An Empirical Inference of Environmental Quenching with Normalizing Flows

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Galaxy properties in the local Universe correlate with both stellar mass and surrounding environment, so galaxy quenching is commonly described in terms of internal "mass quenching" and external "environmental quenching." However, environmental quenching remains difficult to interpret, because different studies adopt different definitions of environment and often conflate mass-driven and environment-driven effects.

We present an empirical inference framework, based on a normalizing flow model, to constrain the environmental contribution to quenching. Our goal is to understand how the specific star formation rate (sSFR) distribution responds to the environment.

The model outputs the conditional sSFR distribution given a set of physically motivated environment descriptors: halo mass, the distance to the nearest more massive halo, and the mass of the neighboring halo. Using mock catalogs together with GAMA DR4 survey data, we train the model with survey-accessible observables: the galaxy's stellar mass, the projected comoving separation, and the neighboring galaxy’s stellar mass. Our current results indicate that this observable set captures the environmental quenching signal, providing an interpretable baseline for testing causal relationships among environmental processes.

In this talk, we will present a comparison of the quenched fraction and the mean sSFR of star-forming galaxies, measured from our model applied to GAMA, against the UniverseMachine mock catalog and the IllustrisTNG simulation.