Inter-University Centre for Astronomy and Astrophysics
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November 25, 2024

Prof. Lina Necib and members of the search committee
Kavli Institute for Astrophysics and Space Research
Massachusetts Institute of Technology, Cambridge, MA, USA

Dear members of the search committee,

With strong expertise in dark matter haloes and galaxies in cosmological simulations, alongside experience working with large observational datasets and machine learning techniques, I find myself well-suited for the postdoctoral associate position at the MIT Kavli Institute to work with Prof. Necib and her team. I am excited to start immediately with the primary research project of understanding dark matter and galactic dynamics by inferring Gaia and LSST observations through simulations; and I also have other research plans and ideas that will be interesting to explore with Prof. Necib and her group.

In my current research at the Inter-University Centre for Astronomy and Astrophysics, my main focus is on understanding and modeling the effects of astrophysical processes on dark matter within haloes. This primarily involves analyzing state-of-the-art cosmological simulations with galaxies such as IllustrisTNG, EAGLE, and CAMELS. While exploring this, I have also developed more tractable numerical experiments to study the dynamical interaction between galaxies and their host dark matter haloes.

As part of my research, I have performed cosmological simulations producing galaxies, dark matter haloes, and other large-scale cosmological quantities using codes such as GADGET, MUSIC, ROCKSTAR, and VELOCIraptor. Additionally, I have worked on a mini-project with Prof. Hector Marin, inferring cosmological parameters from eBOSS and mock DESI datasets. I am currently part of a data science collaboration focused on employing machine learning techniques for cosmological data compression and inference. With these experiences, I am confident I can immediately contribute to the primary project with Prof. Necib and her group.

In direct continuation of my current research, I aim to make significant contributions to understanding and modeling the astrophysical impacts on dark matter haloes, with well-defined research plans as detailed in my research statement. This research will greatly benefit from the resources available at the Kavli Institute and the expertise of Prof. Necib's team.

Thank you for considering my application. I look forward to the opportunity to contribute to the group's efforts and would be delighted to discuss my expertise further.

Sincerely,
Premvijay Velmani,
Senior Research Scholar,
IUCAA Pune, India