# How did heavy elements originate in the Universe?
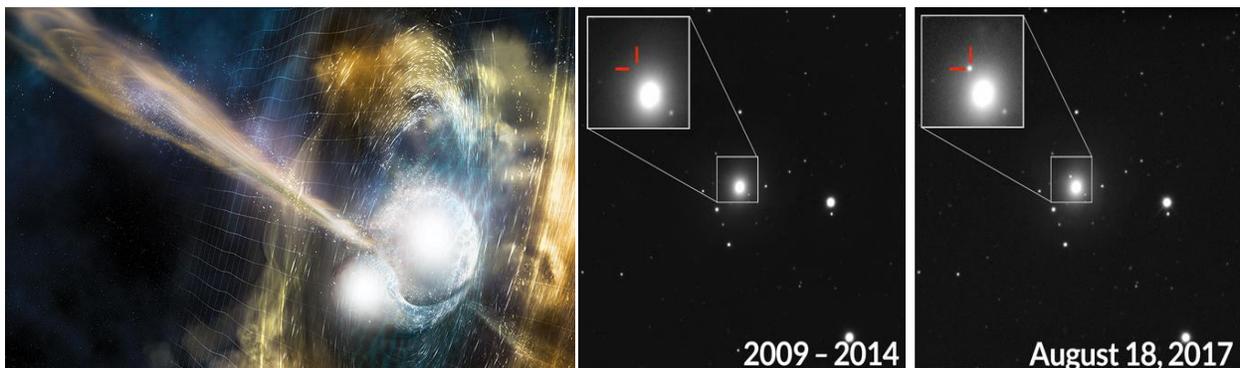
## LIGO at It Again



**Figure 1** (Left): Artist's illustration of two merging neutron stars (Credit: NSF, LIGO, A. SIMONNET/SONOMA STATE UNIV) Right: Observations of the kilonova (Credit: P.K. Blanchard, E. Berger, Pan-STARRS, DECam).

On Oct 16, 2017 Researchers announced that LIGO and its sister experiment set up VIRGO has picked up a second Gravitational Wave signal with the help of 70 observatories around the world. This signal was of 100 seconds, one of the longest and strongest signal detected by LIGO so far.

This second gravitational wave was the result of cosmic crash between two neutron stars in a galaxy NGC 4993, 130 million Light years from Earth. Collision between two neutron stars led to a sequence of events, burst of gamma rays followed by the glow of visible and infrared light (Figure 1, Right). A week later these waves were eclipsed by Radio Waves. Many have dubbed this discovery as a "Rosetta stone" for Astronomy due to richness of data coming from a single astronomical event.

One of the most celebrated aspects of this cosmic event was that scientists where able to confirm that heavy elements such as Gold and Platinum are formed as a result of r- process nucleosynthesis (Neutrons released during the merger combines with the surrounding atoms to form heavy chemical elements). Not only this, but this event has given hope to scientists to accurately determine the expansion rate of the universe. LIGO scientists expect to bring more exciting news from the space in near future.

Shown below is a picture of the periodic table and what physicists understand as the cosmic events that are the origin of the various elements therein (Figure 2).
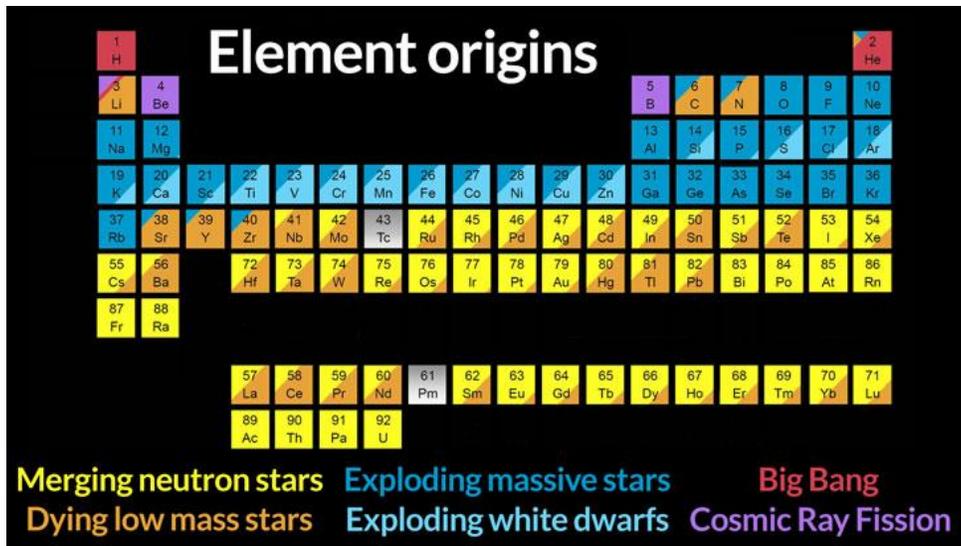
**Figure 2:** The light emitted by a neutron star collision showed signs this event was a factory for new-elements (yellow). Some elements are produced in different ways, including through the explosion of huge stars and dying low-mass stars. (Source: Robert Hurt/IPAC/Caltech).