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• Gravitational wave and E&M wave astronomy event data provide strong evidence for Binary Neutron Star kilonovae, nucleosysnthesis, and one source of Gamma Ray Bursts

en.wikipedia.org/wiki/GW170817
ligo.org/detections/GW170817.php
tinyurl.com/WS-VT-kilonova
www.ligo.caltech.edu/page/press-release-gw170817
en.wikipedia.org/wiki/Nucleosynthesis
www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=243411&org=NSF&from=news
www.caltech.edu/news/caltech-led-teams-strike-cosmic-gold-80074
authors.library.caltech.edu/82362/
iopscience.iop.org/article/10.3847/2041-8213/aa920c/meta

A flood of papers has been released discussing the science emergent from the LIGO-VIRGO network gravitational radiation detection of the August 2017 binary neutron star (BNS) merger, which was accompanied by electromagnetic radiation spectroscopic observation of heavy elements (including gold) theorized to be produced by the rapid-neutron capture process (r-process). Multi-messenger astronomy combined gravitational and traditional electromagnetic radiation signals to help address the question of how elements heavier than iron are produced. Elements lighter than iron can be produced by fusion in stellar cores, but heavier elements require more catastrophic processes, and neutron star collisions have been postulated to be one such mechanism. Observation of GW170817 revealed "unequivocal evidence of a cosmic mine that is forging more than 10,000 earth-masses of heavy elements, such as gold, platinum, and neodymium," according to MIT astronomer Mansi Kasliwal. This phenomenon was previously theoretically postulated as a "kilonova."

The multi-messenger signal sequence from the merger itself told a complex story: the final 3000 neutron star orbits 100 s before the collision was observed as the gravitational chirp. Next followed an (unexpectedly weak) Gamma Ray Burst about 1.7 seconds later, then later ultraviolet, visible spectrum, the x-ray jet cone (9 days later), radio (16 days later) and IR curve signals. All arrived at different times, confirming and extending theories for a complex initial explosion evolving through multiple structures, as well as differing electromagnetic spectral interactions with the interstellar medium.

This was the first gravitational observation of a binary neutron star merger, of a BNS associated Gamma Ray Burst, and the first use of joint gravitational and electromagnetic multispectral data to detect, localize, identify, and study an astronomical event. Astrophysical models describing GRBs, kilonovae and nucleosysthesis have been tested and are being extended and refined. Numerical tests of fundamental physical theories regarding relativity, the speed of light and gravity propagation, and more are all being measured and (so far) confirmed. It's an extraordinarily exciting time in astronomy.

• Polaroid filters, EM waves and an introduction to Bell's theorem/quantum mechanics

youtube.com/user/minutephysics
tinyurl.com/WS-MPqmpolaroids
youtube.com/3blue1brown
tinyurl.com/WS-3B1Bqm

A new collaborative pair of complementary videos were just released: "Bell's Theorem: The Quantum Venn Diagram Paradox" by MinutePhysics, and "Some light quantum mechanics (with MinutePhysics)" by 3Blue1Brown. Henry Reich's MinutePhysics spends time examining and analyzing the properties of three polarizing filters mainly in terms of classical E&M waves, while Grant Sanderson's 3Blue1Brown (his eye color) further discusses introductory QM from a mathematician's standpoint, spending significant time on basis vectors.

• Collection of essays on physics for physics teachers freely available

www.basic-physics.com/

AAPT Oersted Medal recipient Kenneth Ford has produced a free companion website to his book *Basic Physics: A Resource for Physics Teachers*, aimed at introductory physics teachers and learners. These essays (with Hewitt cartoons) cover topics that may be of interest to teachers of introductory physics at both the high school and college levels. The essays are housed in seven sections, the first five of which follow the chronology of the great discoveries of physics—and the corresponding formulations of broad theories—from the 17th through the 20th centuries. The sixth follows physics into the subatomic domain, and the seventh encompasses thoughts of a more general character. Ken solicits teacher feedback and input. *Submitted by Ken Ford*