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Unveiling Cosmic Voids Through Tracer Dynamics: A Novel Approach for Large-Scale Structure Analyses

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With the rise of wide-area galaxy surveys, cosmic voids have emerged as powerful probes of the large-scale structure of the Universe, both as stand-alone observables and as complementary to galaxy clustering statistics. However, cosmological analyses of cosmic voids are subject to various observational systematics, exacerbated by their characteristic size and underdense environment.

To mitigate these systematics and enhance the cosmological constraining power of cosmic voids, I present a novel dynamical void-finding algorithm, the Back-in-Time Void Finder, specifically designed for precision cosmology. This method reconstructs the tracer velocity field to identify cosmic voids as points of maximum divergence in the displacement field, effectively pinpointing regions from which the largest mass outflows originate. Optimized for large-scale surveys, the algorithm produces catalogues of high-purity voids, tailored for various cosmological applications such as the void-galaxy cross-correlation function, void size function, and velocity profile analyses.

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