An Archival Search for Very-High-Energy Counterparts to Sub-Threshold Neutron-Star Merger Candidates

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The recent discovery of electromagnetic signals in coincidence with gravitational waves from neutron-star mergers has solidified the importance of multimessenger campaigns for studying the most energetic astrophysical events. Pioneering multimessenger observatories, such as the LIGO/Virgo gravitational wave detectors and the IceCube neutrino observatory, record many candidate signals that fall short of the detection significance threshold. These sub-threshold event candidates are promising targets for multimessenger studies, as the information provided by these candidates may, when combined with time-coincident gamma-ray observations, lead to significant detections. In this contribution, I cover the past, present, and future of looking at BNS mergers in the multi-messenger domain, with a particular focus on sub-threshold motivation for very-high-energy (VHE) gamma-ray searches.Specifically, I describe our use of sub-threshold binary neutron star merger candidates identified in Advanced LIGO's first observing run (O1) to search for transient events in VHE gamma rays using archival observations from the VERITAS imaging atmospheric Cherenkov telescope array. Figure 1 demonstrates the utility of this method for use in archival data, as well as its promise in future joint sub-threshold searches: all current and future-generation IACTs can participate with minimal-to-no observing burden.

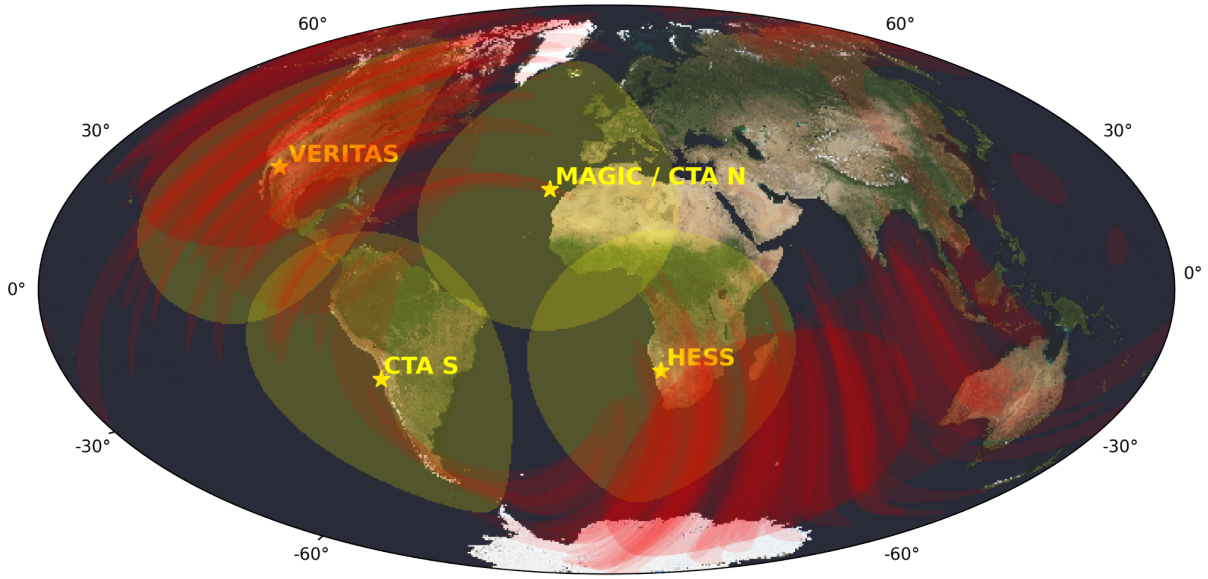

Figure 1. The 50% credible regions of the 103 sub-threshold candidates from LIGO's first observing run are shown in red and are presented in geographic coordinates. The sky coverage of the current (VERITAS, MAGIC, H.E.S.S.) and future (CTA North and CTA South) IACT arrays at any given time, assuming a maximum zenith of 40°, are shown in yellow.