Contribution ID: **34** Type: **Poster**

Relativistic Dynamics and Structure Formation in a Friedmann Universe

Wednesday 2 October 2024 16:00 (20 minutes)

The Friedmann-Lemaître-Robertson-Walker (FLRW) model, which forms the foundation of the Lambda Cold Dark Matter (LCDM) framework, is a key pillar in cosmology. It has effectively explained the formation and evolution of cosmic structures in line with most observational data. Central to the FLRW model is the cosmological principle, asserting that the universe is homogeneous and isotropic on large scales. However, recent three-dimensional catalogues present a contrasting view, showing the universe to be non-homogeneous and non-isotropic up to the furthest observational limits, raising questions about the FLRW model's precision and suggesting a need for its re-evaluation.
In this study, we derive new redshift-light intensity and redshift-number density relations using the Einstein Field Equations (EFE) based on the galaxy number count method, outlining the universe's dynamics and evolution within the FLRW framework. Our results demonstrate that these new relations can accurately describe galaxy formation and evolution, deepening our understanding of the cosmos. Notably, they reproduce the early burst of galaxy formation when $z \geq 1$, aligning with other models. Additionally, our simulation results are consistent with observational data, further validating the FLRW model. These relations also present promising opportunities for future cosmological investigations.

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Session Classification: Poster Session

Track Classification: Other High-Energy Sources