

# GRAVITATIONAL WAVES

## Where did the signal come from?

Gravitational waves were first predicted by Einstein in 1916. 100 years later, the Laser Interferometer Gravitational-wave Observatory (LIGO) announced its historic first direct detection of the phenomena, but where did the signal come from?

**1.** 1.3 billion light years away, there are two black holes orbiting one another – one has a mass 29 times that of our Sun and the other 36 times.

**2.** The pair lose gravitational energy and their orbits shrink.

**3.** Eventually the black holes merge together and form a single, more massive, black hole. The new black hole has just 62 times the Sun's mass – meaning it has lost the mass equivalent of three Suns. This mass is converted into gravitational energy. In a fraction of a second it releases more energy than is radiated as light by all the stars in the Universe in the same time. This creates a surge of gravitational waves.

**4.** As the new black hole settles down, the gravitational energy it released radiates outward through space at the speed of light.



Orbiting black holes

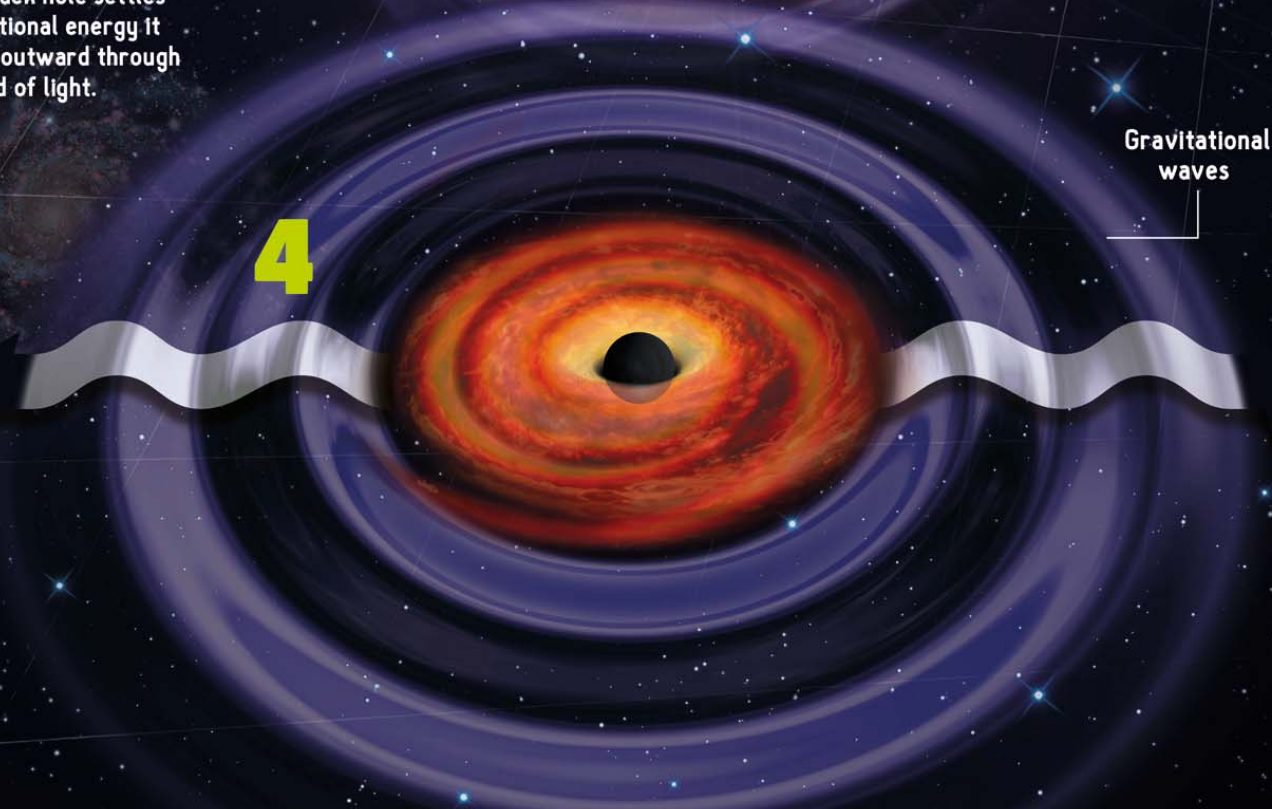


2



Black holes merge

3



Gravitational waves

4



No gravitational wave

Gravitational wave passes through

**5.** Gravitational waves stretch and compress the fabric of the Universe (and anything that occupies it) – so, when the waves reach Earth 1.3 billion years later, they stretch and compress the planet and the LIGO detector by a tiny amount (less than the diameter of a proton). It is this almost imperceptible distortion that LIGO detected.