Black hole merges with unusual compact object

- The LIGO Scientific and VIRGO Collaborations (LSC) have detected an unusual compact object whose mass falls in between that of a typical black hole and a neutron star.

### What is a neutron star?

It a celestial object of very **small radius** (typically 30 km) and **very high density**, composed predominantly of **closely packed neutrons**. It is smaller than a sun but 1.4 times denser than sun. Neutron stars are thought to form by the gravitational collapse of the **remnant of a massive star after a supernova explosion**, provided that the star is **insufficiently massive** to produce a black hole.

- The **absence of accompanying electromagnetic signatures** such as flashes of light are compatible with both.
- This puzzling event was registered by the LIGO and VIRGO detectors on August 14, 2019. The work has been published in *The Astrophysical Journal Letters*.
- Since the first ever detection of **gravitational wave** signals emerging from the coalescing of **binary black holes in 2015**, the LIGO and VIRGO detectors have detected **mergers of pairs of black holes, pairs of neutron stars** and black hole-neutron star duo.

**Inference from signal**

- Looking at the signal waveform, it appeared that the **primary object** in this merger had a **mass of about 23.2 times** that of the Sun and the **smaller**, secondary object had a mass of about **2.6 times the solar mass**.
- The pair joined to form a large black hole of mass 25.6 times the Sun’s mass, having radiated away 0.2 solar masses.
- This is **unusual on many counts**. For one thing, the **mass ratio** was approximately **1:9**.
- This is the **largest disparity** in masses that has been observed till now between **members of the coalescing pair**.
- While at **23.2 solar masses**, the primary is clearly a **black hole**, the calculated mass of the secondary object puts it in a dubious spot. It is **too light to be a black hole and too heavy to be a neutron star**, as far as observations go.

**Topic of discussion**

- There is not much information about the lighter object except for the mass. “Due to the **mass asymmetry**, it becomes very difficult to detect any signatures of neutron star ‘tides’ which could have given us insights about the star. So one may be able to invoke exotic possibilities,” says Prof. Arun.