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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, large scale structure, 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. I have also worked on the thermal evolution of the intergalactic medium during the cosmic dawn era, when the global 21-cm signal is expected to be observable. 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.

A second theme of my research is astrophysical applications of strong gravitational lensing. Along with collaborators, I worked on one of the first theoretical papers about highly magnified stars within background galaxies behind massive galaxy clusters. Our predictions for the observational appearance of the stars, including both the image distribution and the lightcurve, were borne out by the first detection in the lensing cluster MACSJ1149. I am working on several applications of such systems to detecting low-mass dark matter substructure inside lensing clusters. I have also worked on the predictions for strongly lensed and multiply imaged gravitational wave mergers that will be seen by LIGO.

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

Friends of the Institute Membership Institute for Advanced Study	2018 - Present
Schmidt Fellowship Institute for Advanced Study	2015 - 2018

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
Associate International Center for Theoretical Sciences, Bangalore	2019-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.**, Dai, L., Kaurov, A., Zaldarriaga, M., (2018), Physical Review D, 98, 103513
(Editor's suggestion)
Title: Heating of the intergalactic medium by the cosmic microwave background during cosmic dawn
- Kaurov, A., **Venumadhav, T.**, Dai, L., Zaldarriaga, M., (2018), Astrophys. J. Lett., 864, 1
Title: Implication of the Shape of the EDGES Signal for the 21 cm Power Spectrum
- Dai, L., **Venumadhav, T.**, Kaurov, A., Miralda-Escudé, J., (2018), Astrophysical Journal, 867, 24
Title: Probing Dark Matter Subhalos in Galaxy Clusters Using Highly Magnified Stars
- Hirata, C. M., Mishra, A., **Venumadhav, T.**, (2017), Physical Review D, 97, 103521
Title: Detecting primordial gravitational waves with circular polarization of the redshifted 21 cm line: I. Formalism
- **Venumadhav, T.**, Dai, L., Miralda-Escudé, J., (2017), Astrophysical Journal, 850, 49
Title: Microlensing of extremely magnified stars near caustics of galaxy clusters
- Gluscevic, V., **Venumadhav, T.**, Fang, X., Hirata, C. M., Oklopčić, A., Mishra, A. (2017), Physical Review D, 95, 083011
Title: A new probe of magnetic fields in the pre-reionization epoch: II. Detectability
- **Venumadhav, T.**, Oklopčić, A., Gluscevic, V., Mishra, A., & Hirata, C. M. (2017), Physical Review D, 95, 083010
Title: A new probe of magnetic fields in the pre-reionization epoch: I. Formalism
- Dai, L., **Venumadhav, T.**, Sigurdson, K. (2017), Physical Review D, 95, 044011
Title: The effect of lensing magnification on the apparent distribution of black hole mergers
- **Venumadhav, T.**, Cyr-Racine, F.-Y., Abazajian, K. N., & Hirata, C. M. (2016), Physical Review D, 94, 043515
Title: Sterile neutrino dark matter: A tale of weak interactions in the strong coupling epoch
- **Venumadhav, T.**, Chang, T.-C., Doré, O., & Hirata, C. M. (2015), Astrophysical Journal, 826, 116
Title: A practical theorem on using interferometry to measure the global 21 cm signal
- **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

Preprints under review

- Haris, K., Mehta, A. K., Kumar, S., **Venumadhav, T.**, Parameswaran, A. (2018), arXiv:1807.07062
Title: Identifying stringly lensed gravitational wave signals from binary black hole mergers
- Zackay, B., Dai, L., **Venumadhav, T.**, (2018), arXiv:1806.08792
Title: Relative Binning and Fast Likelihood Evaluation for Gravitational Wave Parameter Estimation
- Dai, L., **Venumadhav, T.**, Zackay, B., (2018), arXiv:1806.08793
Title: Parameter Estimation for GW170817 using Relative Binning
- Dai, L., **Venumadhav, T.**, (2017), arXiv:1702.04724
Title: On the waveforms of gravitationally lensed gravitational waves

n^{th} author papers

- Doré, O., et. al., (2014), arXiv:1412.4872
Title: Cosmology with the SPHEREX All-Sky Spectral Survey
- Bull, P., et. al., (2018), arXiv:1810.02680
Title: Fundamental Physics with the Square Kilometer Array

Professional Service

- Referee for Astroparticle Physics
- Referee for the Astrophysical Journal
- Referee for Monthly Notices of the Royal Astronomical Society Letters
- Referee for Monthly Notices of the Royal Astronomical Society
- Referee for Physical Review D

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 presentations

- Lecturer, Summer School on Gravitational-Wave Astronomy, ICTS, Bangalore. 2018
- Invited panelist, Physics and Astrophysics at the eXtreme, IUCAA, Pune. 2018
- Invited talk, Thermal history of the Universe at intermediate redshift: progress with 21cm absorption measurements, CERN. 2018
- Talk, Shedding Light on the Dark Universe with Extremely Large Telescopes, UCLA. 2018
- Invited Cosmology seminar, JHU, Baltimore. 2017
- Invited Seminar, CITA, Toronto. 2017
- Talk, Fundamental Physics with the Square Kilometer Array, Mauritius. 2017
- Invited talk, Tianlai Collaboration Meeting, Fermilab, Batavia. 2016
- Invited talk, CMB Spectral Distortions From Cosmic Baryon Evolution, RRI, Bengaluru. 2016
- Invited seminar, International Centre for Theoretical Sciences, TIFR. 2016

- Invited cosmology seminar, Perimeter institute. 2016
- Cosmology lunch, joint w/ IAS and Princeton University. 2016
- Astrophysics informal seminar, IAS. 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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