MergeFinder: A Deep Learning Model for Galaxy Merger Identification

Lee, Allison (School: East Brunswick High School)

Galaxy mergers play an integral role in galaxy formation and evolution, and with many large upcoming surveys, a reliable and efficient method of identifying mergers is crucial to their study. Currently, mergers are manually classified through visual inspection, which is incredibly time-consuming and biased towards major mergers (those with mass ratios less than 3:1) due to their conspicuous nature. This study developed MergeFinder, a convolutional neural network for galaxy merger identification. MergeFinder was trained on simulation data from the Evolution and Assembly of GaLaxies and their Environments (EAGLE) database, which contains physics-informed models of various types of mergers from different orientations. This enables MergeFinder to identify mergers based on subtle structural asymmetries, as opposed to solely the presence of visible companions. MergeFinder also utilizes a novel sequential classification technique, where it first classifies galaxies by orientation and merging status, then combines the orientation classes into one merging class and one non-merging class; this allows for higher performance than traditional binary classifiers. MergeFinder achieved an accuracy of 94%, a sensitivity of 93%, and a specificity of 96%. In addition, this research used MergeFinder to suggest possible reclassifications for existing galaxy data from the Dark Energy Camera Legacy Survey (DECaLS) and found that at least 12.8% of its current classifications are incorrect.

Awards Won: