भारतीय ताराभौतिकी संस्थान

INDIAN INSTITUTE OF ASTROPHYSICS

कोरमंगला **Koramangala,** बेंगलूरु **Bengaluru – 560034.**

Ph.D THESIS DEFENCE

Name: Ankit Kumar, IIA – JAP, Student

Title: A study of the evolution of bulges and disks of spiral galaxies in interacting and isolated environments.

Research Supervisor: Prof.Mousumi Das, IIA

Dr. Nirupam Roy, IISc.

सार Abstract

Galaxies are usually found in groups and clusters where they interact with each other gravitationally. These interactions affect the internal dynamics of the galaxies. In this thesis, we have studied the effect of flyby interactions and dark matter distributions on the evolution of bulges and disks of spiral galaxies. To understand the effect of flyby interactions on the bulges, disks, and spiral arms of Milky Way mass galaxies, we modelled disk galaxies with two types of bulges: classical bulges and boxy/peanut pseudo-bulges. We have performed N-body simulations of galaxy flybys of 10:1 and 5:1 mass ratios with varying pericenter distances. Using photometric and kinematic bulge-disk decompositions of the major galaxy at regular time steps, we found that the disks become shorter and thicker during flyby interactions. There is no effect of flyby interactions on the classical bulges. However, pseudo-bulges become dynamically hotter at the cost of hosting disks. We also found no effect of flyby interactions on the strength and the formation time of bar buckling. The tidally induced spiral arms are transient and are density waves in nature. Spiral arms form very soon after the pericenter passage of the galaxies and decay in two phases; the initial rapid winding phase and the subsequent slow winding phase. We confirmed that the spiral arms are the main drivers of the observed wave-like vertical breathing motion in the Milky Way, and the effect of tidal interactions does not directly induce breathing motion. In another project, using N-body simulations, we showed that the presence of oblate dark matter halos delay bar formation and so bar buckling is also delayed, but probate halos promote multiple buckling events. As a result of multiple buckling events, boxy/peanut structures in prolate halos show the maximum thickness. We have also studied the cosmic evolution of bulges since z=0.1 using SDSS data. We found that the disk-like pseudo-bulges are growing in number as the Universe is getting older. The pseudo-bulges appear optically diffuse compared to classical bulges and are commonly found in low mass galaxies. In the local volume, pseudo-bulges overcome the classical bulges even in bulge dominated galaxies, and so more than 75% of the local volume is rotation dominated. Finally, we have tested galaxy formation models of the cosmological simulation, Illustris TNG, using bulgeless galaxies. We selected Illustris TNG50 galaxies having mass greater than $10^9 M_\odot$ and performed photometric decomposition to find bulgeless galaxies. We found that the bulgeless galaxies are metal-poor and have high specific angular momentum as compared to the galaxies with bulges and fall at the lower end of the baryonic to dark matter mass ratio. Thus the TNG model is capable of producing a comparable fraction of bulgeless galaxies to those observed in the low redshift Universe.

शुक्रवार Friday 10, फरवरी February 2023

Venue: Multi-Media Room, IISc.

Time: 2:00 PM (Hybrid mode)

सभी का स्वागत है All are welcome

Join Microsoft Teams meeting Link:

Meeting ID: 473 445 881 835

Passcode: 2vSMvR

https://teams.microsoft.com/l/meetupjoin/19%3ameeting_MGViZDNhMjctZTI5Mi00YWQzLWFiM2MtZWNmZGFhMTBiMDIy%40thread.v2/0?context=%7b%22Tid%22%3a%226f15cd97-f6a7-41e3-b2c5-ad4193976476%22%2c%22Oid%22%3a%224f4afc9d-0198-45d3-bd30-e06fecb90263%22%7d