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Gravitational Astronomy: Putting the "O" in LIGO

RAYMOND FREY, University of Oregon

The last five years have been transformational to the field of gravitational wave science and astrophysics. On Sept. 14, 2015, LIGO observed a strong gravitational wave (GW) signal from a binary black hole merger. One of Einsteins most amazing predictions was confirmed. The GW discovery was just the start of a new paradigm in astronomy and astrophysics LIGO had opened the door to a new way to observe the universe. Indeed, in 2017 this vision was realized spectacularly with the discovery of the gravitational wave signal from a binary neutron star (BNS) merger, accompanied within 2 seconds by a gamma-ray burst, and over the next hours, days, weeks, and months by observations across the electromagnetic wavelengths of the mergers afterglow. The era of multi-messenger astronomy involving GWs was born. In this talk, I will discuss some of the key technologies, including squeezed light, which have allowed LIGO to achieve astrophysically relevant sensitivities, and the implications of the observations to astrophysics, fundamental physics, and cosmology.