X75a Disentangling the connection between present-day galaxies and their star formation histories

Suchetha Cooray (1), Tsutomu T. Takeuchi (1 and 2) ((1) Nagoya Univ., (2) ISM)

A key ingredient that needs to be considered when modeling a galaxy's spectral energy distribution (SED) to derive galaxy properties is its star formation history (SFH). It is common to model SFHs with parametric models (e.g., exponential, delayed exponential, lognormal) that impose strong priors on their shape. Consequently, it is known that parametric models can strongly bias measurements such as the star formation rate (Carnall et al. 2019). A solution to the above can be using non-parametric models for SFHs. However, non-parametric SFHs cannot be fully constrained even with high-quality observations because of their flexibility (e.g., Leja et al. 2019). Thus, there is a need to derive physically-motivated prior SFH models. SFHs are also likely to be connected to the galaxy's current properties, such as where quiescent galaxies tend to have previously undergone bursty star formation. In this work, we extract characteristic modes of SFHs with a machine learning technique that reduces the dimensions of the complex SFHs seen in simulated galaxies (IllustrisTNG; Nelson et al. 2019a) into a few parameters. We find that even two parameters of the reduced latent space can successfully reproduce SFHs over any commonly used parametric model. These encoding parameters even relate to their current galaxy properties, such as their star formation rate and stellar mass. The understanding can help break the degeneracy between physical properties and SFHs in SED fitting, enriching our knowledge of galaxy evolution.