

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

## Education

<b>International Max Planck Research School for Solar System Science</b> PhD, <i>Magna cum laude</i>	<b>Göttingen, Germany</b> <i>2013 – 2017</i>
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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> <i>2008 – 2013</i>
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- *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

### Summer/Winter Schools.....

- 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

### Visiting positions.....

2024                                      Invited professorship at École Centrale Méditerranée/IRPHE, Marseille, France. Total funding received : \$10,000

### NASA Grants.....

2020                                      (Co-wrote) NASA grant proposal for the Cassini Data Analysis Program : \$488,710

### Computing time.....

2024                                      PI, ACCESS Discover computing time 1.5 million core-hours  
Jul 2015 - Jul 2020                      Computational time at the North-German Supercomputing Alliance : \$600,000

## Other.....

2021	Postdoctoral science teaching fellowship for course “Stellar & Planetary Waves”
2013	Among top 1% selected for a program for fully sponsored PhD in computational sciences by Shell. (declined)
2013	Best Master’s Thesis, Department of Geology & Geophysics, IIT Kharagpur
2012	Ranked 2 <sup>nd</sup> in India in Schlumberger’s coding competition for a seismic inversion plug-in for their software ‘Petrel’

## Mission involvement

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Part of science team of the InSight (Interior Exploration using Seismic Investigations, Geodesy and Heat Transport) Mars mission.

## 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>)
- **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

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### Articles.....

- [1] **A. Barik**, S. A. Triana, M. Hoff, and J. Wicht. Transition to turbulence in the wide-gap spherical couette system (*Accepted*). *Journal of Fluid Mechanics*, 2024.
- [2] **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.
- [3] F. Seuren, S. A. Triana, J. Requier, **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.
- [4] 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.
- [5] 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.
- [6] **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.
- [7] 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.
- [8] S. A. Triana, G. Guerrero, **A. Barik**, and J. Requier. Identification of inertial modes in the solar convection zone. *The Astrophysical Journal Letters*, jul 2022.
- [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.

#### Book Chapters.....

[12] 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.

#### Submitted/Under review.....

[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.

#### 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.

[16] M. Sadhasivan, **A. Barik**, and S. Stanley. Ice giant dynamos with a highly conducting superionic core.

[17] S. A. Triana, J. Requier, F. Gerick, **A. Barik**, and V. Dehant. Torsional Alfvén modes in the earth's core: A numerical model.

## Selected talks and Posters

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#### Invited talks.....

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| 2024, Aug 26-30 | Effect of the Mantle on Planetary Core-driven Dynamos, <i>Magnetism, Atmospheres, and Life workshop</i> , University of Illinois Urbana-Champaign  |
| 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, Jul 14    | Effect of libration on a stable layer: an application to Mercury, <i>17<sup>th</sup> SEDI symposium</i> , ETH Zurich   |
| 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> , Bern, Switzerland   |
| 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 |
| 2014, Dec 13    | Spherical Couette flow simulations, <i>Workshop on Geomagnetic Prediction</i> , hosted by the CIDER project, UC Berkley, Berkley, California, USA  |

## Invited seminars.....

2024, Sep	Title TBD, <i>Geophysical/Astrophysical Fluid Dynamics Seminar</i> , CU Boulder
2023, Oct 11	(Magneto-)hydrodynamic simulations in rotation spherical shells: inertial modes, triadic resonances and tides, <i>Planetary Lunch Series (PLS)</i> , MIT
2022, Oct 27	Onset of convection in rotating spherical shells : Variations with radius ratio, <i>Fluids &amp; MHD seminar</i> , University of Leeds
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
2018, Feb 15	The spherical Couette system: simple yet complex, <i>Applied Dynamics Seminar Series</i> , University of Maryland, College Park, USA

## Contributed talks.....

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

## Contributed posters.....

2024, Jun 12-13	Interaction of Convection and Tides in Icy Moons, <i>OPAG Meeting</i> , Ithaca, NY, USA
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

## 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.....

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

## Undergraduate courses.....

2014 Spring	<b>Teaching assistant</b> , "Computational Physics", University of Göttingen
2014 Spring	<b>Teaching assistant</b> , "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
- 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

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### Grant review

- Referee, Czech Science Foundation, 2024
- 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 Geomatics
- Journal of Geophysical Research: Planets
- Physics of Fluids

### Member

- Ocean Worlds Working Group (OWWG)
- Executive committee, web / social media manager for Geomagnetism, Paleomagnetism and Electromagnetism (GPE) Section of AGU
- American Geophysical Union (AGU)
- American Physical Society (APS)

Conference organisation.....

2024, Dec 9-13	Convener of session "P023 - Oscillations in Internal Fluid Layers of Planets, Moons, and Stars" at AGU Fall Meeting 2024
2024, Dec 9-13	Co-convener of session "DI003 - Core-Mantle Interactions: The Dynamic Duo Shaping Our Planet" at AGU Fall Meeting 2024
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 <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 "Dynamos in a Nutshell", 35 participants

## 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> ) - 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