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(zoom) Seeing the Universe in 3-d

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The large-scale structure in the Universe is a marvelous laboratory for the study of cosmological physics. By measuring the detailed statistics of the clustering, we can explore important extensions of the standard cosmological model: variations in dark energy density, modifications to large-scale gravity, non-vanilla primordial initial conditions (changes in the primordial power spectrum, novel isocurvature modes, or non-Gaussianity), and so on. We should view large-scale structure as an opportunity for a broad exploration of cosmological physics, and not merely reduce it to a limited set of parameterized models.

Our study of large-scale structure is best done with multiple views: the primordial CMB for the simplicity of the early plasma, gravitational lensing for its access to the true matter distribution, Sunyaev-Zel'dovich for its ability to detect the highest density peaks. But here I want to stress the important role of three-dimensional surveys using spectroscopic redshifts. This is the cleanest mechanism we have to map the cosmic web in detail. With precise redshifts, we can access more linear-theory modes, leverage the environmental markers such as galaxy groups, measure redshift distortions, and avoid the confounding effects that redshift mistakes at even the percent level will cause in high-precision clustering measurements.

As our planning horizon stretches beyond the Rubin/CMB-S4 era, I see large spectroscopic samples growing in importance as our questions get more subtle and the crispness of these maps becomes more prized.

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