MAPPING THE UNIVERSE: A BIG-DATA INVERSE PROBLEM

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Characterising dark energy -- the mysterious phenomenon driving the accelerating expansion of the Universe -- is the holy grail of modern cosmology. To advance into this era of high-precision measurements, we need to accurately reconstruct the dynamics of the large-scale matter density field of our Universe. Large-area photometric surveys like the Rubin Observatory Legacy Survey of Space and Time observe and analyse 60Pb raw imaging data of 2E10 galaxies at 2E15 FLOPS peak compute power using compute clusters across three continents.

I will introduce cosmological inference as a Big-Data inverse problem that poses unprecedented challenges for statistical methodology. In this context, I will present my work on approximate inference, machine learning, and hierarchical Bayesian modeling.
I also provide an outlook on future developments to facilitate multisurvey analyses with complex survey selection functions and highlight Rubin's opportunities for discovering new physics.