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Detecting mergers on simulations and observations with machine learning

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Galaxy mergers are one of the most violent processes and play a crucial role in galaxy evolution. However, the relative importance of mergers in mass growth and evolutionary events like AGN activity is not understood in detail. One of the main reasons is that mergers are difficult to identify with traditional methods and, in addition to being rare events, lead to incomplete and unreliable samples of mergers.

Machine learning methods, and in particular deep learning algorithms have proven to have high success for galaxy classification and recently, have been used with promising performance in selecting mergers from simulated data. However, the relatively high accuracy is obtained under assumptions that do not reflect the real observations completely. And the reliability of such methods on real data is not clearly understood.

We explore how hydrodynamical simulations can be used to predict merger detection on real observations (Hyper Suprime-Cam survey) with traditional machine learning techniques as well as with deep learning methods. We use a larger than previously used sample of mergers from Illustris TNG simulations to train our network. This larger sample allows capturing the variation in merger morphologies based on the interacting galaxies as well as the merger stage. We explore different machine-learning techniques in order to understand the current limitations and the best practices moving forward to detect mergers on observational datasets such as JWST and Euclid.

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