MAGIC

Science of the Cosmos

Contribution ID: **22** Type: **not specified**

Shaping the Cosmos: Mergers and the Transformation of Spiral Galaxies

Galaxy mergers are transformative events that significantly impact the evolution of galaxies by reshaping their structure, morphology, and dynamics. This study focuses on spiral galaxies and investigates how their morphologies evolve after merging with companion galaxies. We integrate observational data from large-scale surveys such as Sloan Digital Sky Survey (SDSS) and the Hubble Space Telescope (HST) with high-resolution numerical simulations (IllustrisTNG, EAGLE, GADGET, RAMSES) to analyze post-merger morphological outcomes. Key initial conditions mass ratios, angular momentum, gas content, and collision geometry are systematically correlated with resulting structures, including elliptical, lenticular, irregular, and transitional morphologies. Unlike prior isolated studies, our comprehensive approach connects multiple physical parameters to these outcomes, providing broader insight.

We also examine the role of environmental factors such as local galaxy density and cluster membership in influencing merger dynamics and final morphology. This dual focus on intrinsic and extrinsic variables presents a holistic framework for understanding galaxy evolution. The analysis leverages Python-based tools, using AstroPy for computations, NumPy and Pandas for data handling, and Matplotlib for visualization. Morphological metrics like Gini-M20 and CAS (Concentration, Asymmetry, Smoothness) indices are applied to quantify structure and classify galaxies post-merger.

This study aims to uncover correlations between mass ratios and morphological transformations, particularly in spiral galaxies situated in dense environments. We investigate how internal dynamics and external conditions jointly influence the structural evolution of galaxies post-merger.
This work contributes a statistically robust perspective on galaxy mergers and their role in shaping the structural diversity of the cosmos, advancing the field of extragalactic astronomy and cosmology.

Keywords: Galaxy mergers, Cosmic Collisions, Galaxy Morphology, Astrophysical Simulations, Galaxy Formation, Cosmological Surveys.

Author: GANDHI, Anmol (Independent Researcher)

Presenter: GANDHI, Anmol (Independent Researcher)