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Discovering Strong Gravitational Lenses in DES: New Lenses and Search Techniques

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The Dark Energy Survey (DES) is observing a large expanse of the southern sky in unprecedented depth and detail. Over the course of 5 years, it will have observed almost half a billion galaxies. Among these galaxies will be the largest single sample of strong gravitational lensing events ever recorded. Strong lenses have potential to provide new and distinct constraints on the content of dark energy and dark matter in the universe.

Typically, gravitational lenses are discovered in imaging data through algorithms, followed by visual inspection. Through this process, we have discovered or confirmed nearly 100 candidates. This process, however, is too inefficient to maintain for DES, and moreso for future surveys, like that of the Large Synoptic Survey Telescope (LSST): no algorithm has yet proven to be better than the train-able human eye, but there aren't enough trained humans to reliably search through all of the data. We require new search methods to realize the potential of lenses to constrain dark energy and the expansion history of the universe.

Recent advances in artificial intelligence have made available new techniques and software that are ideal for the discovery lensing systems in images. Using convolutional neural nets and high-performance computing resources at Fermilab, we are searching DES images (and that of other surveys) for strong lensing events. I will discuss our technique, the challenges and successes in searching for lenses, as well as the recent lens discoveries in DES.

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