

# Dr. Ankit Barik

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## Experience

<b>Dept. of Earth &amp; Planetary Sciences, Johns Hopkins University</b> <i>Assistant Research Scientist</i>	<b>Baltimore, USA</b> Nov 2022 – Present
<b>Dept. of Earth &amp; Planetary Sciences, Johns Hopkins University</b> <i>Postdoctoral researcher</i>	<b>Baltimore, USA</b> Nov 2017 – Nov 2022
<b>Max Planck Institute for Solar System Research</b> <i>Postdoctoral researcher</i>	<b>Göttingen, Germany</b> May 2017 – Oct 2017

## Education

<b>Georg-August-Universität Göttingen/MPI for Solar System Research</b> PhD, <i>Magna cum laude</i>	<b>Göttingen, Germany</b> 2013 – 2017
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- 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

<b>Indian Institute of Technology, Kharagpur</b> Bachelor's + Master's	<b>Kharagpur, India</b> 2008 – 2013
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- *Major*: Exploration Geophysics, *Minor*: Physics
- Thesis title: Effect of gravity environment on dynamo action in rotating spherical shells
- 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<sup>th</sup> 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

2021	Postdoctoral science teaching fellowship for course "Stellar & Planetary Waves" (course cancelled due to low registration)
2020	Co-wrote a successful NASA grant proposal for the Cassini Data Analysis Program. Total amount granted: \$488,710
Jul 2015 - Jul 2020	Granted total computational time worth € 522,000 by the North-German Supercomputing Alliance (HLRN).
2013	Selected for fully sponsored PhD in computational sciences by Shell. (declined)
2012	Ranked 2 <sup>nd</sup> in India by Schlumberger for a seismic inversion plug-in for their software 'Petrel'.

## Publications

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### Published.....

- [1] 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.
- [2] 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.
- [3] **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.
- [4] 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.
- [5] 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.
- [6] 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.
- [7] 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.
- [8] 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.
- [9] **A. Barik**, S. A. Triana, M. Hoff, and J. Wicht. Triadic resonances in the wide-gap spherical couette system. *Journal of Fluid Mechanics*, 2018.

### In prep.....

- [10] **A. Barik**, S. A. Triana, M. Hoff, and J. Wicht. Transition to turbulence in the wide-gap spherical couette system.
- [11] **A. Barik** and S. Stanley. An ancient lunar dynamo driven by mantle precession and convection.
- [12] R. Angappan, **A. Barik**, B. J. Anderson, S. K. Vines, and Stanley S. Fast global wave detection in geomagnetic jerk occurrences with commercial satellites.
- [13] 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.

## Teaching

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| March 2021 | Certificate of completion - Johns Hopkins "Teaching Academy" <ul style="list-style-type: none"><li>○ Attending course "Preparation for university teaching"</li><li>○ Attending pedagogy seminars/workshops</li><li>○ More than six hours of teaching</li></ul> |
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## Graduate courses.....

- 2023 Fall                    **Cloos Memorial Lecturer** “Earth and Planetary Fluids”  
○ Co-teaching full course
- 2021 Spring                **Guest lecturer**, “Planetary Interiors”, Johns Hopkins University  
○ Introduction to planetary magnetic fields
- 2021 Spring                **Guest lecturer**, “Special topics in dynamo theory”, Johns Hopkins University  
○ Converting a solid body rotation to toroidal potential
- 2019 Fall                    **Guest lecturer**, “Earth and Planetary Fluids I”, Johns Hopkins University  
○ Introduction to waves  
○ Surface gravity and internal gravity waves  
○ Introduction to turbulence
- 2019 Spring                **Guest lecturer**, “Planetary Interiors”, Johns Hopkins University  
○ Introduction to dynamo theory  
○ Introduction to spherical harmonics and Gauss coefficients  
○ Brief overview of fluid and magnetohydrodynamic waves

## Undergraduate courses.....

- 2014 Fall                    **Teaching assistant**, “Solar System Science: The Central Star”, University of Göttingen
- 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

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### 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
  - Daily advising, meeting almost every day
- PhD students in the research group:
  - Chi Yan (graduated) : co-advising, meeting once every few weeks, general advice on simulations
  - Regupathi Angappan : daily advising, meeting once or twice every week and when needed
  - Mayuri Sadhasivan : co-advising, meeting once every two weeks, general advice on simulations, physics and mathematics

### Undergraduate students.....

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|-------------|-------------------|---------------------------------------------------------------------------|
| 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

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### 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

- 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 Geomatics
- Journal of Geophysical Research: Planets
- Physics of Fluids

### Member

- Member of executive committee, web and social media manager for Geomagnetism, Paleomagnetism and Electromagnetism (GPE) Section of AGU (Twitter: @AGUMagnetism )
- Member of American Geophysical Union (AGU)

### Conference organisation

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

## Skills

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### 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

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- **MagIC** : 3D pseudo-spectral magnetohydrodynamics (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>)
- **inermodz** : Python package to compute and plot analytical inertial eigenmodes of a sphere (<https://github.com/AnkitBarik/inermodz>).
- **planetMagFields** : Teaching/research tool to visualize magnetic fields of planets in our solar system. (<https://github.com/AnkitBarik/planetMagFields>).

## Selected talks and Posters

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### Invited.....

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

### Contributed.....

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

### Posters.....

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

### Outreach

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2023, Apr 4	AGU "Ask a Scientist" table at Earth Day 2023, Washington DC
2020 - present	Social media manager for DIYdynamics (Twitter: @DIYdynamicsTeam) - 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" ( <a href="https://www.youtube.com/watch?v=7S_VqFJep_0">https://www.youtube.com/watch?v=7S_VqFJep_0</a> ) - narration, sound editing and co-authoring script
2019, Oct 8	Talk "Everything wrong with The Core" for movie night of undergrad club Sigma Gamma Epsilon
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