Archival supernovae co-discovered and detected with the MeerLICHT telescope

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Abstract

Current wide-field optical transient surveys discover thousands of new objects nightly, making rapid, multi-filter and/or spectroscopic follow-up of all but the most exceptional events unfeasible. Consequently, the early light-curve properties of most supernovae (SNe), particularly sub-luminous events, are not characterised. Here, we demonstrate a method to recover key parameters by combining publicly available data from multiple, contemporaneous surveys. We built a catalogue of 126 SNe by cross-matching the MeerLICHT (ML) transient survey with the Transient Name Server list of spectroscopically classified SNe detected between August 2017 and October 2022. For a subset of 14 SNe with good multi-survey photometric coverage, we combined ML-q, ZTF-g, r, and ATLAS-c, o data to construct composite early-time light curves. We then applied an expanding fireball model to constrain their explosion dates and rest-frame rise times. We find that this simple model provides a reliable description for the early emission of most SNe in our sample and successfully constrains their rise time, a key parameter for characterising SN categories and probing progenitor origins. Our results show that a detailed shock-cooling prescription, typically requiring dedicated high-cadence follow-up, is not always necessary to derive these parameters. This multi-survey approach, only using standard survey products, provides a powerful method to characterise large numbers of SNe that would otherwise be lost, a technique that will be essential for maximising the scientific return from current and future surveys like GOTO, BlackGEM, the Vera C. Rubin Observatory’s LSST and Global Open Transient Telescope Array (GOTTA).