Mihir Kulkarni

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Education

Columbia University — New York, U.S.A.
Ph.D. in Astronomy, Advisor: Prof. Greg L. Bryan — 2015–2021
- Thesis: *Modeling the formation, evolution, and observation of first stars*

M.Phil. in Astronomy — 2018
M.A. in Astronomy — 2017

Indian Institute of Science Education and Research, Pune — Pune, India
B.S.-M.S. with distinction in Physics, GPA: 9.1/10 — 2010–2015
- Thesis: *Simulating the distribution of cosmological neutral hydrogen over cosmic times*

Research interests

- First stars, first galaxies, reionization, alternative dark matter models, computational astrophysics, semi-analytic modeling.

Experience

The University of Toledo — Toledo, Ohio
Postdoctoral research associate — Fall 2021 - present

Publications

1. **Kulkarni, M.**; Visbal, E.; Bryan, G.L., *Fragmentation in Population III Galaxies Formed through Ionizing Radiation*, 2019, ApJ, 882, 178. (arXiv:1907.11724).

2. **Kulkarni, M.**; Visbal, E.; Bryan, G.L., *The critical dark matter halo mass for Population III star formation: dependence on Lyman-Werner radiation, baryon-dark matter streaming velocity, and redshift*, 2021, ApJ, 917, 40. (arXiv:2010.04169).

3. **Kulkarni, M.**; Ostriker, J.P., *What is the Halo Mass Function in a Fuzzy Dark Matter Cosmology?*, 2022, MNRAS 510, 1425. (arXiv:2011.02116.)

4. Shao, H.; Villaescusa-Navarro, F.; Villanueva-Domingo, P.; Teyssier, R.; Garrison, L. H.; Gatti, M.; Inman, D.; Ni, Y.; Steinwandel, U. P.; **Kulkarni, M.**; Visbal, E.; Bryan, G. L.; Anglés-Alcázar, D.; Castro, T.; Hernández-Martínez, E.; Dolag, K., *Robust Field-level Inference of Cosmological Parameters with Dark Matter Halos*, 2023, ApJ 944, 27. (arXiv:2209.06843.)

5. **Kulkarni, M.**; Visbal, E.; Bryan, G.L.; Li, X., *If Dark Matter is Fuzzy, the First Stars Form in Massive Pancakes*, 2022, ApJL, 941, 18 (arXiv:2210.11515)

6. Shao, H.; de Santi, N. S. M.; Villaescusa-Navarro, F.; Teyssier, R.; Ni, Y.; Anglés-Alcázar, D.; Genel, S.; Hernquist, L.; Steinwandel, U. P.; Castro, T.; Hernández-Martínez, E.; Dolag, K.; Lovell C. C.; Visbal, E.; Garrison, L. H.; **Kulkarni, M.**, *A universal equation to predict Ω_m from halo and galaxy catalogues*, ApJ 956, 149. (arXiv:2302.14591.)

7. Feathers C. R.; **Kulkarni, M.**; Visbal E.; Hazlett R., *A Global Semi-Analytic Model of the First Stars and Galaxies Including Dark Matter Halo Merger Histories*, Accepted for publication in ApJ. (arXiv:2306.07371).

8. Hazlett R.; **Kulkarni, M.** Visbal E.; Wise, J. H., *Calibrating a Semi-analytic Model to a Radiative Hydrodynamical Simulation of the First Stars*, in prep.

Fellowships and Awards

- **Dean's Fellowship** at Columbia University. 2015–2021
- **Junior Research Fellowship** (JRF - NET) of Council of Scientific and Industrial Research (CSIR), Govt. of India with an All India Rank of 25. 2013
- **Innovation in Science Pursuit for Inspired Research** (INSPIRE), Department of Science and Technology, Govt. of India. 2010–2015
- **National Talent Search Examination** (NTSE) Scholarship, National Council of Education Research and Training (NCERT), India. 2008

Presentations

- *Hydrodynamical simulations of the first stars in the cold and fuzzy dark matter cosmologies*, **HI as a cosmological probe**, Nazareth, Israel, May 2022 (talk).
- *If dark matter is fuzzy, the first stars form in massive pancakes*, **MIT Computational Structure and Galaxy Formation group meeting**, May 2022 (seminar).
- *If dark matter is fuzzy, the first stars form in massive pancakes*, **Columbia University**, New York, May 2022 (seminar).
- *Hydrodynamical simulations of the first stars in the cold and fuzzy dark matter cosmologies*, **Fermilab**, Illinois, May 2022 (seminar).
- *If dark matter is fuzzy, the first stars form in massive pancakes*, **University of Toledo**, Ohio., February 2023 (**Colloquium**).
- *If dark matter is fuzzy, the first stars form in massive pancakes*, **Tata Institute of Fundamental Research (TIFR)**, Mumbai, India, December 2022 (seminar).
- *If dark matter is fuzzy, the first stars form in massive pancakes*, **Inter-University Center for Astronomy and Astrophysics (IUCAA)**, Pune, India, December 2022 (seminar).
- *Formation of the first stars and galaxies in a fuzzy dark matter cosmology*, **AAS 240th meeting**, July 2022 (talk).
- *Population III stars and processes that delay their formation*, **AAS 237th meeting**, January 2021 (dissertation talk).
- *Population III star formation: effects of UV radiation, baryon-dark matter streaming velocity, and redshift*, **Galaxies discussion group, University of Cambridge**, October 2020 (talk).
- *The critical dark matter halo mass for Population III star formation: dependence on Lyman-Werner radiation, baryon-dark matter streaming velocity, and redshift*, **The First Stars, SAZERAC**, October 2020 (talk).
- *A critical mass for Pop III stars: dependence on LW radiation, dark matter-baryon streaming and redshift*, **SAZERAC**, July 2020 (poster).
- *A critical mass for Pop III stars: dependence on LW radiation, dark matter-baryon streaming and redshift*, **First Stars VI**, Concepción, Chile, March 2020 (poster).
- *A critical mass for Pop III stars: dependence on Lyman-Werner radiation, baryon/dark-matter streaming, and redshift*, **AAS 235th meeting**, Honolulu, Hawaii, January 2020 (talk).

- *Fragmentation in Ionized Pop III Galaxies*, **Into the Starlight: The End of Cosmic Dark Ages**, Aspen, Colorado, March 2019 (talk).
- *Fragmentation in Ionized Pop III Galaxies*, **Cosmology: the Next Decade**, International Centre for Theoretical Sciences, Bengaluru, India, January 2019 (talk).
- *Fragmentation in Ionized Pop III Galaxies*, **Astrophysical Frontiers in the Next Decade and Beyond**, Portland, Oregon, June 2018 (poster).
- *Fragmentation in Ionized Pop III Galaxies*, **Enzo workshop**, Atlanta, Georgia, May 2018 (talk).
- *Commissioning of a new 15-m radio telescope at NCRA*, **Astronomical Society of India**'s annual meeting, Pune, India, February 2015 (poster).

Teaching

- **Guest lectures** at the University of Toledo — Spring 2021-Fall 2021
  on numerical methods in the class Computational Physics
- **Guest lectures** at the University of Toledo — Fall 2021
  on Planetary Geology in the class Solar System Astronomy
- **Co-Instructor** at Columbia University — Fall 2017 - Spring 2020
  Modern Cosmology course for the Science Honors Program for high school students
- **Teaching Assistant** at Columbia University — Spring 2018
  Modeling the Universe.
- **Instructor** at Columbia University — Fall 2017
  Astronomy Lab 1: Earth, Moon and Planets.
- **Observational Teaching Assistant** at Columbia University — Spring 2017
  Setting up and helping with the observing sections of Astronomy labs.
- **Instructor** at Columbia University — Fall 2016
  Astronomy Lab 2: Stars, Galaxies and Cosmology.

Mentoring

- **Colton Feathers** Graduate student at the University of Toledo. — Fall 2021–present
- **Ryan Hazlett** Graduate student at the University of Toledo. — Fall 2021–present
- **Abigail Ambrose** Graduate student at the University of Toledo. — Fall 2021–present
- **James Sullivan** Graduate student at Columbia University. — Fall 2022–present
- **Thomas Behling** Undergraduate student at the University of Toledo. — Summer 2023–present

Public Outreach

- Public Outreach talk on 'Clocks of the Universe' — September 2018
  A part of the Columbia astronomy outreach lectures series. Covered in press 1, 2.
- Regular volunteer for Columbia astronomy outreach events — 2015–2018
  Night sky observations using telescopes.
- Regular volunteer for Rooftop Variables at Columbia University — 2015–2021
  A group for interacting with high school astronomy clubs in the New York City area.
- Volunteer at Reading Team Math — 2017–2018
  After school program for math education for young children.

Skills

- **Languages:** Python (13 years), Cython (7 years), C (7 years).
- **Tools:** ENZO, GADGET-2, MUSIC, YT, YTREE.

Github profile

References

1. Prof. Greg L. Bryan
   Department of Astronomy,
   Columbia University,
   New York, NY, U.S.A.
   email: gbryan@astro.columbia.edu

2. Prof. Eli Visbal
   Department of Physics and Astronomy,
   University of Toledo,
   Toledo, OH, U.S.A.
   email: elijah.visbal@utoledo.edu

3. Prof. Zoltan Haiman
   Department of Astronomy,
   Columbia University,
   New York, NY, U.S.A.
   email: zoltan@astro.columbia.edu