

# Towards a New Era of Simulation-Based Cosmology Enabled by Deep Learning

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In the last few years, the field of astrophysics has seen an explosion of new deep learning-based methodologies. As methods start to mature, a number of interesting trends are emerging, which could lead to a significant shift in our approach to cosmological inference.

In particular, in this talk I will review the state of deep-learning accelerated cosmological simulations, simulation-based inference methodologies for cosmology, and automatically differentiable HPC for high-dimensional Bayesian inference over simulation models.

These trends share the particularly interesting characteristic of placing simulations (and not neural networks) at the core of the cosmological inference paradigm, which is in contrast to classical cosmological inference that relies mainly on analytic models. All these methods point to a future where cosmological simulations could be run online, as part of the cosmological inference process from observed data. I will discuss both the advantages of these emerging approaches but also comment on their pitfalls and highlight the most interesting open research directions that still need to be resolved before their mainstream adoption.