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Exploring Cosmic Anisotropy in the Bianchi-I Cosmological Model

We delve into the intricacies of the Bianchi-I cosmological model, driven by the intriguing backdrop of anisotropic cosmic microwave background (CMB) observations. In our pursuit to understand the underlying anisotropy of this model, we introduce anisotropic sources into the framework, augmenting the isotropic matter with dust-like dark matter and dark energy in the form of a cosmological constant (Λ). Our investigation centers on the constraint of critical parameters, including the Hubble parameter, density fractions associated with anisotropic matter, cold dark matter (CDM), and dark energy (Λ), within the context of the Bianchi-I metric, notable for its planar symmetry and global ellipsoidal geometry. Our primary objective is to detect signs of a cosmic preferred axis within this cosmological paradigm.

Our analysis yields intriguing results, providing weak evidence for the existence of a cosmic anisotropy axis. Remarkably, this preferred axis is found to align, at the very least, with the same quadrant as several other cosmic axes previously examined in the scientific literature. Additionally, our investigation uncovers indications of non-trivial shear and eccentricity, adding a layer of complexity to the cosmic landscape. Our study relies on Pantheon Type Ia supernova (SNIa) data, offering substantial constraints on fundamental cosmological parameters. However, to refine our understanding of the anisotropy axis, we anticipate that future observations, such as those from the James Webb Space Telescope (JWST) and other forthcoming surveys, will provide the necessary SNIa host galaxy data required for more precise constraints on distance measurements and absolute magnitude calibration. These forthcoming data sources hold the promise of unveiling deeper insights into the cosmic mysteries that continue to captivate our curiosity.

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