Soumyaranjan Dash

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Education

Institute for Astronomy, University of Hawaii at Manoa, Pukalani, HI, US
Solar Physics Postdoctoral Fellow, *Mar' 2023 - Present*
Supervisor : Dr. Xudong Sun

Indian Institute of Science Education and Research Kolkata, West Bengal, India
Doctor of Philosophy (PhD), *Jul' 2016 - Nov' 2022*
Supervisor : Prof. Dibyendu Nandy **CGPA: 8.5/10**

Central University of Himachal Pradesh, Dharamshala, Himachal Pradesh, India
Master of Science in Theoretical Physics, *Jul' 2013 - Jun 2015*
MSc. Thesis Supervisor : Dr. Ayan Chatterjee **CGPA: 5.07/6**

Ravenshaw University, Cuttack, Odisha, India
BSc. Physics Hons., *Jun' 2010 - Jul' 2013*
Percentage: 70.03 (Distinction)

Research Interests

- Magnetohydrodynamic evolution of the solar corona
  Understanding the coronal magnetic field dynamics at different length scales with MHD simulations (Modules in PLUTO and SWMF/BATSRUS). We have developed a global Coronal simulation module in PLUTO framework.
- Predicting the solar coronal magnetic field configuration during solar eclipses
  Employing Surface Flux Transport (SFT) simulations and Potential Field Source Surface (PFSS) extrapolation we predicted the large scale coronal structure for several solar eclipses which reasonably matched the observations.
- Inferring the polarization characteristics in the solar corona
  Utilizing the magnetic field information we have also computed the different polarization vectors using FORWARD (IDL) suite which shows the polarized brightness and total brightness.
- Long-term evolution of the solar corona
  Solar energy output becomes low during solar minimum phases. In order to understand the geo-effectiveness of solar energetic output during grand minimum episodes, we are studying model reconstructed (solar dynamo+coronal extrapolation) proxies.

Publications

1. **Dash, Soumyaranjan**, DeRosa, Marc L, Dikpati, Mausumi, Sun, Xudong, Mahajan, Sushant S, Liu, Yang, and Hoeksema, J Todd, "Ensemble Kalman Filter Data Assimilation into the Surface Flux Transport Model to Infer Surface Flows: An Observing System Simulation Experiment, 2024, *The Astrophysical Journal*, 975 (2), 288
2. **Dash, Soumyaranjan**, Nandy, Dibyendu, and Usoskin, Ilya, "Long-term forcing of the Sun's coronal field, open flux, and cosmic ray modulation potential during grand minima, maxima, and regular activity phases by the solar dynamo mechanism, 2023, *Monthly Notices of the Royal Astronomical Society*, 525, 4, 4801-4814
3. Nandy, Dibyendu, Baruah, Yoshita, Bhowmik, Prantika, **Dash, Soumyaranjan**, Gupta, Sakshi, Hazra, Soumitra, B Lekshmi, Pal, Sanchita, Pal, Shaonwita, Roy, Souvik, Saha, Chitradeep, and Sinha, Suvadip, "Causality in heliophysics: magnetic fields as a bridge between the Sun's interior and the Earth's space environment", 2023, *Journal of Atmospheric and Solar-Terrestrial Physics*, 248, 106081
4. Nandy, Dibyendu, Martens, PCH, Obridko, V, **Dash, Soumyaranjan**, and Georgieva, K, "Solar evolution and extrema: current state of understanding of long-term solar variability and its planetary impacts", 2021, *Progress in Earth and Planetary Science*, 8 (1), 1-21

5. **Dash, Soumyaranjan**, Bhowmik, Prantika, Athira, B. S., Ghosh, Nirmalya, and Nandy, Dibyendu, "Prediction of the Sun's Coronal Magnetic Field and Forward-modeled Polarization Characteristics for the 2019 July 2 Total Solar Eclipse", 2020, *The Astrophysical Journal*, 890 37
6. Nandy, Dibyendu, Bhowmik, Prantika, Yeates, Anthony R, Panda, Suman, Tarafder Rajashik, and **Dash, Soumyaranjan**, "The Large-scale Coronal Structure of the 2017 August 21 Great American Eclipse: An Assessment of Solar Surface Flux Transport Model Enabled Predictions and Observations", 2018, *Astrophysical Journal*, 853 (1), 72
7. Pal, Sanchita, **Dash, Soumyaranjan**, and Nandy, Dibyendu , "Flux Erosion of Magnetic Clouds by Reconnection With the Sun's Open Flux", 2020, *Geophysical Research Letters*, 47, e2019GL086372
8. **Dash, Soumyaranjan**, and Nandy, Dibyendu , "A Magnetofrictional model for the solar corona", 2018, *Proceedings of the International Astronomical Union*, 13 (S340), 87-88

Research Presentations

1. Presented an oral presentation on **Understanding The Global Coronal Magnetic Field Evolution Using Data-constrained Magnetohydrodynamic Model** in 15th Quadrennial Solar-Terrestrial Physics Symposium (STP-15) on 22 February 2022.
2. Presented a poster on **Understanding the Global Coronal Magnetic Fields using Data-constrained Magnetohydrodynamic Model** in AGU Fall meeting 2021 on 13th December 2021. The poster can be found at https://doi.org/10.1002/essoar.10510887.1.
3. Presented a workshop colloquium on **Data Driven Models for Coronal Magnetic Field: Aditya-L1 Perspective** at Multi-payload and Multi-Observatory Science with Aditya-L1 (Workshop in 39th Meeting of ASI) in virtual mode on 19 February 2021.
4. Presented a Oral Presentation on **Dynamics of the Sun's Polar Field: Possible Insights from Out of the Ecliptic Observations** at AGU Fall Meeting 2020 in Virtual mode on 04 December 2019. The presentation can be accessed with this link.
5. Presented a poster on **The 2019 July 2 Total solar eclipse: prediction of the coronal magnetic field structure and polarization characteristics** at 5th Asia Pacific Solar Physics Meeting on 03rd February 2020.
6. Presented a poster on **A Magnetofrictional model for the solar corona** at IAU Symposium 340 on 19th February 2018.

Observing Proposals

DKIST Operation Commissioning Phase Cycle 3 (Upcoming): Understanding Physical Mechanisms that Drive Solar Wind with DKIST Coronal Magnetometry
PI: Dr. Soumyaranjan Dash
Summary: Formation of the solar wind is often attributed to either turbulent Alfvèn wave-driven in-situ formation scenario that aligns with various observational constraints, or interchange reconnection which shows a compelling explanation for the observed ionization degree and elemental abundance. Indicators of interchange reconnection include presence of strong current sheets at the interface between open and closed magnetic fields, enhanced temperatures, and confined upward plasma flows. To further investigate these mechanisms, we propose targeted observations using the Daniel K Inouye Solar Telescope (DKIST). By inferring magnetic topology and examining the spatial distribution of temperature, electron density and Doppler shifts, these high-resolution novel observations will enhance our understanding of the underlying physics governing solar wind generation and its driving mechanisms.

Outreach Projects

Space weather assessment and predictions
PI: Prof. Dibyendu Nandy *2017-continuing*
Based on computational modelling, big data analytics, machine learning and empirical techniques applied to satellite and ground-based observations, CESSI is developing a variety of space environment monitoring and forecasting tools. This covers observation of solar surface in various wavebands, modelling of surface and coronal magnetic fields, flare potential of an active region and several other solar wind parameters. The assessment dashboard can be accessed at www.cessi.in/spaceweather.

Modelling the progression of Covid19 in India
PI: Prof. Dibyendu Nandy *2020-continuing*
We at CESSI have developed our epidemiological model to understand the progression. A wide range of parameter space studies and data analysis have been done in this regard to better constrain our model. The model description and the comparisons for the pandemic progression in the Indian context can be found at www.cessi.in/coronavirus.

Achievements Scholarships

Achievements: Referee for peer-review articles for journals: The Astrophysical Journal, Monthly Notices of the Royal Astronomical Society, Open Research Europe, etc.
Geospace SHINE Panel reviewer (2024)
Secured All India Rank 98 in Joint Entrance Screening Test (JEST) 2016
Scholarships: Doctoral fellowship from Department of Science and Technology (DST), Government of India under INSPIRE Fellowship program.
Newspaper Mentions: (a) IISER Kolkata and scientists across the world are trying to use the eclipse to verify their theories.
(b) CESSI team accurately predicts shape of Sun's corona 43 days ahead of eclipse.
(c) Total Solar Eclipse 2017: Team led by Indian astrophysicist predicts solar corona.

Teaching Assistantships

SS4203 Fluid- and Magnetohydrodynamics (F-MHD)
PH4102 Introductory Astrophysics
PH3105 Computational Physics

Computer Skills

Operating Systems: Linux (MacOS, Ubuntu, Redhat, CentOS), Windows
Languages: Fortran, C, Python, IDL, Bash, LaTeX
Visualization Tools: Tecplot, VisIT, Paraview, Matlab
Web: HTML, CSS
Others: GitHub

References

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Dr. Xudong Sun
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Dr. Mausumi Dikpati
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