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Galaxies and Graphs

Monday 30 October 2023 17:20 (10 minutes)

Graph Neural Networks are the premier method for learning the physics of a given system, since abstracting physical systems as graphs fits naturally with common descriptions of those systems. I will show how the fundamental processes that shape galaxies and dark matter halos can be learned efficiently by embedding galaxies and halos on either temporal or spatial graphs. Learning the temporal co-evolution of galaxies and their dark matter halos allows us to connect one of the most successful modern astrophysical theories, Lambda-CDM, with the poorly understood processes that shape galaxies, opening new pathways for both understanding, and speeding up simulations by ~6 orders of magnitude. Learning the spatial correlations between galaxies and halos also offers important insights into galaxy evolution, and lends itself more easily to comparisons with observations.

Since GNNs work well with Symbolic Regression, I will also show how low-dimensional, analytic laws of galaxy formation can be derived from these models.

Brainstorming idea [title]

Orthogonalizing Latent Spaces

Brainstorming idea [abstract]

Analyzing latent spaces is crucial for actually learning meaningful physical relations from trained ML models. However, since each latent dimension is never guaranteed to be independent from other latent dimensions, the conclusions that we draw are rarely on very sure footing. I would like to discuss how latent spaces in models trained for physics can be orthogonalized so that robust symbolic regression can be done.

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