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## Extracting the Full Cosmological Information of Galaxy Surveys with SimBIG

The 3D distribution of galaxies encodes key cosmological information that can probe the growth and expansion history of the Universe. In my talk, I will present how we can leverage simulations and machine learning to go beyond current analyses and extract the full cosmological information of the next-generation galaxy surveys. In particular, I will present SimBIG, a forward modeling framework for analyzing galaxy clustering using simulation-based inference based on normalizing flows. I will show the latest results from applying SimBIG to BOSS observations to analyze the bispectrum, wavelet scattering transform, and a field-level summary based on convolutional neural networks—all down to small, non-linear, scales. By robustly extracting additional cosmological information, we constrain  $\Lambda$ CDM parameters,  $\Omega_b$ ,  $h$ ,  $n_s$ ,  $\Omega_m$ , and  $\sigma_8$ , that are 2.4, 1.5, 1.7, 1.2, and  $2.7\times$  tighter than standard power spectrum analyses. With this increased precision, we derive constraints on the Hubble constant,  $H_0$ , and  $S_8 = \sigma_8 \sqrt{\Omega_m/0.3}$  that are competitive with other cosmological probes and inform cosmic tensions, even with a sample that only spans 10% of the full BOSS volume. Lastly, I will discuss how SimBIG can be extended to upcoming spectroscopic galaxy surveys (DESI, PFS, Euclid) to produce leading  $H_0$  and  $S_8$  constraints.

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