Identifying strong gravitational lenses in current and future large-scale imaging surveys

Raoul Canameras*[1]

[1]MPA, Garching – Germany

Abstract

Strong gravitational lensing is a very powerful tool for probing dark matter properties, high-redshift galaxies, and for measuring cosmological parameters such as the Hubble constant H0. Forthcoming imaging surveys, and in particular the Rubin Observatory Legacy Survey of Space and Time (LSST), will revolutionize the field by increasing lens samples from about 1000 to nearly 100000 systems, which will open new avenues for statistical studies. Finding these new lens systems among the extensive data sets is however a challenging task. While this a classical binary classification problem, the rarity of strong lenses and the similar morphologies of spirals, ring or merging galaxies make it difficult to exclude interlopers. I will present our on-going developments of supervised machine learning algorithms for identifying strong lenses in deep multi-band imaging surveys. Firstly, I will describe our two-step procedure with a catalog-based neural network classification of source photometry, and a CNN trained on gri image cutouts, followed by a visual inspection. This method was applied to the 3 billion detections in the PanSTARRS 3pi survey and allowed us to identify 330 new high-quality candidates. This automated two-step classification allows for a systematic analysis of the entire sky and will be applicable to the _˜4 mag deeper gri stacks from LSST. Secondly, I will present our on-going efforts to test network architectures in order to further increase the selection purity, minimize the visual inspection stage, and improve the classification efficiency.
Slides: in PDF

Video: https://youtu.be/msfZZRBWi4w

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*Speaker