Astronomy Talk 9th May 2017
Gravitational Waves

Mark Gibbons came from the Cotswold Astronomical Society to tell us all about this topical subject. To start he explained the difference between gravity waves and gravitational waves. Gravitational waves (G waves) were mooted by Oliver Heaviside many years before Einstein's General Relativity theory in 1915. It was many years before they were generally believed, and only in recent years have they been demonstrated by looking at decaying orbits of binary pulsars and anomalous apsidal precession.

The biggest hole in our understanding is that General Relativity assumes a smooth continuum in space, whereas quantum theory suggests it may be discrete. However we looked in passing at rotating black holes and their ergosphere, including frame dragging effects.

Almost any asymmetric effect can generate G waves, e.g. the collapse of mountains on neutron stars (typically 1 mm high), merging of massive bodies, etc.

LIGO was only able to detect small mass collisions as larger mass collisions have much longer wavelengths to which the instruments are insensitive. The distortion of space in the LIGO instrument arising from the detected waves is about 1/1,000 of the diameter of a proton. For comparison that's about a hair's breadth compared to the distance to Alpha Centauri.

Lots of new instruments are in design all over the world, so we should get lots more data in the future. In particular the space based LISA experiment will have arms of 5 million km, as opposed to LIGO's 4 km. Hence LISA will be able to detect much longer wavelength waves, and should be able to pick up millions of events.

The eventual LISA equipment will enable us to make strong tests of General Relativity: it will be able to detect black hole events anywhere in the universe.