Curriculum Vitae

Updated: July 5, 2024

Sagnick Mukherjee

Designation: 4th Year PhD Candidate,
PhD Program in Astronomy and Astrophysics,
Department of Astronomy and Astrophysics,
University of California, Santa Cruz
Email: samukher@ucsc.edu
Website: https://sagnickm.github.io/
ORCID: 0000-0003-1622-1302

Academic Qualification

Examination / Degree	Board / Institute	Subjects	Year	Percentage/ Grade Points
All India Secondary School Examination (10^{th} Grade)	Central Board of Secondary Education	General Stream including English	2013	10/10
All India Senior School Certificate Examination (12th Grade)	Central Board of Secondary Education	Chemistry, Biology English, Mathematics, Physics	2013-15	94.8%
Bachelor of Science	Presidency University	Physics Major	2015-18	9.21/10 (Gold Medal)
Master of Science	Presidency University	Physics Major	2018-20	9.65/10 (Gold Medal)
Master of Science	UC Santa Cruz	Astronomy and Astrophysics	2020-22	4/4

Research Work

I am primarily interested in building models of exoplanet and brown dwarf atmospheres and using them with observational data to probe the physical/chemical processes ongoing in these atmospheres. I have used my models with James Webb Space Telescope (JWST) and ground-based telescope observations for both exoplanets and brown dwarfs. I aim to probe the nature of multiple physical processes like vertical mixing, photochemistry, and cloud formation in exoplanet and brown dwarf atmospheres. I am also an expert in data reduction and analysis of JWST observations of transiting exoplanets. I am the Principal Investigator and Co-Investigator of several JWST observational and theoretical proposals on exoplanet and brown dwarf atmospheres.

First Authored Publications

1. "Effects of Planetary Parameters on Disequilibrium Chemistry in Irradiated Planetary Atmospheres: From Gas Giants to Sub-Neptunes", **Sagnick Mukherjee**, Jonathan J. Fortney, Nicholas F. Wogan, David K. Sing, Kazumasa Ohno, (2024, AAS Journals, Under Review)

2. "The Sonora Substellar Atmosphere Models. IV. Elf Owl: Atmospheric Mixing and Chemical Disequilibrium With Varying Metallicity and C/O Ratios", **Sagnick Mukherjee**, Jonathan J. Fortney, Caroline V. Morley , Natasha E. Batalha , Mark S. Marley , Theodora Karalidi , Channon Visscher , Roxana Lupu, Richard Freedman, Ehsan Gharib-Nezhad, (2023, The Astrophysical Journal)

3. "Probing the Extent of Vertical Mixing in Brown Dwarf Atmospheres with Disequilibrium Chemistry", **Sagnick Mukherjee**, Jonathan J. Fortney, Natasha E. Batalha, Theodora Karilidi, Mark S. Marley, Channon Visscher, Brittany E. Miles, Andrew J. I. Skemer (**2022**, The Astrophysical Journal (ApJ), Volume 938, 107)

4. "PICASO 3.0: A One-Dimensional Climate Model for Giant Planets and Brown Dwarfs", **Sagnick Mukherjee**, Natasha E. Batalha, Jonathan J. Fortney, Mark S Marley (**2022**, The Astrophysical Journal (ApJ, Volume 942, Number 2))

5. "Modeling Polarization Signals from Cloudy Brown Dwarfs Luhman 16 A and B in Three Dimensions", **Sagnick Mukherjee**, Jonathan J. Fortney, Rebecca Jensen-Clem, Xianyu Tan, Mark S. Marley, and Natasha E. Batalha (**2021**, The Astrophysical Journal, Volume 923, Number 1)

6. "Cloud Parameterizations and their Effect on Retrievals of Exoplanet Reflection Spectroscopy", **Sagnick Mukherjee**, Natasha E. Batalha, and Mark S. Marley (**2021**,The Astrophysical Journal, Volume 910, Number 2)

7. "The accretion disc-jet connection in blazars", **Sagnick Mukherjee**, Kaustav Mitra, and Ritaban Chatterjee (**2019**, Monthly Notices of the Royal Astronomical Society, Volume 486, Issue 2)

8. "X-Ray Surface Brightness Profiles of Optically Selected Active Galactic Nuclei: Comparison with X-Ray AGNs", **Sagnick Mukherjee**, Anirban Bhattacharjee, Suchetana Chatterjee, Jeffrey A. Newman, and Renbin Yan (**2019**, The Astrophysical Journal, Volume 872, Number 1)

Selected Co-Authored Publications

1. "Early Release Science of the exoplanet WASP-39b with JWST NIRSpec PRISM", Zafar Rustamkulov, David K. Sing, **Sagnick Mukherjee**, et al. (**2023**, Nature, Volume 614)

2. "Methane Throughout the Atmosphere of the Warm Exoplanet WASP-80b", Taylor J. Bell1, Luis Welbanks, Everett Schlawin, Michael R. Line, Jonathan J. Fortney, Thomas P. Greene, Kazumasa Ohno, Vivien Parmentier, Emily Rauscher, Thomas G. Beatty, **Sagnick Mukherjee**, Lindsey S. Wiser, Martha L. Boyer, Marcia J. Rieke, and John A. Stansberry (**2023**, Nature)

3. "The atmosphere of HD 149026b: Low metal-enrichment and weak energy transport", Anna Gagnebin, **Sagnick Mukherjee**, Jonathan J. Fortney, Natasha E. Batalha. (**2024**, ApJ)

4. "The First JWST Spectral Energy Distribution of a Y Dwarf", Samuel A. Beiler , Michael C. Cushing , J. Davy Kirkpatrick , Adam C. Schneider , **Sagnick Mukherjee**, Mark S. Marley (**2023**, ApJ, Volume 951)

5. "Identification of carbon dioxide in an exoplanet atmosphere", JWST Transiting Exoplanet Community Early Release Science Team, (**2022**, Nature)

6. "The JWST Early Release Science Program for Direct Observations of Exoplanetary Systems II: A 1 to 20 Micron Spectrum of the Planetary-Mass Companion VHS 1256-1257 b", Brittany E. Miles, Beth A. Biller...**Sagnick Mukherjee**, et al., (**2023**, ApJL, Volume 951)

7. "The Infrared Colors of 51 Eridani b: Micrometeoroid Dust or Chemical Disequilibrium?", Alexander Madurowicz , **Sagnick Mukherjee** , Natasha Batalha , Bruce Macintosh, Mark Marley,Theodora Karalidi, (**2023**, ApJ, Volume 165)

8. "A Clear View of a Cloudy Brown Dwarf Companion from High-Resolution Spectroscopy", Jerry W. Xuan, Jason Wang,...**Sagnick Mukherjee**, et al.,(**2022**, ApJ, Volume 937).

9. "The Sonora Substellar Atmosphere Models. III. Diamondback: Atmospheric Properties, Spectra, and Evolution for Warm Cloudy Substellar Objects", Caroline V. Morley, **Sagnick Mukherjee**, Mark S. Marley, Jonathan J. Fortney, et al. (**2023**, Under Preparation)

Conference, Talks and Posters

1. Contributed Talk, 'Effects of Planetary Parameters on Disequilibrium Chemistry: From Gas Giants to Sub-Neptunes', July 2024, Challenge Accepted! Linking Planet Formation with Present-Day Atmospheres, MPIA Heidelberg, Germany.

2. Contributed Talk, 'Revisiting GJ 436b's Atmosphere with Panchromatic JWST Emission Spectroscopy', June 2024, Exoplanets V, Leiden, Netherlands.

3. Invited Talk, 'Constraints on Atmospheric Mixing in Brown Dwarf and Exoplanet Atmospheres in the JWST Era', Februrary 2024, Carnegie Earth and Planets Laboratory, Washington DC.

4. Invited Talk, 'Constraints on Atmospheric Mixing in Brown Dwarf and Exoplanet Atmospheres in the JWST Era', November 2023, Cornell University, Ithaca.

5. Invited Talk, 'Constraints on Atmospheric Mixing in Brown Dwarf and Exoplanet Atmospheres in the JWST Era', October 2023, School of Earth and Planetary Sciences, NISER Bhubaneswar, India.

6. Invited Talk, 'Constraints on Atmospheric Mixing in Brown Dwarf and Exoplanet Atmospheres in the JWST Era', November 2023, Department of Astrophysics and High Energy Physics, SNBNCBS, Kolkata, India.

7. Contributed Talk, 'PICASO: An Unified Atmospheric Model of Exoplanetary Atmospheres with Photochemistry and Vertical Mixing', June 2023, ERES Conference, Yale University.

8. Poster Presentation, 'Constraints on Atmospheric Vertical Mixing in Giant Exoplanets and Brown Dwarfs', September 2023, Exoplanets: Atmospheres to Architecture, Washington DC.

9. Poster Presentation, 'PICASO: An Unified Atmospheric Model of Exoplanetary Atmospheres with Photochemistry and Vertical Mixing', June 2023, Exoclimes Conference, University of Exeter.

10. Contributed Talk , 'Atmospheric and Evolutionary Models of Substellar Objects with Disequilibrium Chemistry for the JWST Era', January 2023, AAS Conference, Seattle.

11. Contributed Talk , 'Atmospheric and Evolutionary Models of Substellar Objects with Disequilibrium Chemistry for the JWST Era', January 2023, ExoPAG 27, Seattle.

12. Contributed Talk , 'PICASO 3.0: A One-Dimensional Open Source Climate Model for Giant Planets and Brown Dwarfs', October 2022, 42nd Bay Area Exoplanets Meeting, SETi.

13. Contributed Talk , 'Understanding Atmospheric Mixing with Disequilibrium Chemistry in Brown Dwarfs', July 2022, Other Worlds Laboratory (OWL) Summer Program.

14. Invited Talk , 'Understanding Exoplanet and Brown Dwarf Atmospheres in the JWST Era', June 2022, CESSI Seminar, IISER Kolkata.

15. Poster Presentation, 'Measuring Vertical Mixing in Giant Planets and Brown Dwarf Atmospheres', September 2023, Ninth Annual Giant Magellan Telescope Community Science Meeting, Washington DC.

16. Poster Presentation, 'PICASO+VULCAN: Modeling Exoplanetary Atmospheres Self-Consistently with Photochemistry and Vertical Mixing', June 2023, Exoclimes VI, June 2023, University of Exeter, UK.

17. Poster Presentation, 'Probing Atmospheric Mixing with Disequilibrium Chemistry in Brown Dwarfs and Warm Exoplanets', May 2022, Exoplanets IV, Las Vegas.

18. Contributed Talk , 'Understanding Atmospheric Mixing with Disequilibrium Chemistry in Brown Dwarfs', January 2022, CHAMPs Exoplanet Early Career Seminar.

19. Contributed Talk , 'Modeling Polarization Signals from Cloudy Brown Dwarfs: Luhman 16 A and B in Three Dimensions', September 2021, Bay Area Exoplanet Meeting 38.

20. Poster Presentation, 'Modeling Polarization signals in 3D from brown dwarfs Luhman 16 and B', April 2021, STScI Spring Symposium

21. Contributed Talk , 'Cloud Complexity Required for Retrievals on Reflected Spectroscopy of Cool Giants', September 2020, Bay Area Exoplanet Meeting 34.

22. Contributed talk, 'The accretion disc-jet connection in blazars', 37th Annual meeting of the Astronomical Society of India , Christ University, Bangalore, Spring 2019

Awards and Fellowships

1. Templeton Theory-Experiment Cross Training (TEX) fellowship co-hosted by UCSC and JHU.

2. UC President's Lindau Fellow 2024, Participant in the 73rd Lindau Nobel Laureate Meeting (Physics), July 2024, Lindau, Germany.

3. Barbara Walker Best Paper Award 2023-24 for "PICASO 3.0: A One-dimensional Climate Model for Giant Planets and Brown Dwarfs".

4. UC Regent's fellowship for first year graduate study at Department of Astronomy and Astrophysics, UCSC.

5. 2021-2022 Whitford Prize for highest achievement in research, coursework, and teaching as a 2nd year Graduate Student in the Astronomy department at UCSC.

6. Awarded the S.N. Bose Scholarship from Indo-US Science and Technology Forum (IUSSTF), 2019 for participating in short-term summer research at University of California, Santa Cruz.

7. Stood first in M.Sc Physics (Gold medalist) (2018-2020) and B.Sc Physics (Gold Medalist) (2015-18).

8. INSPIRE fellow, Department of Science and Technology, Government of India.

9. Jagadis Bose National Science Talent Search scholarship for undergraduate research (2015-2020).

Teaching and Mentoring Experience

1. Mentoring undergraduate student Anna Gagnebin (California State University, Sacramento) for the project "Exoplanet Atmosphere Models for JWST Spectroscopy", 2022.

2. Teaching Assistant for ASTR-10 "From the Big Bang to Planet Earth" with Prof. Alexie Leauthead, Spring 2023.

3. Teaching Assistant for ASTR-16 "Astrobiology: Life in the Universe" with Prof. Natalie Batalha, Fall 2021.

4. Mentored 6 high school students for the astronomy project "Photometrically variable stars in M31" as a part of the Science Internship Program (SIP) at summer 2019 and 2020.

Observational Astronomy Experience

1. Co-PI and theory lead of Awarded James Webb Space Telescope Cycle 2 time for the GO program 4094 named "Probing the Depths: Disequilibrium Chemistry as a Tracer of Mixing Processes in Brown Dwarf Atmospheres".

2. PI of Awarded James Webb Space Telescope Cycle 2 AR GO program 3245 named "Up to the Task? A New Generation of Atmospheric and Interior Models of Brown Dwarfs for the JWST Era".

3. Co-I of Awarded James Webb Space Telescope Cycle 2 AR GO program 3201 named "The Utility of Self-Consistent Models and Photochemistry in Understanding Transiting Planet Atmospheres"

4. Awarded Hubble Space Telescope Cycle 30 GO time for the proposal "Photometry of a Young Planetary-Mass Companion to a Taurus M Dwarf Star" (Co-I).

5. Optical observations of astrometry of Pluto and photometry of star clusters using the Nickel 1-m Telescope, Lick Observatory as a part of observational astronomy course at UCSC, 2021.

6. AO assisted IR imaging of Neptune using Shane-AO with the Shane 3-m Telescope at Lick Observatory as a part of observational astronomy course, 2021.

7. Long slit spectroscopy of galaxies for measuring their rotation curve using Kast Spectrograph with the Shane 3-m Telescope at Lick Observatory as a part of observational astronomy course at UCSC, 2021.

8. Optical Spectroscopy Observation of variable stars in the Andromeda galaxy at Shane 3-m optical telescope, Lick Observatory with PI Prof. Puragra GuhaThakurta and Co-I Mr. Rafael Nunez, UCSC, Summer 2019.

Press Coverage

1. "India's Space Success Continues: Know All About Indian Scientists Awarded Webb Telescope Usage Time In Cycle 2", The Weather Channel, August 24, 2023

2. "Methane Throughout The Atmosphere Of The Warm Exoplanet WASP-80b", Astrobiology, September 7, 2023

3. "JWST makes first unequivocal detection of carbon dioxide in an exoplanet atmosphere", UCSC Newscenter, August 25, 2022

4. "James Webb telescope detects dust storm on distant world", BBC News, March 22, 2023.
5. "NASA's Webb Detects Carbon Dioxide in Exoplanet Atmosphere", NASA JPL, August 25, 2022. Also covered by leading news platforms across the world.
6. "JWST's First Direct Spectrum of a Planetary-Mass Object", Astrobites, September 2, 2022,
7. "NASA releases Webb telescope's first exoplanet image", UCSC Newscenter, September 1, 2022. Also covered by leading news platforms across the world.
8. "James Webb Space Telescope: Carbon Dioxide in an Atmosphere which is 700 light years away", Anandabazar Patrika, August 27, 2022

Scientific Computing Experience

1. Developed the open-source atmospheric model `PICASO 3.0` for exoplanets and brown dwarfs
2. 4 years experience with exoplanet atmospheric simulation package `PICASO`.
3. Contributed to development of exoplanet cloud modeling package `VIRGA`.
4. Proficient scientific programming with Python and Fortran.
5. Proficient in GPU based Python programming with Numba Cuda and CuPy.
6. Selected and Participated in the NASA GPU Hackathon 2022 co-organised by NASA and NVIDIA.