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Core-Collapse Supernovae: Future Synergy Between LSST and ET

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The Vera Rubin Observatory's (VRO) Legacy Survey of Space and Time (LSST) will revolutionize time-domain optical astronomy, detecting faint sources down to r~27.5 mag and generating nearly 32 trillion observations over 10 years. Among these, ~10 million will be supernovae (SNe), covering a wide range of redshifts and enabling studies of known and rare types, progenitors, and strongly lensed SNe (LSST Collaboration, Abell, P. A., Allison, J., et al. 2009).

Multimessenger astronomy is a key LSST objective. The detection of neutrinos from SN 1987A highlighted the potential of observing CCSNe through multiple messengers, and models predict gravitational wave (GW) emission from these events. A synergy between LSST and the Einstein Telescope offers a unique opportunity to detect the first GW signal from a CCSN.

We focus on LSST's ability to characterize CCSNe using a dataset of 6730 high-detail simulations from Moriya et al. 2023, analyzed with CASTOR (Simongini et al. 2024) to reconstruct the parametric map. We put particular emphasis on the synergy with current and future multiwavelength and multimessenger detectors. Comparing reconstructed and injected parameters, we find LSST alone cannot fully constrain progenitor properties and explosion parameters due to limited spectral coverage, bolometric luminosity uncertainties, and redshift-absorption degeneracy. Follow-up observations, particularly in the infrared, will be essential for precise parameter determination. Additionally, LSST's rigorous survey schedule limits targeted follow-ups.

This work is under review at A&A.

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