

SHUBHAN BHATIA

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Research Interests

My research focuses on numerical cosmological simulations, particularly hydrodynamical zoom-in simulations of dwarf galaxies. I am currently involved in modeling and analyzing the effects of Fuzzy Dark Matter (FDM) cosmologies on small-scale structure formation using zoom-in simulations created with a hybrid code *Fuzzy-Gasoline* which combines the Tree+SPH formalism of *Gasoline2* and the SPH formalism for FDM from *AX-Gadget*.

In addition to cosmological simulations, I have previously developed machine learning models to predict planetary habitability in binary star systems, reflecting my broader interest in applying computational methods to astrophysical problems.

Education

Bachelor of Science in Physics Aug. 2020 - May 2024
New York University Abu Dhabi, Abu Dhabi, United Arab Emirates
Cumulative GPA: 3.86/4.00 **Major GPA:** 3.90/4.00
Founders' Day Award Recipient
Study Abroad: NYU New York (Spring 2022)

Research Experiences

Undergraduate Researcher September 2022 - Present
Research Supervisors: Dr. Andrea Valerio Macciò and Dr. Matteo Nori
Galaxy Formation Group, Center for Astrophysics and Space Science (CASS), New York University Abu Dhabi

- Developed a novel suite of thirty hydrodynamical and dark matter-only zoom-in simulations of dwarf galaxies in Fuzzy Dark Matter (FDM) cosmologies using the *Gasoline2* code, run till the present day ($z = 0$).
- Developed pipelines using the *Pynbody* analysis package to probe the evolution of dwarf galaxy systems under the influence of various dark matter distribution profiles.
- Analyzed the hydrodynamical evolution of dwarf galaxies in FDM cosmologies and the impact of these cosmologies on observable properties such as star formation histories, and stellar velocity dispersion profiles.
- Discovered a lack of impact on stellar observables in FDM galaxies compared to CDM galaxies (obtained from the *NIHAO* suite of simulations), except for diminished and delayed star formation in FDM dwarf galaxies for a particular halo mass range.

Research Assistant May 2021 - August 2021
Research Supervisor: Dr. Mohammad Ali-Dib
Center for Astro-Particle and Planetary Physics (CAP3), New York University Abu Dhabi

- Developed a supervised learning regression algorithm to predict the critical semi-major axis of S-type circumbinary planets

- Used results from precursory N-body simulations as the training data set for the prediction model.

Software Development Intern

March 2021 - May 2021

Ashanti AI

Mentored by Dr. Olufemi Olaoye

- Implemented web scraping and advanced feature engineering to streamline resume collection and preprocessing for a Machine-Learning based CV-Ranking system.
- Developed a Gradient Boosting model, improving candidate assessment efficiency by 30%.

Publications

M. Nori, S. Bhatia, A.V. Macciò, *Fuzzy-Gasoline: hydro-dynamical N-body code with full Fuzzy Dark Matter description* *In preparation*

Relevant Coursework

Electricity and Magnetism, Astrophysics, General Relativity, Mechanics, Advanced Experimental Laboratory, Introduction to Detector Electronics.

Skills

- **Programming languages:** Python, C++, C, IDL, HTML, CSS, Javascript, Java, Fortran, PHP, R, Qiskit, Arduino, Tensorflow, SQL
- **Libraries:** NumPy, SciPy, Matplotlib, Pandas, PyTorch
- **Operating systems:** Mac OS, Linux, Windows, Ubuntu
- **Software:** LaTeX, Mathematica, MATLAB, Statistica, Endnote, IRAF/ds9, Git, Stata
- **Text Editors/Computing platforms:** Jupyter, Emacs, Vim

Community Engagement

Treasurer and Outreach Coordinator - Spacebar (Astronomy Student Interest Group)

- Organized and led numerous on-campus and off-campus astronomy outreach events, including group-led tours and an external visit to the Al Sadeem Observatory.
- Secured consistent funding for the group, ensuring timely execution of planned events and completion of inventory purchases.

Podcast Co-host - Spaced Out

- Co-hosted an episode of the Spaced Out Podcast (available on Apple Podcasts) with Dr. Mohammad Abbas featuring Dr. Emily Levesque. The discussion focused on stellar evolution processes and the life and future of Betelgeuse.

NYU Abu Dhabi Men's Varsity Cricket Team

Web Development Team, weSTEM, NYUAD