Tejaswi Venumadhav Nerella — Curriculum Vitae

Member, School of Natural Sciences
1 Einstein Drive
Institute for Advanced Study
Princeton, NJ 08540

Contact:
Phone: (626) 826-3571
email: tejaswi@sns.ias.edu

Education

California Institute of technology 2010-2015
Ph.D. in Physics,
Advisor: Christopher Hirata

Indian Institute of Technology, Kanpur 2005-2010
M.Sc (Integrated) in Physics

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

Schmidt Fellowship 2015 - Present
Institute for Advanced Study

Robert A. Millikan Fellowship 2010
California Institute of Technology

International Fulbright Science and Technology Award — 2010
Bureau of Education and Cultural Affairs, U.S. Department of State

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 — 2007, 2008
California Institute of Technology

Academic Excellence Award — 2007, 2008, 2009, 2010
IIT Kanpur

Silver Medal, 36th International Physics Olympiad — 2005

KVPY Fellowship — 2004
Department of Science and Technology, Govt. of India

NTSE Fellowship — 2003
National Council of Educational Research and Training, Govt. of India

Work Experience

Member — Sep 2015-Present
Institute for Advanced Study, Princeton

Graduate Student — Sep 2010-Aug 2015
California Institute of Technology, Pasadena
Advisor: Christopher M. Hirata

Visiting Scientist — May-August 2009
Max-Planck-Institut für Physik komplexer Systeme, Dresden
Advisor: Roderich Moessner

Summer Undergraduate Research Fellow — May-August 2008
California Institute of Technology, Pasadena
Advisor: Re'em Sari

Summer Undergraduate Research Fellow — May-August 2007
California Institute of Technology, Pasadena
Advisor: Andrew Lange

Refereed publications

- **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

- 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
- Kaurov, A., **Venumadhav, T.**, Dai, L., Zaldarriaga, M., (2018), arXiv:1805.03254
  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), arXiv:1804.03149
  Title: Probing Dark Matter Subhalos in Galaxy Clusters Using Highly Magnified Stars
- **Venumadhav, T.**, Dai, L., Kaurov, A., Zaldarriaga, M., (2018), arXiv:1804.02406
  Title: Heating of the intergalactic medium by the cosmic microwave background during cosmic dawn
- Hirata, C. M., Mishra, A., **Venumadhav, T.**, (2017), arXiv:1707.03513
  Title: Detecting primordial gravitational waves with circular polarization of the redshifted 21 cm line: I. Formalism
- 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

Professional Service

- Referee for Astroparticle Physics
- Referee for the Astrophysical Journal

- Referee for Monthly Notices of the Royal Astronomical Society Letters

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

- Talk, Shedding Light on the Dark Universe with Extremely Large Telescopes, UCLA. 2018
- Cosmology seminar, JHU, Baltimore. 2017
- Seminar, CITA, Toronto. 2017
- Talk, Fundmental Physics with the Square Kilometer Array, Mauritius. 2017
- Talk, Tianlai Collaboration Meeting, Fermilab, Batavia. 2016
- Talk, CMB Spectral Distortions From Cosmic Baryon Evolution, RRI, Bengaluru. 2016
- Seminar, International Centre for Theoretical Sciences, TIFR. 2016
- 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

Christopher M. Hirata
The Ohio State University
191 West Woodruff Lane
Columbus, OH 43210, USA
email: hirata.10@osu.edu

Christian D. Ott
California Institute of Technology
MC 350-17
1200 E California Blvd
Pasadena, CA 91125, USA
email: cott@tapir.caltech.edu

Olivier Doré
Jet Propulsion Laboratory
M/S 169-327
4800 Oak Grove Drive
Pasadena, CA 91109, USA
email: olivier.p.dore@jpl.nasa.gov

Jordi Miralda Escudé
Institut de Cincies del Cosmos
Universitat de Barcelona
08028 Barcelona Catalonia, Spain
email: miralda@icc.ub.edu

Matias Zaldarriaga
Institute for Advanced Study
1 Einstein Drive
Princeton, NJ 08540, USA
email: matiasz@ias.edu