising University of Edinburgh Research Advisor 2019-2023 Designed and advised two MPhys projects. Designed, successfully sought funding for, and advised four summer research projects for advanced undergraduate students at the University of Edinburgh. Designed and advised eight Senior Honours over five semesters.

Columbia University Post-Baccalaureate Bridge Advisor 2020-2022 Assisted advising, providing project guidance and numerical training, to a postbaccalaureate student at Columbia University, New York.

Recent Invited **Durham University** October 2022 Science Talks A new picture for the Large Magellanic Cloud-Milky Way interaction **Institute Astrophysica Canarias** March 2022 A new picture for the Large Magellanic Cloud-Milky Way interaction

2019-2021

2019-2021

	Strasbourg Observatory A new picture for the Large Magellanic Cloud-Milky Way in	March 2022 teraction	
Public Engagement Talks	Pint of Science Edinburgh A year in the life of the Galaxy	May 2023	
	Royal Observatory Edinburgh A billion years of stargazing	March 2023	
	Moray Astronomy Club A billion years of stargazing	September 2022	
Affiliations	Higgs Centre for Theoretical Physics, University of Edinburgh Astrophysical Structure Formation group		
Professional Links	Research Webpage https://michael-petersen.github.io		
	Github Code Repository https://github.com/michael-	petersen	
Maintained Codes	exp: N-body simulations using basis functions (C++/CUDA). exptool: Basis function expansion analysis of N-body simulations (Python). LinearResponse.jl: Linear theory implemented in Julia.		