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Vera Rubin Observatory and Einstein Telescope: kilonova observation strategies to understand ET detector design

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The Vera Rubin Observatory will be a powerful instrument in the discovery and follow-up of kilonovae (KNe), especially in the perspective of third generation gravitational wave (GW) observatories which will come online towards the end of the tenure of Rubin's decadal survey (LSST WFD) in the mid 2030s. Follow-up of electromagnetic (EM) counterparts of binary neutron star (BNS) mergers provides a unique window into the population studies of kilonova and gamma ray-burst (GRB) central engines and their properties. We have been working on optimizing observation strategies to follow up BNS merger triggers with Rubin and other next generation optical observatories to search and observe KNe and GRB optical afterglows with different configurations of GW detectors, in particular focusing on the Einstein Telescope (ET) which is proposed to be the first underground interferometer.
Exploring these strategies has helped us compare different detector designs for ET and how it will perform in networks with the other ground-based GW observatories which will be its contemporaries. An extensive theoretical framework for kilonova modelling has helped us compare how ET-Rubin synergies will help us understand and compare the different conditions under which BNS systems form and merge, as well as potentially give us a handle on a better understanding of neutron star equations of state (EOS). I will be presenting our results and projections drawn from a BNS population of 10 years and present optical observation strategies that will help us make meaningful predictions using Rubin.

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