Title:	Strategies to identify strongly lensed type Ia supernovae in the Rubin LSST
Authors:	Mane, Prajakta Tanaji
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Abstract:	Gravitational strong lensing is the deflection of light rays due to intervening inhomogeneous matter distributions in the universe, which can lead to the formation of multiple images of the same source. For such a multiply-imaged system, the multiple images appear offset in time to the observer. Sjur Refsdal, in 1964, showed that this offset, known as the time delay, is mathematically related to the value of the Hubble Constant (H 0). Because of this explicit dependence, lensed sources provide an independent method - time delay cosmography - to test the Hubble tension problem in cosmology. Strongly lensed type Ia supernovae (SNe Ia) present a uniquely suited tool for time delay cosmog- raphy owing to their relatively homogeneous and well-understood light curves and their transient and standard candle nature. In addition to obtaining accurate time delays, lensed SNe Ia also enable valuable constraints on the lens mass model and cosmological parameters with an assumed H 0 value. The Vera Rubin Observatory, currently under construction in Chile, will conduct the Legacy Survey of Space and Time (LSST), imaging the southern sky in six optical bands for ten years. LSST is anticipated to improve the current sample of multiply-imaged supernovae by order of magnitude, en- abling per cent-level constraints on H 0 . However, finding such systems in the ground-based imaging data is a challenge. In this thesis, we explore two different strategies to identify strongly lensed SNe Ia in the Rubin LSST. Firstly, we use the Rubin Science Pipelines' difference imaging (DI) module to identify lensed SNe. We test the DI pipeline on the real imaging data from the Subaru Hyper-Cam Survey, a precursor to LSST, injected with a realistically simulated population of lensed SNe Ia. We study the properties of the sources detected in the difference images compared to the properties of the injected sources to determine the recovery efficiency of the employed DI pipeline and the factors affecting the efficiency. Secondly, we investigate and assess the suitability of the colour-magnitude diagram as a rapid diagnostic tool for screening promising lensed SNe Ia candidates. We propose colour-magnitude diagram-based selection criteria to identify lensed SNe Ia under consideration of different SNe properties.
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