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Education

California Institute of technology Ph.D. in Physics, <i>Advisor:</i> Christopher Hirata	2010-2015
Indian Institute of Technology, Kanpur M.Sc (Integrated) in Physics	2005-2010

Research Interests

My research area is astrophysics, with a primary focus on cosmology. I have research interests in a number of areas, including but not limited to the pre-atomic era of the very early universe, recombination, reionization, and binary systems.

I am interested in doing cosmology with the 21-cm signal from neutral hydrogen during the reionization epoch. My current work in this area focuses on developing new methods to study observables such as primordial magnetic fields and gravitational waves using high-resolution maps of the 21-cm line. I also enjoy thinking about radio interferometry, and have previously worked on its application to studying the global 21-cm signal. In a broader sense, I also think about aspects of cosmic structure formation in the dark-ages, and its implications for observables in the later universe.

I am also interested in the use of the Cosmic Microwave Background (CMB), and Large Scale Structure (LSS) as probes of curvature fluctuations in the primordial universe. I am currently developing a computer-algebra system to perform non-linear evolution of stochastically seeded fields from first-principles. I plan to use it to evaluate all lowest-order corrections to the two-, three- and four-point correlation functions of the CMB and LSS purely due to non-linear evolution.

My other research interests include weak interactions of neutrinos in the early universe, and the secular evolution of binary systems. Previously, I have worked on tidal deformation of neutron stars, and its consequence for their internal oscillatory modes. Apart from these topics, at various periods, I have worked on orbital resonances in eccentric binaries, optics design for CMB experiments and, very briefly dabbled in X-ray fluorescence from kilonovae.

Academic Honors

Schmidt Fellowship Institute for Advanced Study	2015
Robert A. Millikan Fellowship California Institute of Technology	2010
International Fulbright Science and Technology Award Bureau of Education and Cultural Affairs, U.S. Department of State	2010
President's Gold Medal for the best academic performance in the graduating class in all disciplines, IIT Kanpur	2010

General Proficiency Medal for the best academic performance in the graduating class in Physics, IIT Kanpur	2010
Summer Undergraduate Research Fellowship California Institute of Technology	2007, 2008
Academic Excellence Award IIT Kanpur	2007, 2008, 2009, 2010
Silver Medal, 36th International Physics Olympiad	2005
KVPY Fellowship Department of Science and Technology, Govt. of India	2004
NTSE Fellowship National Council of Educational Research and Training, Govt. of India	2003

Work Experience

Member Institute for Advanced Study, Princeton	Sep 2015-Present
Graduate Student California Institute of Technology, Pasadena <i>Advisor:</i> Christopher M. Hirata	Sep 2010-Aug 2015
Visiting Scientist Max-Planck-Institut für Physik komplexer Systeme, Dresden <i>Advisor:</i> Roderich Moessner	May-August 2009
Summer Undergraduate Research Fellow California Institute of Technology, Pasadena <i>Advisor:</i> Re'em Sari	May-August 2008
Summer Undergraduate Research Fellow California Institute of Technology, Pasadena <i>Advisor:</i> Andrew Lange	May-August 2007

Refereed publications

- **Venumadhav, T.**, & Hirata, C. M. (2015), Physical Review D, 91, 123009
Title: Stability of small-scale baryon perturbations during cosmological recombination
- **Venumadhav, T.**, Zimmerman, A., & Hirata, C. M. (2014), Astrophysical Journal, 781, 23
Title: The stability of tidally deformed neutron stars to three- and four-mode coupling
- **Venumadhav, T.**, Haque, M., & Moessner, R. (2010), Physical Review B, 81, 054305
Title: Finite-rate quenches of site bias in the Bose-Hubbard dimer

Submitted preprints

- **Venumadhav, T.**, Chang, T.-C., Doré, O., & Hirata, C. M. (2015), arXiv:1512.05248
Title: A practical theorem on using interferometry to measure the global 21-cm signal
Submitted to ApJ
- **Venumadhav, T.**, Cyr-Racine, F.-Y., Abazajian, K. N., & Hirata, C. M. (2015), arXiv:1507.06655
Title: Sterile neutrino dark matter: A tale of weak interactions in the strong coupling epoch
Submitted to Physical Review D
- **Venumadhav, T.**, Oklopčić, A., Gluscevic, V., Mishra, A., & Hirata, C. M. (2014), arXiv:1410.2250
Title: A new probe of magnetic fields in the pre-reionization epoch: I. Formalism
Submitted to Physical Review D

Manuscripts in Preparation

- Gluscevic, V., Mishra, A., **Venumadhav, T.**, Oklopčić, A., & Hirata, C. M. (2014)
Title: A new probe of magnetic fields in the pre-reionization epoch: II. Detectability
- Hirata, C. M., **Venumadhav, T.**, Gluscevic, V., Mishra, A., & Oklopčić, A. (2014)
Title: Primordial gravitational waves and circular polarization in the redshifted 21 cm line

Work in Progress

- Computing all the lowest-order corrections to the CMB power spectrum due to non-linear evolution
Collaborators: de Putter, R., Doré, O., Hirata, C. M. (planned 2015)

Other work

- Probing Primordial Magnetic Fields with 21-cm Line Observations of the High-redshift Intergalactic Medium
Oklopčić, A., Gluscevic, V., Hirata, C.M., Mishra, A., **Venumadhav, T.** (2014)
AAS presentation by Oklopčić, A.
- Spin-orbit resonances for satellites on highly eccentric orbits, SURF (2008)
Mentors: Re'em Sari and Daniel Babich
Report at http://www.its.caltech.edu/~tnerella/draft_v7.pdf
- Wave plate modeling, SURF (2007)
Mentor: Andrew Lange
Report at http://www.its.caltech.edu/~tnerella/waveplate_07.pdf

Talks and poster presentations

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| • Cosmology seminar, Perimeter institute. | 2016 |
| • Cosmology lunch, joint w/ IAS and Princeton University. | 2016 |
| • Seminar, Inter University Center for Astronomy and Astrophysics, Pune. | 2015 |
| • Seminar, National Center for Radio Astronomy, Pune. | 2015 |
| • Talk, The Primordial Universe after Planck, IAP, Paris. | 2014 |
| • Seminar, McGill University, Montreal. | 2014 |
| • Seminar, CITA, Toronto. | 2014 |
| • ITC Seminar, Harvard University, Boston. | 2014 |

- Cosmology lunch, joint w/ IAS and Princeton University. 2014
- Talk, Theoretical Astrophysics in Southern California (TASC), UCSD, San Diego. 2014
- Special seminar, KICP, University of Chicago. 2014
- Cosmology Lunch talk, CCAPP, Ohio State University, Columbus. 2014
- Poster, Gravitational Wave Physics and Astronomy Workshop (GWPAW) at IUCAA, Pune. 2013
- Seminar, Inter University Center for Astronomy and Astrophysics, Pune. 2013
- Talk, Theoretical Astrophysics in Southern California (TASC), Carnegie Observatories, Pasadena. 2012
- Poster, Summer school on cosmology, ICTP, Trieste. 2012

Teaching Experience and outreach

- Volunteer for event on occasion of partial solar eclipse Oct 2014
Location: McKinley School, Pasadena
- Volunteer for public viewing of Supernova SN2014J Jan 2014
Location: California Institute of Technology, Pasadena
- Teaching assistant for Ph 12a: Waves, taught by Jeff Kimble Fall 2012
- Volunteer for public event on the occasion of Venus transit May 2012
Location: California Institute of Technology, Pasadena

References

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