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Searching for off-axis radio emission from binary neutron star mergers using optically detected kilonovae

Abstract

The discovery of gravitational and electromagnetic waves from the same event, at cosmological distances, was one of the great scientific breakthroughs of the 21st century so far. The binary neutron star gravitational wave event GW 170817 confirmed the origin of some short gamma-ray bursts (sGRB) and kilonovae. At optical wavelengths, the kilonova was observed as a rapidly evolving transient, changing from blue to red in colour in a week. Radio emission from the sGRB, observed as a mildly off-axis jet, was viewed on much longer time scales with the last detection 942 days after the merger. With this proposal, we aim to triple the sample size of off-axis sGRB jets using target of opportunity observations triggered by optically detected kilonovae, from systems without observed sGRBs, during 2021 when LIGO is not active. Observations one week, two months, six months and one year after the trigger will enable us to follow the evolution of the jet as it decelerates upon interacting with the circumburst medium. With these data, we will be able to determine if GW 170817 was 'normal', study the lateral structure of the jet, and aid in determining the true rate of cosmological short gamma-ray bursts.