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Optimization Simulations for Kilonova Detections in Optical and Near Infrared

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The search for kilonovae, either serendipitously or following a short gamma-ray burst (SGRB) or a gravitational-wave (GW) signal, has become a hot topic in astronomy in general, and multi-messenger astronomy (MMA) in particular. Efforts can be conducted with a variety of instruments (optical or near-infrared, where light curves and timelines are most conducive) and methods (filtering, fixed or dynamic exposures, different cadences and sky coverage, etc.).
We have performed simulations to try to determine the best observational scenarios to maximize kilonova detections, and we here report our work and findings. We have considered observational capabilities and settings of both the Zwicky Transient Facility (ZTF), with its wide field-of-view surveys, and the upcoming Vera C. Rubin Observatory, with its 10-year Legacy Survey of Space and Time (LSST) project.
We find that some observational choices, e.g. the adoption of three epochs per night on a nightly basis, and the prioritization of redder photometric bands, detection efficiencies improve by about a factor of two relative to the nominal cadence. We infer approaches for the optimization of the kilonova searches, e.g. filter selections, notably red/IR filters (i, z, y) compared to bluer filters (u, g, r), the return timescales for visits of the same area in the sky, and other relevant factors, comparing them with existing baseline strategies.

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