

Philip Breen

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Employment

Postdoctoral Researcher - University of Edinburgh May 16 - Present

- Applying machine learning techniques to problems in theoretical astrophysics
- Projects include:
 - Training deep neural networks to tackle the 3-body problem
 - Developing a novel Monte Carlo code powered by a generative adversarial trained network
 - Density estimation of phase space distribution functions
 - Dynamical evolution of collision systems (e.g. Globular clusters, Nuclear star clusters)
 - Collaborating with ESO based team on a population dynamics modelling code
- Contributing to the development of HyPrColco which performs multi-trait co-localization
- Primarily working in Python (numpy, scipy, tensorflow, scikit-learn) with numerical simulations in C++, Fortran, CUDA

Senior Software Engineer - Xhail May 15 - Oct 15

- Full stack developer, developing real-time music composition software
- Technology stack included Play framework, Amazon Web Services, PostgreSQL

Senior Risk and Valuation Specialist - Citco Fund Services Feb 14 - April 14

- Pricing OTC and other derivatives for hedge funds
- Regulatory and operation risk reporting, VaR, scenario analysis
- Developing internal software tools (Java, Oracle SQL, VBA and Excel)

Reservoir Engineer - Belltree Limited Mar 13 - Feb 14

- Predictive modelling of oil and gas fields
- Statistical analysis of real and simulated reservoir data
- Developing a prototype statistical software tool

PhD researcher & Undergraduate Tutor, University of Edinburgh Sept 09 - April 13

- Research focused on the evolution of stellar mass black holes in globular star clusters
- Running numerical simulations on GPU (Fortran, C++, CUDA)
- Tutoring numerous undergraduate mathematics courses

Education

PhD Applied and Computational Mathematics Sept 2009 - July 2013

Thesis: *Dynamical evolution of idealised star cluster models*

Supervisor: Prof. Douglas Hoggie.

University of Edinburgh, Edinburgh, Scotland

BSc (Hons) Mathematics 1st class

Sept 2005 - July 2009

Honours Project: *Algorithms for Sparse Approximation*

Honours Project supervisor: Prof. Jared Tanner

University of Edinburgh, Edinburgh, Scotland

Programming Experience

Languages: Python, Java (including J2EE, Spring Framework), C++ (including stl, boost), C, FORTRAN
Databases: Oracle SQL, PostgreSQL, MySQL
Web: Play Framework, JavaScript, HTML5, CSS3
High performance: CUDA, openMP, MPI

Teaching Experience

Mathematics Tutor, University of Edinburgh

Sept 09 - July 2013

I have tutored numerous undergraduate mathematics courses over the course of my PhD. I frequently motivated and encouraged students to reach their full potential. I have developed the ability to identify any barriers or difficulties which the students were experiencing and helped them to overcome these. Encouraging teamwork is an important aspect of my role as students are often required to work together to solve mathematical problems. I have also worked as a computer laboratory assistant for the Mathematical Communication and Computation module where I helped teach students mathematical programming skills.

Modules tutored:

Mathbase (drop in center for undergraduate students)
Complex Variables & Differential Equations
Mathematics for Electrical and Mechanical Engineers 3 & 4
Calculus and its Applications
Group Theory: An Introduction to Abstract Mathematics
Geometry and Convergence
Mathematical Communication and Computation
Applied Mathematics 1 & 2
Mathematical Methods 1& 2

Conference Talks

Light element variations in globular clusters via nucleosynthesis in black hole accretion discs
Multiple Populations in Stellar Clusters, Sixten Center for Astrophysics, July 2018

Dynamical evolution of globular clusters in dark matter halos
Tracing star and cluster formation across cosmic times, Sixten Center for Astrophysics, July 2018

Unveiling the Kinematic Richness of Star Clusters
MODEST-18: Dense Stellar Systems in the Era of Gaia, Ligo & Lisa, June 2018

The physical origin of stellar envelopes around globular clusters
MODEST-17: Under Pragues starry skies, Prague, Czech, Sept 2017

Dynamical evolution of globular clusters in dark matter halos
AAS DDA Meeting, London, UK, June 2017

Core Collapse Times in Anisotropic Plummer Models (Poster)
Wilhelm und Else Heraeus-Seminar: Stellar aggregates over mass and spatial scales,
Physikzentrum Bad Honnef, Germany, Dec 2016

Lynden-Bell, phase space parity, and rotating stellar systems
Gaia Challenge, Nordita, Stockholm, Sweden, Oct 2016

The Dynamical Evolution of Stellar-mass Black Hole Subsystems in Star Clusters
SUPA Cormack Astronomy Meeting, Royal Society of Edinburgh, Edinburgh, Nov 2012

Gravothermal Oscillations in Two-component Models of Star Clusters
Dark Energy Probes and the Dynamical Evolution of Globular Clusters, Bertinoro, May 2011

Galactic Disks and Bar Formation (workshop project)
Advanced School and Workshop on Computational Gravitational Dynamics,
Lorentz Center, Leiden, Netherlands, May 2010

Publications in review

Newton vs the Machine: solving the chaotic three-body problem using deep neural networks
P.G. Breen, C.N. Foley, et al, (under review Nature Communications)

Mapping the stability of stellar rotating spheres via linear response theory
S. Rozier, J.B. Fouvry, P.G. Breen, et al, (under review MNRAS)

Publications in preparation

Fast and efficient co-localization algorithm for identifying shared genetic risk factors across numerous traits
C.N. Foley, J.R. Staley, P.G. Breen et al, (to be submitted shortly to Nature Genetics)

Gecko: a novel Monte Carlo code powered by generative adversarial networks for collisional stellar systems
P.G. Breen et al, (to be submitted to Nature Astronomy)

The Kinematic Richness of Star Clusters - II. Isolated Rotating Models
P.G. Breen, A.L. Varri, D.C. Heggie

The Kinematic Richness of Star Clusters - III. Bar Formation in Rotating Models
P.G. Breen, A.L. Varri, D.C. Heggie

The physical origin of stellar envelopes around globular clusters
P.G. Breen, A.L. Varri, J. Pearrubia, D.C. Heggie

Publications in peer reviewed journals

Light element variations in globular clusters via nucleosynthesis in black hole accretion discs
P.G. Breen, 2018, MNRAS Letters, L110-L114

The kinematic richness of star clusters I. Isolated spherical models with primordial anisotropy
P.G. Breen, A.L. Varri, D.C. Heggie, 2017, MNRAS, 471 (3), 2778

Stellar envelopes of globular clusters embedded in dark mini-haloes
J. Pearrubia, A.L. Varri, P.G. Breen, A. Ferguson, R. Sanchez-Janssen, 2017, MNRAS, 471 (1), L31

On black hole subsystems in idealized nuclear star clusters
P.G. Breen, D.C. Heggie, 2013, MNRAS, 436 (1), 584

Dynamical evolution of black hole subsystems in idealized star clusters
P.G. Breen, D.C. Heggie, 2013, MNRAS, 432 (4), 2779

Gravothermal oscillations in multicomponent models of star clusters
P.G. Breen, D.C. Heggie, 2012, MNRAS, 425 (4), 2493

Gravothermal oscillations in two-component models of star clusters
P.G. Breen, D.C. Heggie, 2012, MNRAS, 420 (1), 309