Understanding the physical properties of galaxies using machine learning and Bayesian model selection

Spectral Energy Distribution (SED) fitting has been a very successful tool in understanding the physical properties of galaxies and their evolution over cosmic time. In the last decade, the astronomical community has made enormous progress both in modeling the stellar populations and our ability to extract information about them using increasingly sophisticated algorithms. This process has also shed light on the most crucial sources of lingering systematic uncertainties, which range from incompleteness and uncertainties in stellar spectra and stellar evolution to measurement biases associated to template-based SED fitting. Here I give an overview of our ongoing efforts at extracting information from galaxy SEDs using two new techniques. In one example, we use machine learning algorithms trained on state-of-the-art cosmological simulations to constrain the star formation history and metallicity of galaxies, and we discuss the possibility of validating these efforts on low-redshift galaxies for which an unbiased learning set might be available. In the second example, we use Bayesian model selection to limit the number of parameters that need to be used for SED fitting and to answer questions such as: “How many major episodes of star formation do galaxy have?”, and “Does the dust attenuation law vary with redshift and environment?”