Michael S. Petersen

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Research

Design, implement, execute, and analyse precision numerical models to understand dark matter dynamical evolution in disk galaxies and their halo environs, particularly our own Milky Way.

Position

Postdoctoral Research Associate September 2021-
Institut d'Astrophysique de Paris

Postdoctoral Research Associate May 2019-August 2021
Institute for Astronomy, Royal Observatory Edinburgh

Education

Doctor of Philosophy, Astronomy February 2019
University of Massachusetts at Amherst, Amherst, MA, USA
The non-linear dynamics of barred galaxy evolution in ΛCDM
Advisors: Martin D. Weinberg, Neal Katz

Bachelor of Arts, Astronomy & Physics, Music May 2010
Colgate University, Hamilton, NY, USA

Collaborations

Basis-function expansion (Beefy) 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.

SEGAL Collaboration
Assisting analysis of barred galaxies in the New Horizon simulation within the SEGAL collaboration (PI: Christophe Pichon [Institut Astrophysique de Paris]). The collaboration is developing a new kinetic theory-based picture of galactic dynamics. I am responsible for supplying a novel kinematic method to detect barred galaxies with unprecedented sensitivity.

Surrey-Edinburgh Streams Collaboration
Responsible for building a revolutionary numerical framework to simulate stellar streams in the presence of an evolving potential. Development is directly supporting a PhD project in Surrey.

Service

ROE Equality, Diversity and Inclusion Team Organiser 2020-2021
Initiated a team to study issues of equality, diversity and inclusion at the Institute for Astronomy.

ROE Seminar Organiser 2019-2021
Responsible for selection of speakers and organising delivery of talks for the Royal Observatory. Includes remote organisation and hosting during work-from-home period.

ROE Local Universe Reading Group Organiser 2019-2021
Responsible for programming and hosting a roughly dozen-person reading group covering multiple research teams at the ROE. Includes remote organisation and hosting during work-from-home period.

Teaching & Advising

Columbia Post-Baccalaureate Program Research Advisor 2020-
Assisted advising, providing project guidance and numerical training, to a post-baccalaureate student at Columbia University, New York.

University of Edinburgh Research Advisor 2019-2021
Designed and advised a masters project at the University of Edinburgh. Designed, sought funding for, and advised two summer research projects for advanced undergraduate students at the University of Edinburgh. Designed and advised seven research projects for undergraduate students at the University of Edinburgh over four semesters.

Recent Invited Science Talks

University of Surrey February 2021
Modelling Milky Way dark matter from the largest to the smallest scales

Institute of Astronomy (Cambridge) Dynamics Group May 2020
Bar models beyond analytic formulae

AIP (Potsdam) Local Universe Group January 2020
Bespoke N-body experiments in barred galaxy dynamics

Recent Outreach Talks

Royal Observatory Edinburgh January 2021
How do astronomers model gravity?

Royal Observatory Open Days September 2020
Spaceship Earth: The amazing travels of our home through the cosmos

Highlands Astronomical Society August 2020
Why Can't We Find Dark Matter?

Recent Meetings & Conferences

AAS DDA, May 2021, online
Contributed Talks: *Bringing Potentials to life: Milky Way-Large Magellanic Cloud modelling and non-linear dynamics*, *Building an Equality, Diversity, and Inclusion team at the Royal Observatory Edinburgh*

Streams21, February 2021, online
Contributed Talk: *Bringing Potentials to life: Milky Way-Large Magellanic Cloud modelling and non-linear dynamics*

Referee Experience

Monthly Notices of the Royal Astronomical Society.

Publications

First-author publications

8. **Petersen, M. S.**, Weinberg, M. D., and Katz, N. exp*: N-body integration using basis function expansions*, MNRAS accepted.
7. **Petersen, M. S.**, Weinberg, M. D., and Katz, N. *Using commensurabilities and orbit structure to understand barred galaxy evolution*, 2021, MNRAS, 500:838.
6. **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.
5. **Petersen, M. S.** & Peñarrubia, J. *Reflex motion in the Milky Way stellar halo resulting from the Large Magellanic Cloud infall*, 2020, MNRASL, 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.

First-author publications in review

2. **Petersen, M. S.**, Peñarrubia, J., and Jones, E. *Tidally stripped halo stars from the Large Magellanic Cloud in the Galactic North*, arXiv e-prints.
1. **Petersen, M. S.**, Weinberg, M. D., and Katz, N. *Using harmonic decomposition to understand barred galaxy evolution*, arXiv e-prints.

Significant co-authored publications

5. Donaldson, K., **Petersen, M. S.**, and Peñarrubia, J.. *Effects on the local dark matter distribution due to the Large Magellanic Cloud*, MNRAS submitted.
4. Reddish, J., Kraljic, K, **Petersen, M. S.**, and others. *The NewHorizon Simulation – To Bar Or Not To Bar*, MNRAS submitted.
3. Peñarrubia, J. & **Petersen, M. S.** *Identification of Sagittarius stream members in Angular Momentum space with Gaussian mixture techniques*, 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.

Selected Observational Experience

NASA IRTF, Co-I (2018B, 2019B, 2020B), 12 nights
SpeX+MORIS Star Spot Monitoring of K2 Selected T Tauri Stars
iSHELL Accretion and Gas Dynamics in Transition Disk-bearing Young Stars Across the Substellar Boundary

KPNO 0.9m, PI (2016-2017), 5 nights; Co-I (2014-2018), 30 nights
Deep Imaging of Nearby Low Surface Brightness Disks
Ionization States of Green Pea Galaxies

Large Millimeter Telescope, PI (Early Science 2,3,4 2014-2016), 60 hours
Circumstellar Disk Masses in IC 348

Professional Links

Research Webpage `https://michael-petersen.github.io`

Github Code Repository `https://github.com/michael-petersen`

References

Christophe Pichon
Institut d'Astrophysique de Paris postdoctoral research supervisor.

Jorge Peñarrubia
University of Edinburgh postdoctoral research supervisor.

Martin D. Weinberg
University of Massachusetts, Amherst, dissertation advisor.