Sindhu Satyavolu

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Education

Doctor of Philosophy in Theoretical Physics 2021–
Tata Institute of Fundamental Research, Mumbai, India.

- Advised by Prof. Girish Kulkarni
- Thesis title: Constraining supermassive black hole growth using quasar proximity zones
- Expected date of completion is on or before September 2024.

Master of Physics 2018–2021
Tata Institute of Fundamental Research, Mumbai, India.

- As a part of the Integrated M.Sc.-Ph.D. programme, I spent the first three years on graduate coursework. Worked on two semester-long research projects on Cosmology and Astroparticle physics.
- Graduated First Class with Distinction.

Bachelor of Technology in Engineering Physics 2014–2018
Indian Institute of Technology Madras, Chennai, India.

- Advised by Prof. L. Sriramkumar on one year thesis project, in which I studied cosmological perturbation theory and derived the observed matter power spectrum in the Universe.
- Minored in Photonics

Research Interests

- **First billion years of the Universe:** Simulations and observations of quasars, Supermassive black hole formation and growth, Intergalactic medium, Epoch of Reionisation, Science with JWST and LSST.

Publications

[1] **S. Satyavolu**, G. Kulkarni, L. C. Keating, and M. G. Haehnelt, "Robustness of measurements of the mean free path of hydrogen-ionizing photons in the epoch of reionization", Nov. 2023. arXiv: 2311.06344.

[2] Y. Zhu, G. D. Becker, H. M. Christenson, A. D'Aloisio, S. E. I. Bosman, T. Bakx, V. D'Odorico, M. Bischetti, C. Cain, F. B. Davies, R. L. Davies, A.-C. Eilers, X. Fan, P. Gaikwad, M. G. Haehnelt, L. C. Keating, G. Kulkarni, S. Lai, H.-X. Ma, A. Mesinger, Y. Qin, **S. Satyavolu**, T. T. Takeuchi, H. Umehata, and J. Yang, "Probing Ultralate Reionization: Direct Measurements of the Mean Free Path over $5 < z < 6$", ApJ, vol. 955, no. 2, 115, p. 115, Oct. 2023.

[3] C. Mazzucchelli, M. Bischetti, V. D'Odorico, C. Feruglio, J.-T. Schindler, M. Onoue, E. Bañados, G. D. Becker, F. Bian, S. Carniani, R. Decarli, A.-C. Eilers, E. P. Farina, S. Gallerani, S. Lai, R. A. Meyer, S. Rojas-Ruiz, **S. Satyavolu**, B. P. Venemans, F. Wang, J. Yang, and Y. Zhu, "XQR-30: Black hole masses and accretion rates of 42 $z \gtrsim 6$ quasars", A&A, vol. 676, A71, A71, Aug. 2023.

[4] V. D'Odorico, E. Bañados, G. D. Becker, M. Bischetti, S. E. I. Bosman, G. Cupani, R. Davies, E. P. Farina, A. Ferrara, C. Feruglio, C. Mazzucchelli, E. Ryan-Weber, J.-T. Schindler, A. Sodini, B. P. Venemans, F. Walter, H. Chen, S. Lai, Y. Zhu, F. Bian, S. Campo, S. Carniani, S. Cristiani, F. Davies, R. Decarli, A. Drake, A.-C. Eilers, X. Fan, P. Gaikwad, S. Gallerani, B. Greig, M. G. Haehnelt, J. Hennawi, L. Keating, G. Kulkarni, A. Mesinger, R. A. Meyer, M. Neeleman, M. Onoue, A. Pallottini, Y. Qin, S. Rojas-Ruiz, **S. Satyavolu**, A. Sebastian, R. Tripodi, F. Wang, M. Wolfson, J. Yang, and M. V. Zanchettin, "XQR-30: The ultimate XSHOOTER quasar sample at the reionization epoch", MNRAS, vol. 523, no. 1, pp. 1399–1420, Jul. 2023.

[5] **S. Satyavolu**, A.-C. Eilers, G. Kulkarni, E. Ryan-Weber, R. L. Davies, G. D. Becker, S. E. I. Bosman, B. Greig, C. Mazzucchelli, E. Bañados, M. Bischetti, V. D'Odorico, X. Fan, E. P. Farina, M. G. Haehnelt, L. C. Keating, S. Lai, and F. Walter, "New quasar proximity zone size measurements at $z \sim 6$ using the enlarged XQR-30 sample", MNRAS, vol. 522, no. 4, pp. 4918–4933, Jul. 2023.

[6] **S. Satyavolu**, G. Kulkarni, L. C. Keating, and M. G. Haehnelt, "The need for obscured supermassive black hole growth to explain quasar proximity zones in the epoch of reionization", MNRAS, vol. 521, no. 2, pp. 3108–3126, May 2023.

In preparation

[7] **S. Satyavolu**, A.-C. Eilers, G. Kulkarni, and the XQR-30 collaboration, "XQR-30: Quasar lifetimes and constraints on black hole growth parameters", 2023.

[8] D. Ďurovčíková, A.-C. Eilers, **S. Satyavolu**, H. Chen, and G. Kulkarni, "Chronicling the reionization history and quasar lifetimes with redshift $6 < z < 7$ quasars", 2023.

Skills

- **Computation:** Programming in C, Python, Mathematica. HPC computing.
- Cosmological simulations using GADGET
- **Languages:** English, Hindi, Telugu (native)

Awards

- Infosys–TIFR Leading Edge Award 2023
  A grant amount of 200,000 Indian Rupees is awarded annually to "young researchers showing promise as future leaders in academia, on the basis of their research accomplishments". I received the grant for travel to the First Light conference at MIT.

Talks

- Reionisation in the Summer conference, MPIA Heidelberg, Germany — Jun 2023
- First Light conference, MIT, USA — Jun 2023
- Largest Cosmological Surveys and Big Data Science conference, ICTS, Bengaluru, India — May 2023
- Cosmology on Safari conference, Hluhluwe, South Africa — Mar 2023
- 41st meeting of Astronomical Society of India, IIT Indore, Indore, India — Mar 2023
- UK National Astronomy Meeting (online poster and flash talk), University of Warwick, UK — Jul 2022
- State of the Universe seminar, Tata Institute of Fundamental Research, Mumbai, India — Oct 2022

Conferences and Workshops

- Rubin LSST workshop, 41st meeting of Astronomical Society of India, IIT Indore, India — Mar 2023
- What Drives the Growth of Black Holes?, conference, Iceland (online) — Sep 2022
- 40th meeting of Astronomical Society of India, IIT Roorkee, India — Mar 2022
- Quasars and Galaxies through Cosmic Time conference, online — Jan 2022
- SAZERAC conference, online — Jul 2021
- Royal Astronomical Society meeting: Edge of Cosmic Reionisation, online — Feb 2021
- SAZERAC: Quasars during Reionisation specialist session, onlilne — Dec 2020
- SAZERAC conference, online — Jul 2020
- GIAN course on Dark Matter: The Astroparticle Perspective, JNU, New Delhi, India — Dec 2018
  The Global Initiative for Academic Networks (GIAN) is a program run by the Government of India that brings international experts to teach at Indian higher education institutions, promoting international collaboration and improving the quality of teaching and research. I attended a week-long course on astrophysical probes of dark matter as a part of GIAN.
- Refresher course on Astrophysics, Inter-University Center for Astronomy and Astrophysics, Pune, India
  May 2017

Collaborations

- **EREBUS** collaboration — 2023–
  Coordinators: Prof. Xiaohui Fan (Arizona), Prof. Jinyi Yang (Arizona), Prof. Fiege Wang (Arizona), Dr. Eduardo Bañados (MPIA), Prof. Joseph Hennawi (UCSB)
  - EREBUS is a JWST science collaboration for observing high-redshift quasars. I am currently a part of the IGM working group.
- **LSST** — 2022–
  DP0 delegate
  - I am an LSST data rights holder and a DP0 delegate. DP0 delegates are the data rights holders who have access to Rubin Science Platform and mock LSST catalogs, for testing the platform and preparing for science with LSST.
- **XQR-30** collaboration — 2022–

Coordinator: Dr. Valentina D'Odorico (INAF)

– XQR-30 is a high-quality spectroscopic survey of the brightest and highest redshift quasars between redshifts $z \sim 5$–7. I measured proximity zones of XQR-30 quasars and used them to estimate quasar lifetimes, duty cycles (Satyavolu et al. 2023; Satyavolu et al. in prep). I have contributed as an author on the papers summarising the survey (D'Odorico et al. 2023), measurement of black hole masses (Mazzuchhelli et al. 2023) and the mean free path of ionising photons (Zhu et al. 2023).

Teaching, Outreach and Academic Services

- **Session Chair**, First Light conference, MIT, USA 2023
  The First Light conference saw around 150 scientists from across the world discuss results from the one year run of JWST. I co-chaired the session on high-z quasars and SMBH seeds.
- **Tutor and Mentor**, Classical Mechanics, Vigyan Vidushi program for women graduates Jul 2022
  Vigyan Vidushi is a program to encourage women students to pursue physics as a research career. I led three tutorial sessions on Classical Mechanics. I also participated in an interaction session where I shared my research experience as a woman scientist.
- **Teaching Assistant** at TIFR, Mumbai, India Aug–Dec 2020
  As a grader, I aided about 30 graduate students in problem solving through biweekly tutorial sessions for the course "Advanced Electrodynamics".
- **Teaching Assistant** at TIFR, Mumbai, India Jan–May 2020
  As a grader, I aided about 20 graduate students in problem solving through biweekly tutorial sessions for the course "Introduction to Electrodynamics".
- **Co-organiser**, State of the Universe Seminar (SOTU), TIFR, Mumbai, India 2022-present
  SOTU is the weekly seminar series of the cosmology group in the Department of Theoretical Physics. I was responsible for inviting around 15 speakers across several disciplines in Cosmology and Astroparticle Physics. I have also been maintaining the SOTU public website for over an year.
- **Volunteer**, Frontiers of Science (FoS), TIFR, Mumbai, India 2018
  FoS is TIFR's Annual outreach event. I guided around 30 high school students through the campus lab facilities, detailing them about research.
- **Coordinator**, Bhoutics: Physics fest of IIT Madras, Chennai, India 2016
  Bhoutics is the inaugural edition of Physics fest of IIT Madras for undergraduate students in science and engineering across India. I organised and judged an event to design a Physics-themed poster.

Short-term Research Projects

Density profiles of ultra-light scalar dark matter TIFR, Mumbai
Advisor: Prof. Basudeb Dasgupta Aug–Dec 2019

– Studied density profiles of dark matter halos made up of ultra-light scalar dark matter using the Schrödinger-Poisson equation and their implications for the core-cusp problem.

Spherical Collapse model to explain Dark matter halo formation IUCAA, Pune
Advisor: Prof. Aseem Paranjape May–June 2017

– Spent two months as a summer project student. Studied spherical collapse model to derive the required density contrast in halos for collapse/shell crossing to occur in different cosmologies.

Other Accomplishments

- Ranked 3rd across India amongst 7000 students in the Joint Entrance Screening Test for admission into PhD programs across more than 15 leading Indian research institutes. (2018)
- Ranked in the top 0.1% amongst 200,000 students in the Engineering Agriculture and Medical Common Entrance Test (EAMCET) for admission into undergraduate programs in the state of Andhra Pradesh, India. (2014)
- Ranked in the top 1% amongst 200,000 students in the IIT Joint Entrance Exam (JEE) - Advanced, for admission into the prestigious Indian Institutes of Technology. (2014)