Contribution ID: **59**   Type: **Flash talk**

DeepSZSim: Fast Simulations of the Thermal Sunyaev–Zelʾdovich Effect in Galaxy Clusters for Simulation-based Inference

Monday, November 27, 2023 4:00 PM (3 minutes)

Simulations of galaxy clusters that are well-matched to upcoming data sets are a key tool for addressing systematics (e.g., cluster mass inference) that limit current and future cluster-based cosmology constraints. However, most state-of-the-art simulations are too computationally intensive to produce multiple versions of relevant physics systematics. We present DeepSZSim, a lightweight framework for generating simulations of Sunyaev–Zel'dovich (SZ) effect clusters based on average thermal pressure profile models. These simulations offer a fast and flexible method for generating large datasets for testing mass inference methods like machine learning and simulation-based inference. We present these simulations and their place within the larger Deep Skies nexus of versatile, multi-wavelength galaxy cluster and cosmic microwave background simulators. We discuss progress and prospects for using these SZ simulations for machine learning, including simulation-based inference of cluster mass.

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Session Classification: Contributed talks

Track Classification: New York