Dr. Ankit Barik

224 Olin Hall, Johns Hopkins University, 3400 N. Charles St., Baltimore 21218, USA
abarik@jhu.edu • ankitbarik.github.io • AnkitBarik
MHDwizard • Ankit Barik

Experience

Dept. of Earth & Planetary Sciences, Johns Hopkins University — **Baltimore, USA**
Assistant Research Scientist — *Nov 2022 – Present*

Dept. of Earth & Planetary Sciences, Johns Hopkins University — **Baltimore, USA**
Postdoctoral researcher — *Nov 2017 – Nov 2022*

Max Planck Institute for Solar System Research — **Göttingen, Germany**
Postdoctoral researcher — *May 2017 – Oct 2017*

Education

Georg-August-Universität Göttingen/MPI for Solar System Research — **Göttingen, Germany**
PhD, *Magna cum laude* — *2013 – 2017*

- Thesis title: Inertial modes, turbulence and magnetic effects on a differentially rotating spherical shell
- Thesis supervisors: Dr. Johannes Wicht, Prof. Dr. Ulrich R. Christensen, Prof. Dr. Andreas Tilgner
- Defence date: 08 May, 2017

Indian Institute of Technology, Kharagpur — **Kharagpur, India**
Bachelor's + Master's — *2008 – 2013*

- *Major*: Exploration Geophysics, *Minor*: Physics
- Thesis title: Effect of gravity environment on dynamo action in rotating spherical shells
- Thesis supervisors: Dr. Johannes Wicht, Prof. W.K. Mohanty
- Awarded Best Master's Thesis by the Department of Geology & Geophysics

Summer/Winter Schools

As instructor:

- Kavli Summer Program In Astrophysics 2021: "Fluid dynamics of the Sun and Stars", virtual, hosted by MPI for Solar System Research, Göttingen, Germany, June 7th - July 16th, 2021

As student:

- 12^{th} International School/Symposium for Space Simulations (ISSS-12), Prague, Czech Republic, July 2 - 6, 2015
- 'Turbulence, magnetic fields and self organization in laboratory and astrophysical plasmas', Les Houches, France, March 23 - April 03, 2015

Grants/Awards

2024	Invited professorship at École Centrale Méditerranée/IRPHE, Marseille, France
2024	PI, ACCESS Discover computing time 1.5×10^6 core-hours
2021	Postdoctoral science teaching fellowship for course "Stellar & Planetary Waves"
2020	NASA grant proposal for the Cassini Data Analysis Program. Total amount granted: $488,710
Jul 2015 - Jul 2020	Granted total computational time worth ≈$600,000 by the North-German Supercomputing Alliance
2013	Among top 1% selected for a program for fully sponsored PhD in computational sciences by Shell. (declined)
2012	Ranked 2^{nd} in India in Schlumberger's coding competition for a seismic inversion plug-in for their software 'Petrel'.

Skills

Programming languages:
- Well-versed : C, Fortran, Python, MATLAB
- Some experience : C++, HTML, CSS
- Scripting : Bash, CMake, Sphinx (documentation)

Research computing skills:
- Spectral/Pseudo-spectral methods in magnetohydrodynamics, particularly in spherical geometry
- MICE : MATLAB interface for NASA's SPICE Toolkit
- Visualisation : Paraview, MATLAB
- Parallel Programming : MPI, OpenMP
- Version control systems : Git, Mercurial, Subversion
- HPC batch schedulers : PBS, LSF, LoadLeveler, SLURM

Other:
- Illustration : Inkscape, Adobe Illustrator
- Video/audio editing : DaVinci Resolve, Audacity, Garage Band

Code development

- **MagIC** : 3D pseudo-spectral magnetohydodynamics (MHD) code to study planetary and stellar interiors. Community code used in over 100 publications. (https://github.com/magic-sph/magic)
- **Kore** : 3D Spectral MHD eigenvalue code. (https://github.com/repepo/kore)
- **GAMERA** : 3D finite volume MHD code to study magnetospheres
- **planetMagFields** : Teaching/research tool to visualize magnetic fields of planets in our solar system. (https://github.com/AnkitBarik/planetMagFields).
- **inermodz** : Python package to compute and plot analytical inertial eigenmodes of a sphere (https://github.com/AnkitBarik/inermodz).

Publications

Published

[1] **A. Barik** and R. Angappan. planetmagfields: A python package for analyzing and plotting planetary magnetic field data. *Journal of Open Source Software*, 9(97):6677, 2024.

[2] F. Seuren, S. A. Triana, J. Rekier, **A. Barik**, and T. Van Hoolst. Effects of the Librationally Induced Flow in Mercury's Fluid Core with an Outer Stably Stratified Layer. *The Planetary Science Journal*, 4(9):161, September 2023.

[3] C. Yan, **A. Barik**, S. Stanley, J. Leung, A. Mittelholz, C. L. Johnson, A.-C. Plesa, and A. Rivoldini. An ancient martian dynamo driven by hemispheric heating: effect of thermal boundary conditions. *Planetary Science Journal*, 2023.

[4] T. Gastine, **A. Barik**., rraynaud, t schwaiger, B. Putigny, thtassin, J. Wicht, L. Duarte, and B. Dintrans. magic-sph/magic: release magic 6.2, December 2022.

[5] **A. Barik**, S. A. Triana, M. Calkins, Stanley S., and J. Aurnou. Onset of convection in rotating spherical shells: Variations with radius ratio. *Earth and Space Science*, 2022.

[6] K. M. Moore, **A. Barik**, S. Stanley, D. J. Stevenson, N. Nettelmann, R. Helled, T. Guillot, B. Militzer, and S. Bolton. Jupiter's dynamo magnetic field: The role of stable stratification and a dilute core. *Journal of Geophysical Research: Planets*, 2022.

[7] S. A. Triana, G. Guerrero, **A. Barik**, and J. Rekier. Identification of inertial modes in the solar convection zone. *The Astrophysical Journal Letters*, jul 2022.

[8] M. Le Bars, **A. Barik**, F. Burmann, D. P. Lathrop, J. Noir, N. Schaeffer, and S. A. Triana. Fluid Dynamics Experiments for Planetary Interiors. *Surveys in Geophysics*, December 2021.

[9] B. J. Anderson, R. Angappan, **A. Barik**, S. K. Vines, S. Stanley, P. N. Bernasconi, H. Korth, and R. J. Barnes. Iridium Communications Satellite Constellation Data for Study of Earth's Magnetic Field. *Geochemistry, Geophysics, Geosystems*, August 2021, **Highlighted by the Nature magazine** (`https://www.nature.com/articles/d41586-021-01860-9`).

[10] V. Perera, C. Mead, K. J. van der Hoeven Kraft, S. Stanley, R. Angappan, S. MacKenzie, **A. Barik**, and S. Buxner. Considering intergroup emotions to improve diversity and inclusion in the geosciences. *Journal of Geoscience Education*, July 2021.

[11] **A. Barik**, S. A. Triana, M. Hoff, and J. Wicht. Triadic resonances in the wide-gap spherical couette system. *Journal of Fluid Mechanics*, 2018.

Submitted/Under review

[12] C. Yan, **A. Barik**, S Stanley, A-C. Plesa, A. Rivoldini, A. Mittelholz, and C. L. Johnson. Mars' hemispheric magnetic field from a full-sphere dynamo.

[13] **A. Barik**, S. A. Triana, M. Hoff, and J. Wicht. Transition to turbulence in the wide-gap spherical couette system.

Soon to be submitted

[14] **A. Barik**, S. Stanley, B. Tian, S. Tikoo, and B. Weiss. An ancient lunar dynamo driven by mantle precession and convection.

[15] R. Angappan, **A. Barik**, B. J. Anderson, S. K. Vines, and Stanley S. Fast global wave detection in geomagnetic jerk occurrences with commercial satellites.

Selected talks and Posters

Invited

2023, Oct 11	(Magneto-)hydrodynamic simulations in rotation spherical shells: inertial modes, triadic resonances and tides, *Planetary Lunch Series (PLS)*, MIT
2022, Dec 12-16	Comparison of Jupiter's and Saturn's magnetic fields and implications for their interiors, *AGU Fall Meeting 2022*, Chicago
2022, Oct 27	Onset of convection in rotating spherical shells : Variations with radius ratio, *Fluids & MHD seminar*, University of Leeds
2022, Jul 14	Effect of libration on a stable layer: an application to Mercury, *17th SEDI symposium*, ETH Zurich
2022, May 27	Onset of convection in rotating spherical shells, *IGPP Seminar*, UC Santa Cruz
2021, Nov 11	The ancient lunar dynamo, *EPM Group Seminar*, ETH Zurich
2021, Jul 27	planetMagFields : A python package for planetary magnetic fields, *OpenPlanetary Virtual Lunches*, Virtual
2020, Sep	Dynamos driven by convection and precession, *17th Symposium of Study of the Earth's Deep Interior (SEDI)*, Virtual
2020, Sep 1-4	Triadic resonances in the spherical Couette system, *ISSI workshop on Deep Earth*, (Hybrid) Bern, Switzerland
2018, Feb 15	The spherical Couette system: simple yet complex, *Applied Dynamics Seminar Series*, University of Maryland, College Park, USA
2017, Feb 27-28	Inertial and magneto-Coriolis modes in the spherical Couette flow, 3^{rd} *ANR IMAGINE Meeting*, L'Institut de Recherche en Astrophysique et Planétologie (IRAP), Toulouse, France

Contributed

2021, Dec 13-17 Onset of convection in rotating spherical shells, *AGU Fall Meeting 2021*
2020, Dec 1-17 The ancient lunar dynamo, *AGU Fall Meeting 2020*, Virtual
2019, Dec 9-13 Inertial Wave Generation from Boundary Layer Turbulence, *AGU Fall Meeting 2019*, San Francisco, USA
2019, May 20-22 A Lunar dynamo driven by mantle precession and convection, *Core of the Moon workshop*, Marseille, France
2017, Jun 25-Jul 1 Triadic resonances in the spherical Couette flow, 2^{nd} *Conference on Natural Dynamos*, Valtice, Czech Republic
2017, Jun 25-Jul 1 Spherical Couette dynamos, 2^{nd} *Conference on Natural Dynamos*, Valtice, Czech Republic
2015, Jun 22-24 Flow instabilities in the Spherical Couette System, *19th International Couette-Taylor Workshop*, Brandenburg University of Technology, Cottbus, Germany

Posters

2023, Nov 19-21 Kore : A spectral anelastic MHD eigenvalue code for rotating fluids in spherical geometries, *76th Annual Meeting of the Division of Fluid Dynamics*, Washington DC, USA
2018, Dec 10-14 A Lunar Dynamo Driven by Mantle Precession and Convection, *AGU Fall Meeting 2018*, Washington DC, USA
2018, Jul 8-13 Turbulence in spherical Couette flow and the effect of density stratification, *Study of the Earth's Deep Interior (SEDI) 2018*, Edmonton, Canada
2016, Dec 12-16 Identification and onset of inertial modes in the wide-gap spherical Couette system, *AGU Fall Meeting 2016*, San Francisco, USA

Teaching

March 2021 Certificate of completion - Johns Hopkins "Teaching Academy"
- Attending course "Preparation for university teaching"
- Attending pedagogy seminars/workshops
- More than six hours of teaching

Graduate courses

2024 Sep - Nov **Invited lecturer** at École Centrale Méditerranée / IRPHE, Marseille, France
2023 Fall **Cloos Memorial Lecturer** "Earth and Planetary Fluids"
2021 Spring **Guest lecturer**, "Planetary Interiors", Johns Hopkins University
2021 Spring **Guest lecturer**, "Special topics in dynamo theory", Johns Hopkins University
2019 Fall **Guest lecturer**, "Earth and Planetary Fluids I", Johns Hopkins University
2019 Spring **Guest lecturer**, "Planetary Interiors", Johns Hopkins University
2014 Fall **Teaching assistant**, "Solar System Science: The Central Star", University of Göttingen

Undergraduate courses

2014 Spring **Teaching assistant**, "Computational Physics", University of Göttingen
2014 Spring **Teaching assistant**, "Introduction to Astro-and Geophysics", University of Göttingen

Other

2015 Nov 4-6 **Tutor**, hands-on workshop on 'MagIC' code "Dynamos in a Nutshell"

Mentoring and supervision

Graduate students

- Hachem Dhouib, PhD student at CEA Saclay, for Kavli Summer Program in Astrophysics 2021, June 7th to July 16th, 2021
  - Project: Angular momentum transport by gravito-inertial waves in intermediate-mass stars
- PhD students in the research group: Chi Yan (graduated), Regupathi Angappan (graduated), Mayuri Sadhasivan

Undergraduate students

Fall 2018	Nina Amezcua	Exoplanet magnetic fields
Fall 2018	Mackenzie Mills	Ancient martian dynamo
Summer 2020	Brian Song	(co-advising) Magnetic data from Iridium Satellites
Summer 2021	Nick Lu	(co-advising) Magnetospheric simulations of the Earth
Summer 2021	Vishnu Srinivasan	(co-advising) Spherical harmonic transforms, use of MagIC simulation code

Professional services

Grant review

- Referee, ETH Zurich Research Grant Program, Sep 2022
- Referee, ETH Zurich Research Grant Program, May 2022
- External reviewer, NASA review panel, 2020
- Primary/secondary reviewer, NASA review panel, 2019

Journal referee

- European Journal of Mechanics - B/Fluids
- Geophysical & Astrophysical Fluid Dynamics
- Earth and Space Science
- The Astrophysical Journal
- Journal of Open Source Software
- Space Science Reviews
- Astronomy & Astrophysics
- Planetary Science Journal
- Geophysical Journal International
- Earth, Planets and Space
- Geophysical Research Letters
- International Journal on Geomathematics
- Journal of Geophysical Research: Planets
- Physics of Fluids

Member

- Excutive committee, web / social media manager for Geomagnetism, Paleomagnetism and Electromagnetism (GPE) Section of AGU
- American Geophysical Union (AGU)
- American Physical Society (APS)

Conference organisation

2023, Dec 12	Co-convener of session "P23G - Oscillations in Internal Fluid Layers of Planets, Moons, and Stars" at AGU Fall Meeting 2023
2016, Nov 30-Dec 2	17^{th} MHD Days, 88 participants
2015, Nov 22-24	14^{th} General meeting of PhDnet, 99 participants
2015, Nov 4-6	MagIC code workshop "Dynamos in a Nutshell", 35 participants

Outreach

2023, Apr 4	AGU "Ask a Scientist" table at Earth Day 2023, Washington DC
2020 - present	Social media manager for DIYnamics (Twitter: @DIYnamicsTeam) - an outreach effort from UCLA for studying/demonstrating geophysical fluid dynamics at home/class
2019, Sep/Oct	Outreach video "The Magnetic Fields of the Solar System" (https://www.youtube.com/watch?v=7S_VqFJep_0) - 37k views
2019, Oct 8	Talk "Everything wrong with The Core" - a talk on the movie
2019, Jul 24	Talk "Planetary magnetic fields: where do they all come from?" at the 2019 QuarkNet workshop
2018	Volunteer at the National Air and Space Museum, Washington DC