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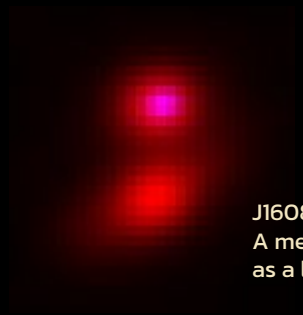
Discovering strong lenses in UNIONS with CNNs using color differences between galaxies

INTRODUCTION

Strong-lensed galaxies can be used to probe a vast range of important astrophysical questions such as the determination of cosmological parameters (Wong et al. 2020), galaxy mass profiles (Bellagamba et al. 2017), and halo substructure (Ritondale et al. 2019). However, because these systems are very rare, many of these studies are limited by a small sample size.

PREVIOUS RESULTS

In recent years, convolutional neural networks (CNNs) have become reliable lens-finding tools. Nonetheless, these algorithms often misclassify other systems as lenses, like spiral galaxies, ring galaxies and mergers (see below).

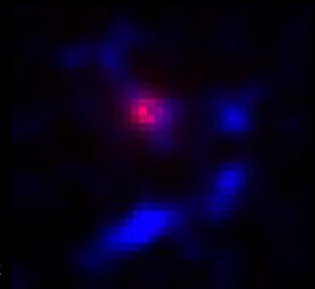


J160840+300932
A merger misclassified as a lens by a CNN

Image ceredit: ALMA (NRAO/ESO/NAOJ); B. Saxton NRAO/AUI/NSF; NASA/ESA Hubble, T. Hunter (NRAO)

METHODS

Previous approached to train CNNs (Savary et al. 2022) often only use images at one wavelength. However, due to the fact that the lensed source is at a higher redshift than the lensing source, there can be a noticeable colour difference between the two sources (see above). We will implement a CNN with the EfficientNet model and add multiwavelength data as a new feature. We will also include the number of nearby sources as a new feature in order to help prevent mergers from being classified as lenses. The training set will be built using data from the Canada-France Imaging Survey (CFIS) and Pan-STARRS.



J171340+364204
A strongly lensed galaxy in the U and R band

OUTLOOK

This new CNN will be applied to future missions such as Euclid, which has a spatial resolution three times better than the best CFIS images.

REFERENCES
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