Z116a Field Level Inference in Hydrodynamical Simulations with JAX

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Hydrodynamical simulations are a powerful tool for modeling structure formation in the universe, capturing the complex interplay between baryons and dark matter across cosmic time. However, the high computational cost of these simulations presents challenges for efficiently exploring the associated high-dimensional parameter spaces.

In this talk, I will introduce a fully differentiable framework for cosmological hydrodynamical simulations, along with a proof-of-concept implementation, diffhydro. This facilitates scalable field-level inference and parameter estimation through gradient-based optimization. Built in JAX, the implementation supports rapid prototyping and GPU acceleration, opening the door to flexible and efficient cosmological and astrophysical analysis using modern automatic differentiation techniques.