

CURRICULUM VITAE

Dhiraj Kumar Hazra

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Date of birth: April 30, 1986

❖ Current position

Marie Skłodowska-Curie Astrofit fellow, [INAF - Osservatorio di Astrofisica e Scienza dello Spazio di Bologna, Italy](#)

❖ Academic history

- 2017-2019 ❖ INFN fellow
[Istituto Nazionale di Fisica Nucleare](#), Bologna, Italy
Mentor: Prof. Fabio Finelli
- 2015-2017 ❖ PCCP fellow
[Paris Centre for Cosmological Physics, Astroparticule et Cosmologie](#), Paris, France
Mentor: Prof. George F. Smoot III
- 2013-2015 ❖ Post doctoral fellow
[Asia Pacific Centre for Theoretical Physics](#), Pohang, Korea
Mentor: Prof. Arman Shafieloo
- 2006-2012 ❖ Integrated M.Sc.–Ph.D. Physics
[Harish Chandra Research Institute](#), Allahabad, India
Thesis topic: [Primordial features and non-Gaussianities](#)
Thesis supervisor: Prof. L. Sriramkumar
- 2003-2006 ❖ B.Sc. Physics
[Jadavpur University](#), Kolkata, India

❖ Research interests

- ❖ Constraining primordial excitations of the Universe using Cosmic Microwave Background (CMB) and Large Scale Structure (LSS)
- ❖ Witnessing the history of reionization
- ❖ Beyond the concordance: exploring new physics with the observations

Last updated: August 18, 2019

❖ Publications and preprints

Published paper and letters, preprints, survey collaboration papers, conference proceedings and upcoming works are listed below.

❖ JOURNAL ARTICLES AND LETTERS

Published papers in refereed journals are presented in reverse chronological order of publication.

- 2019 29. **D. K. Hazra**, A. Shafieloo and T. Souradeep, *Parameter discordance in Planck CMB and low-redshift measurements: projection in the primordial power spectrum*, *JCAP* 1904, 036 (2019), [arXiv:1810.08101 \[astro-ph.CO\]](#)
- 2018a 28. **D. K. Hazra**, D. Paoletti, F. Finelli, G. F. Smoot, *Reionization in the dark and the light from Cosmic Microwave Background*, *JCAP* 1809, 016 (2018), [arXiv:1807.05435 \[astro-ph.CO\]](#)
- 2018b 27. B. L'Huillier, A. Shafieloo, **D. K. Hazra**, G. F. Smoot and A. A. Starobinsky, *Probing features in the primordial perturbation spectrum with large-scale structure data*, *Mon. Not. Roy. Astron. Soc.* 477, no. 2, 2503 (2018), [arXiv:1710.10987 \[astro-ph.CO\]](#)
- 2018c 26. **D. K. Hazra**, D. Paoletti, M. Ballardini, F. Finelli, A. Shafieloo, G. F. Smoot and A. A. Starobinsky, *Probing features in inflaton potential and reionization history with future CMB space observations*, *JCAP* 1802, 017 (2018), [arXiv:1710.01205 \[astro-ph.CO\]](#)
- 2018d 25. A. Shafieloo, **D. K. Hazra**, V. Sahni and A. A. Starobinsky, *Metastable dark energy with radioactive-like decay*, *Mon. Not. Roy. Astron. Soc.* 473, 2760 (2018), [arXiv:1610.05192 \[astro-ph.CO\]](#)
- 2017a 24. **D. K. Hazra**, G. F. Smoot, *Witnessing the reionization history using Cosmic Microwave Background observation from Planck*, *JCAP* 1711, 028 (2017), [arXiv:1708.04913 \[astro-ph.CO\]](#)
- 2017b 23. A. Shafieloo and **D. K. Hazra**, *Consistency of the Planck CMB data and Λ CDM cosmology*, *JCAP* 1704, 012 (2017), [arXiv:1610.07402 \[astro-ph.CO\]](#)
- 2016a 22. **D. K. Hazra**, A. Shafieloo, G. F. Smoot and A. A. Starobinsky, *Primordial features and Planck polarization*, *JCAP* 1609, 009 (2016), [arXiv:1605.02106 \[astro-ph.CO\]](#)
- 2016b 21. S. Appleby, J. -O. Gong, **D. K. Hazra**, A. Shafieloo and S. Sypsas, *Direct search for features in the primordial bispectrum*, *Phys. Lett. B* 760, 297 (2016), [arXiv:1512.08977 \[astro-ph.CO\]](#)
- 2015a 20. **D. K. Hazra**, A. Shafieloo, *Search for a direction in the forest of Lyman- α* , *JCAP* 1511, 012 (2015), [arXiv:1506.03926 \[astro-ph.CO\]](#)

- 2015b 19. **D. K. Hazra**, S. Majumdar, S. Pal, S. Panda and A. A. Sen, *Post-Planck Dark Energy Constraints*, *Phys. Rev. D* 91, 083005 (2015), [arXiv:1310.6161 \[astro-ph.CO\]](#)
- 2015c 18. V. Sreenath, **D. K. Hazra** and L. Sriramkumar, *On the scalar consistency relation away from slow roll*, *JCAP* 1502, 029 (2015), [arXiv:1410.0252 \[astro-ph.CO\]](#)
- 2014a 17. **D. K. Hazra**, A. Shafieloo and T. Souradeep, *Primordial power spectrum from Planck*, *JCAP* 1411, 011 (2014), [arXiv:1406.4827 \[astro-ph.CO\]](#)
- 2014b 16. J. Martin, L. Sriramkumar, **D. K. Hazra**, *Sharp inflaton potentials and bi-spectra: Effects of smoothing the discontinuity*, *JCAP* 1409, 039 (2014), [arXiv:1404.6093 \[astro-ph.CO\]](#)
- 2014c 15. **D. K. Hazra**, A. Shafieloo, G. F. Smoot and A. A. Starobinsky, *Wiggly Whipped Inflation*, *JCAP* 1408, 048 (2014), [arXiv:1405.2012 \[astro-ph.CO\]](#)
- 2014d 14. **D. K. Hazra**, A. Shafieloo, G. F. Smoot and A. A. Starobinsky, *Inflation with Whip-Shaped Suppressed Scalar Power Spectra*, *Phys. Rev. Lett.* 113, 071301 (2014), [Editors' Suggestion], [arXiv:1404.0360 \[astro-ph.CO\]](#)
- 2014e 13. **D. K. Hazra**, A. Shafieloo, G. F. Smoot and A. A. Starobinsky, *Ruling out the power-law form of the scalar primordial spectrum*, *JCAP* 1406, 061 (2014), [arXiv:1403.7786 \[astro-ph.CO\]](#)
- 2014f 12. **D. K. Hazra**, A. Shafieloo, *Test of Consistency between Planck and WMAP*, *Phys. Rev. D* 89, 043004 (2014), [arXiv:1308.2911 \[astro-ph.CO\]](#)
- 2014g 11. **D. K. Hazra**, A. Shafieloo, *Confronting the concordance model of cosmology with Planck data*, *JCAP* 1401, 043 (2014), [arXiv:1401.0595 \[astro-ph.CO\]](#)
- 2013a 10. **D. K. Hazra**, A. Shafieloo and G. F. Smoot, *Reconstruction of broad features in the primordial spectrum and inflaton potential from Planck*, *JCAP* 1312, 035 (2013), [arXiv:1310.3038 \[astro-ph.CO\]](#)
- 2013b 9. **D. K. Hazra**, A. Shafieloo and T. Souradeep, *Cosmological parameter estimation with free-form primordial power spectrum*, *Phys. Rev. D* 87, 123528 (2013), [arXiv:1303.5336 \[astro-ph.CO\]](#)
- 2013c 8. **D. K. Hazra**, A. Shafieloo and T. Souradeep, *Primordial power spectrum: a complete analysis with the WMAP nine-year data*, *JCAP* 1307, 031 (2013), [arXiv:1303.4143 \[astro-ph.CO\]](#)
- 2013d 7. **D. K. Hazra**, L. Sriramkumar and J. Martin, *BINGO: A code for the efficient computation of the scalar bi-spectrum*, *JCAP* 1305, 026 (2013), [arXiv:1201.0926 \[astro-ph.CO\]](#)

- 2013e 6. M. Aich, **D. K. Hazra**, L. Sriramkumar and T. Souradeep, *Oscillations in the inflaton potential: Complete numerical treatment and comparison with the recent and forthcoming CMB datasets*, *Phys. Rev. D* **87**, 083526 (2013), [arXiv:1106.2798 \[astro-ph.CO\]](#)
- 2013f 5. T. Guha Sarkar and **D. K. Hazra**, *Probing primordial non-Gaussianity: The 3D Bispectrum of Ly- α forest and the redshifted 21-cm signal from the post reionization epoch*, *JCAP* **1304**, 002 (2013), [arXiv:1211.4756 \[astro-ph.CO\]](#)
- 2013g 4. **D. K. Hazra**, *Changes in the halo formation rates due to features in the primordial spectrum*, *JCAP* **1303**, 003 (2013), [arXiv:1210.7170 \[astro-ph.CO\]](#)
- 2012a 3. **D. K. Hazra** and T. Guha Sarkar, *Primordial non-Gaussianity in the forest: 3D bi-spectrum of Ly-alpha flux spectra along multiple lines of sight*, *Phys. Rev. Lett.* **109**, 121301 (2012), [arXiv:1205.2790 \[astro-ph.CO\]](#)
- 2012b 2. **D. K. Hazra**, J. Martin and L. Sriramkumar, *The scalar bi-spectrum during preheating in single field inflationary models*, *Phys. Rev. D* **86**, 063523 (2012), [arXiv:1206.0442 \[astro-ph.CO\]](#)
- 2010 1. **D. K. Hazra**, M. Aich, R. K. Jain, L. Sriramkumar and T. Souradeep, *Primordial features due to a step in the inflaton potential*, *JCAP* **1010**, 008 (2010), [arXiv:1005.2175 \[astro-ph.CO\]](#)
- ✧ **PREPRINTS**
- 2019 1. **D. K. Hazra**, D. Paoletti, F. Finelli, G. F. Smoot, *Joining bits and pieces of reionization history*, [arXiv:1904.01547 \[astro-ph.CO\]](#)
- ✧ **SURVEY COLLABORATION PAPERS**
- 2016a 2. F. Finelli *et al.* [CORE Collaboration], *Exploring Cosmic Origins with CORE: Inflation*, *JCAP* **1804** 016 (2018), [arXiv:1612.08270 \[astro-ph.CO\]](#)
- 2016b 1. E. Di Valentino *et al.* [CORE Collaboration], *Exploring Cosmic Origins with CORE: Cosmological Parameters*, *JCAP* **1804** 017 (2018), [arXiv:1612.00021 \[astro-ph.CO\]](#)
- ✧ **CONFERENCE PROCEEDING**
- 2014 A. Shafieloo, **D. K. Hazra** and T. Souradeep, *Primordial Spectrum and Cosmological Parameters*, *JPS Conf. Proc.* **1**, 013094 (2014)

❖ Participation in cosmological surveys

- ❖ I am a member of CMB-BHARAT Consortium and I have lead the *Cosmological Parameters* working group in the proposal for the fourth generation CMB space mission submitted to the Indian Space Research Organisation on April 16, 2018.
- ❖ I am a member of [Euclid Consortium Collaboration](#). I am working on forecasts on initial condition.

❖ Numerical codes and simulations developed

- ❖ [BINGO \(BI-spectra and Non-Gaussianity Operator\)](#) (in Fortran 90): Calculates the non-Gaussianity (three-point correlations of perturbations, bispectrum) and the power spectrum from any single canonical scalar field model of inflation. This is the first public code to calculate the inflationary bispectrum.
- ❖ A Fortran 90 code that evaluates the perturbation spectra in two field inflationary models. The code takes the iso-curvature perturbations into account exactly, and it evaluates the curvature and iso-curvature perturbation spectra as well as the correlations between them. In addition to evaluating the scalar power spectra, the code also evaluates the tensor power spectrum.
- ❖ A code suite for deconvolution, including Landweber iteration, modified Richardson-Lucy (MRL) algorithm (designed in collaboration with Prof. Shafieloo and Prof. Souradeep), singular value decomposition, Tikhonov regularization, aimed towards general deconvolution problems that can be used in different areas of astrophysics involving point spread functions and convolution integrals. MRL has been used in [JCAP 1411, 011 \(2014\)](#), [Phys. Rev. D 87, 123528 \(2013\)](#) and [JCAP 1307, 031 \(2013\)](#).
- ❖ Code for mass function of halos from arbitrary inflation models and arbitrary dark energy models and implemented in [JCAP 1303, 003 \(2013\)](#).
- ❖ Prepared software pipeline for statistical analysis of quasar Lyman- α forest data for SDSS-BOSS data (independent of quasar surveys) and implemented in [JCAP 1511, 012 \(2015\)](#). An extended version is being prepared for the continuum estimation of quasars.
- ❖ Developed semi-analytical simulations for Lyman- α forest.
- ❖ Developed highly parallel cold dark matter simulation code ‘COSMOS’ in collaboration with Dr. Appleby and Dr. Sypsas. Presently being benchmarked for forthcoming Euclid and LSST type data.

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