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Galaxy stellar and total mass estimation using machine learning

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I will talk about a successful proof of concept test on galaxy stellar and total mass estimation using machine learning. Conventional galaxy mass estimation methods suffer from model assumptions and degeneracies. Machine learning, which avoids many of assumption, can be a potential method to predict galaxy properties. In our work, we use a general sample of galaxies from the TNG100 simulation to investigate the ability of multi-branch convolutional neural network (CNN) to predict the central (i.e., within 1-2 effective radii) stellar and total masses, and the stellar mass-to-light ratio M/L. *These models take galaxy images and spatially-resolved mean velocity and velocity dispersion maps as inputs. Such CNN-based models can in general break the degeneracy between baryonic and dark matter in the sense that the model can make reliable predictions on the individual contributions of each component. For example, with r-band images and two galaxy kinematic maps as inputs, our model predicting M* has a prediction uncertainty of 0.04 dex. Moreover, to investigate which (global) features significantly contribute to the correct predictions of the properties above, we utilize a gradient boosting machine. We find that galaxy luminosity dominates the prediction of all masses in the central regions, with stellar velocity dispersion coming next. We also investigate the main contributing features when predicting stellar and dark matter mass fractions (f*, fDM) and the mass-to-light ratio M*/L, and discuss the underlying astrophysics.

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Session Classification: FlashTalks