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A catalog of high significance cosmic voids in the Local Universe

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Cosmic voids are the largest objects emerging in the cosmic web, covering the majority of the volume of the Universe. They are a well-established probe to gather cosmological information from the large-scale structure, as well as interesting regions to study how the underdense environment affects the behavior of astrophysical objects. Unfortunately, identifying voids in a galaxy catalog is challenging for multiple reasons: observational effects such as holes in the mask or magnitude selection hinder the detection process; galaxies are biased tracers of the underlying dark matter distribution; and it is non-trivial to estimate the detection significance and parameter uncertainties for individual voids.

We use a set of constrained simulations of the large-scale structure that are consistent with the observed galaxy positions, effectively representing statistically independent realizations of the probability distribution of the cosmic web. We run the VIDE void finding algorithm on each individual simulation, and compare the detected voids to identify regions that are voids with high statistical significance. As this framework is fully Bayesian, we evaluate the probability distributions of the centers and radii of the voids. Finally, we characterize the actual shape of these regions, resulting in a template for density environments that can be used in astrophysical applications, e.g. studying the evolution of galaxies. We plan to make the resulting catalog of high-significance voids and their properties publicly available.

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