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Reconstruction of cosmological initial conditions with sequential simulation-based inference

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Knowledge of the primordial matter density field from which the present non-linear observations formed is of fundamental importance for cosmology, as it contains an immense wealth of information about the physics, evolution, and initial conditions of the universe. Reconstructing this density field from the galaxy survey data is a notoriously difficult task, requiring sophisticated statistical methods, advanced cosmological simulators, and exploration of a multi-million-dimensional parameter space. In this talk, I will discuss how simulation-based inference allows us to tackle this problem and sequentially obtain data-constrained realisations of the primordial dark matter density field in a simulation-efficient way for general non-differentiable simulators. In addition, I will describe what network architectures can be used for galaxy maps, and how our results compare to those obtained with classical likelihood-based methods such as Hamiltonian Monte Carlo.

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