Sapna Mishra

Space Telescope Science Institute (STScI)

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Research Interest:

• Galaxy evolution within the Local Group, • Study of the diffuse gas in and around the Magellanic systems, • Investigating the multiphase extremely diffuse gas in the outskirts of the galaxy clusters, • Gas inflow and outflow in and around the circumgalactic medium (CGM), • CGM of cluster galaxies to understand environmental effects such as ram-pressure stripping, overshooting, and pre-processing, • Strong outflows in the broad absorption line quasars and their blazar-like subclass, • Incidence rate (dN/dz) of intervening absorbers across different background sources, • Absorption line spectroscopy.

Academic Positions

Space Telescope Science Institute — Baltimore, USA
Postdoctoral Fellow — 2023 - present

Inter-University Centre for Astronomy & Astrophysics — Pune, India
Postdoctoral Fellow — 2021 - 2023

Aryabhatta Research Institute of observational sciencES — Nainital, India
Post Thesis Submission Fellow (PTSF) — 2020 - 2021

Education

Aryabhatta Research Institute of observational sciencES — Nainital, India
Ph. D — 2015 - 2020

- **Thesis:** Probing environment of AGNs based on their feedback processes
- **Advisor:** Prof. Hum Chand
- **Degree Awarded:** July 2021

Aryabhatta Research Institute of observational sciencES — Nainital, India
Pre-Ph. D Course work — 2014 - 2015

Department of Physics & Astrophysics, Delhi University — Delhi, India
Master of Science, Physics and Astronomy — 2012 - 2014

Miranda House College, Delhi University — Delhi, India
Bachelor of Science, Physics honors — 2012 - 2014

Highlights

- **Publication:** 8 first author publications, 14 total refereed publications since 2018, $\sim$ 107 citations, h-index = 8.
- **Media:** My recent study on the CGM of the LMC was featured in Jeopardy (American TV game show on 12-Feb-2025). This study was also highlighted in a NASA press release and covered by over five prestigious media outlets worldwide.
- **Grants and observations:** PI of HST-Cycle 32 proposal (29 orbits, $\sim$ \$110K), PI of VLT/FORS2 proposal, PI of more than 10 proposals for 2-4m class national ground based telescopes in India with observing experience of >50 nights.
- **Selected Awards:** Awarded international prize fellowships such as: FONDECYT-2023 Chilean Prize fellowship, and Research Grant type A2 in MILANO-BICOCCA, 2022, Italy.
- **Conferences and Workshops:** Presented my research at $\sim$20 conferences worldwide and provided astronomical tool trainings at around five workshops.

Telescope time and grants as Principle Investigator

- HST/COS, Cycle 32, "Probing the front-side of the Circumgalactic Medium of the Large Magellanic Cloud" (PID: GO-17757): 29 orbits
- ESO/FORS2, Cycle P109, "MgII tomography of cluster outskirts using 11 background quasars" (PID: 109.23G6).
- Devasthal Optical Telescope (DOT), 3.6m international telescope, India, DOT-2022-C1: "NIR spectroscopy of post-starburst galaxies to probe obscured star formation and stellar population" (PID: DOT-2022-C1-P18).
- DOT, DOT-2021-C1,"Probing connection between the emission and absorption outflows in IR-bright BAL quasars", PID: DOT-2021-C1-P32.
- DOT, DOT-2018-C1, "Resolving the narrow emission line region of the quadruply imaged quasar: RXS J113155.4-123155" (PID: P325-2018A).
- DOT, DOT-2017-C1, "Infrared properties of the jet dominated BALQSOs" (PID: P31-2017A).
- Himalayan Chandra Telescope (HCT), 2m national telescope, India, HCT-2021-C2, "Probing the spectral variability of X-Ray bright high ionization Broad absorption line Quasars" (PID: HCT-2021-C2-P56).
- HCT, HCT-2021-C1: "Intranight monitoring of blazar counter parts of BAL quasars (PID: HCT-2021-C1-P52).
- HCT, 3 proposals in various cycles on "Probing environment of emerging Broad absorption line quasars" (PIDs: HCT-2020-C2-P27, HCT-2020-C1-P170, HCT-2019-C3-P117).

Service

- Reviewed applications for Space Astronomy Summer Program (SASP)-2025 at STScI.
- Co-Organize: HotSci, 2024, colloquium series at STScI.
- Panel Support Scientist (PSS): moderated the TAC of HST Cycle, 32, JWST Cycle 3.
- Served as a **service observer** at the Devasthal Optical Telescope (3.6m) during the COVID period, conducting observations on behalf of other proposers.

Mentoring, Teaching and Outreach

- Co-mentoring undergraduate student, Zhibin You at John Hopkins University (JHU) (from Feb-10-2025- present).
- Presented public talk at "Astronomy on Tab", Baltimore, Jan-30-2025.
- Given optical data reduction training in ARIES Training School in Observational Astronomy (ATSOA), 2016, 2017, 2018, 2019, ARIES, Nainital, India.
- Given high-resolution UVES spectra data reduction training in TMT workshop on large telescope data handling, Jan 15-27, 2017, IUCAA, Pune, INDIA.
- Guided two master degree project students for the credit on the photometric and spectroscopic data reduction techniques during my Phd.

Prize fellowships and Awards

- 2023: FONDECYT-2023 Chilean Prize fellowship.
- 2022: MILANO-BICOCCA, 2022, Italy, Research Grants type A2.
- 2014: All India "Graduate Aptitude Test in Engineering" (GATE), India.
- 2012: All India "Joint Admission Test for Master (JAM)", India
- 2012: Selected as top 10% graduate level student in Delhi University.

Technical and Software experience

- Observing Experience — $>$ 50 nights with 2-4m ground based Indian telescopes.
- Operating System — Linux: Ubuntu, Fedora; MACOS, Windows
- Programming Languages — `Python`, `IDL`, C, C++, `ecl−IRAF` script, Unix Shell−Scripts
- Web programming — `Php`, `mysql`, `HTML`
- External Plotting Tools — `Supermongo`, `GNUPLOT`
- Other Astronomy software — `IRAF`, `DAOPHOT`, `CLOUDY`, `Topcat`, `Esorex`, `Gasgano`, `vpfit`
- Written big dataset `SQL` casjob queries for — `SDSS`, `HST-MAST`, `SIMBAD`, `NED`

Scientific Talks

- Summer Conference 2025, Ninth Edition, "The Truncated CGM of the Large Magellanic Cloud", May 2025 (Invited).
- ACP, Aspen, "Holistic picture of CGM", September 2024.
- CfA, Harvard, "Multiphase Madness", August 2024.
- Space Telescope Science Institute, "Spring Symposium", April 2024.
- Flatiron Institute, "Milky Clouds over Manhattan", February 2024.
- Space Telescope Science Institute, "Galaxy/AGN Journal Club", January 2024.
- Space Telescope Science Institute, "CoolSci", January 2024.
- IUCAA, India, "Galactic inflows and outflows on all Scales", February 2023
- Università Milano-Bicocca, Milan, "What matter(s) around galaxies", September 2022
- IUCAA, India, "Monthly Last Friday Talk series", January, 2022
- IISER, Tirupati, India, "Astronomical Society of India", Poster, March 2020.
- Department of Physics & Astrophysics, Delhi University, "Departmental Talk", October 2019.
- IUCAA, India, "Recent Trends in the study of Compact Objects Theory and Observations (RETCO-IV)', Poster, April 2019.
- Institut d'Astrophysique de Paris(IAP), Paris, FR, "massive black holes in evolving galaxies: from quasars to quiescence", Poster/Flash Talk, May 2018.
- Dèpartement d'Astrophysique, Gèophysique, Universitè de Liège, Liège, Belgium, December 2017.
- ARIES, India, "ARIES Training School in Observational Astronomy (ATSOA)", March 2018, March 2017, February 2016.
- ARIES, India, "Tuesday Seminar series", February 2017.
- IUCAA, India, "Thirty Meter Telescope (TMT) Conference", January 2017.
- ARIES, India, "Belgo-Indian Network for Astronomy and Astrophysics (BINA)", Poster/Flash Talk, November 2016.
- ARIES, India, "Tuesday Seminar series", May 2016.
- IUCAA, India, "Cloudy Workshop", September 2015.

Workshops and Schools

- AstroSat data analysis workshop, August 8-11, 2017, ARIES, Nainital, India
- TMT workshop on large telescope data handling, Jan 15-27, 2017 , IUCAA, Pune, India
- Extragalactic Relativistic Jets: Cause and Effect, FERMI satellite data reduction school, ICTS Bangalore; October 14-21, 2015
- Cloudy workshop, Sept 21-26, 2015, IUCAA, Pune, India
- Workshop on the radio data reduction, Radio Astronomy School-2015 (RAS), August 31, 2015, NCRA, Pune, India

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Detailed multi-wavelength Research Experience

§1. **Optical Astronomy:**

- **Spectroscopy:**
  - Extensive observational experience as Principal Investigator (PI) with national and international telescopes, including the 3.6m Devathal Optical Telescope (DOT, India), 2m Himalayan Chandra Telescope (HCT, India), 2.4m Lijiang Astronomical Observatory (CAS, China), 6m Special Astrophysical Observatory (SAO, Russia), and 8m European Southern Observatory (ESO)/FORS2 for quasar absorption line studies
  - Skilled in advanced data reduction and analysis using IRAF, ESOREX, ESO-GASGANO, and LPIPE (IDL). Developed automatic data reduction pipelines in `Python`, `ecl-IRAF`, `ESOREX`+UNIX script for various spectrographs mentioned above.
  - Proficient in handling large (>100,000 quasars) archival spectra from facilities: Sloan Digital Sky Survey (SDSS), ESO (UVES, FORS1/2, X-SHOOTER), and Keck Observatory/LRIS, covering a wide spectral resolution range (900−40,000).
  - Developed multiple GUI-based automation tools for quasar continuum fitting and identification of doublet absorption lines (MgII, CIV), and simultaneous emission and absorption spectral fitting.
- **Photometry:**
  - Conducted observational AGN variability studies using ground-based 1-4m class national telescopes at ARIES, Nainital, India.
  - Performed differential photometry using IRAF and DAOPHOT for continuum variability studies and developed automatic data reduction and photometric analysis pipeline in `IDL` (Interactive data language).
  - Devolved astrometry correction pipeline (in python) for the mock dataset for the 4m international liquid mirror telescope (ILMT), ARIES, Nainital, India.

§2. **Ultraviolet (UV) Astronomy:**

- Principal Investigator (PI) for **Hubble Space Telescope / Cosmic Origins Spectrograph (HST/COS) Cycle-32** proposal.
- Handled large HST datasets of quasar spectra from the Hubble Spectroscopic Legacy Archive (HSLA), developing automated Python tools for spectral addition, continuum fitting, and line identification.
- Conducted photoionization modeling using `Cloudy` and absorption line modeling using `vpfit` to analyze diffuse gas in cluster outskirts and the circumgalactic medium (CGM).
- Experienced in `AstroSat-UVIT` satellite data reduction and `LAXPC` data analysis (trained in a dedicated data reduction workshop, ARIES, Nainital, 2017).

§3. **X-ray Astronomy:** Expertise in Chandra and XMM-Newton satellite data reduction and spectral modeling using `Xspec` (submitted proposals), focusing on shielding gas in X-ray bright BAL quasars (trained through a dedicated data reduction workshop).

§4. **Radio and γ-ray Astronomy:** GMRT data reduction using `AIPS` and `CASA` (trained in a dedicated data reduction workshop, RAS, NCRA, Pune, 2015) and FERMI satellite data reduction using `FREMI-LAT` and high-energy astrophysical analysis (trained in a dedicated data reduction workshop, ICTS, 2015).

List of publications

First-author publications

§8. **Mishra, Sapna**; Fox, Andrew; Smoker, J; Lucchini, Scott; D'Onghia, Elena; 2025, ApJ (under revision), *"The Distance to the Magellanic Stream: Constraints from Optical Absorption along Stellar Sightlines"*.

§7. **Mishra, Sapna**; Fox, Andrew; Krishnarao, Dhanesh; Lucchini, Scott; D'Onghia, Elena; Cashman, Frances; Barger, Kathleen; Lehner, Nicolas; Tumlinson, Jason, 2024, ApJ Letters, 976, L28, *"The Truncated Circumgalactic Medium of the Large Magellanic Cloud"*

§6. **Mishra, Sapna**, Muzahid Sowgat, Dutta Sayak, Srianand, Raghunathan, Charlton, Jane, 2024, MNRAS, 527, 3858, *"Characterizing cool, neutral gas, and ionized metals in the outskirts of low-z galaxy clusters"*.

§5. **Mishra, Sapna**, & Muzahid Sowgat, 2022, ApJ, 933, 229, *"Discovery of a Cool, Metal-rich Gas Reservoir in the Outskirts of $z \approx 0.5$ Clusters"*.

§4. **Mishra, Sapna**, Gopal-Krishna, Chand H., Chand K., Kumar A., Negi V., 2021, MNRAS Letters, 2021, 507, 46, *"A search for blazar activity in broad-absorption-line quasars"*.

§3. **Mishra, Sapna**, Vivek M., Chand H., Joshi R, 2021, MNRAS, 504, 3187, *"Appearance versus disappearance of broad absorption line troughs in quasars"*.

§2. **Mishra, Sapna**, Krishna G, Chand H, Chand K, Ojha V, 2019, MNRAS Letters, 489, L42, *"Are there broad absorption line blazars?"*.

§1. **Mishra Sapna**, Chand H, Krishna G, Joshi R., Shchekinov Y. A., Fatkhullin T. A., 2018, MNRAS, 473, 5154, *"On the incidence of MgII absorbers along the blazar sightlines"*.

Co-author publications †

§5. Dutta, Sayak; Muzahid, Sowgat; Schaye, Joop; **Mishra, Sapna**; Chen, Hsiao-Wen; Johnson, Sean; Wisotzki, Lutz; Cantalupo, Sebastiano, 2024, MNRAS, 528, 3745, *"MUSEQuBES: mapping the distribution of neutral hydrogen around low-redshift galaxies"*.

§4. Gopal-Krishna, Chand K., Chand H., Negi V., **Mishra, Sapna**, Britzen S., Bisht S., 2023, MNRAS, 518, 13, *"Intranight optical variability of low-mass active galactic nuclei: a pointer to blazar-like activity"*.

§3. Kumar B., Negi V., Ailawadhi B., **Mishra, Sapna**, Pradhan B., Misra K., Hickson P., Surdej J., 2022, JAA, 43, 10, *"Upcoming 4m ILMT facility and data reduction pipeline testing"*.

§2. Chand K., Gopal-Krishna, Omar A., Chand H., **Mishra, Sapna**, Bisht S., Britzen S, 2022, MNRAS, 511, 13, *"Intranight variability of ultraviolet emission from powerful blazars"*.

§1. Ojha V., Chand H., Gopal-Krishna, **Mishra, Sapna**, Chand, K, MNRAS, 2020, 493, 3642, *"Comparative intra-night optical variability of X-ray and γ-ray detected narrow-line Seyfert 1 galaxies"*.

†: provided data analysis codes and mentored first authors in their application.

Conference Proceedings & GCN Circular

§4. Kumar, Amit; Gupta, Rahul; Dastidar, Raya; Dimple; Ghosh, Ankur; **Mishra, Sapna**; et al. 2020GCN.29030....1K, *"GRB 201203A: 1.3m DFOT, optical upper limits"*.

§3. Kumar A., Aryan, A., Pandey S.B., **Mishra, Sapna**; et al. 2020GCN.27564....1K, *"GRB 200412B: Optical afterglow detection with 1.3m DFOT"*.

§2. **Sapna Mishra**, H. Chand, et al. 2018, Bulletin de la Société Royale des Sciences de Liège, 87, 325, *"Revisiting the incidence of Mg II absorbers along the blazar sightlines"*.

§1. Hum Chand, Suvendu Rakshit, Priyanka Jalan, Vineet Ojha, Raghunathan Srianand, Mariappan Vivek, **Sapna Mishra** et al. 2018, Bulletin de la Société Royale des Sciences de Liège, 87, 291, *"Probing the central engine and environment of AGN using ARIES 1.3-m and 3.6-m telescopes"*.