Worksheet 1: Introduction

"Ladies and gentlemen – we have detected gravitational waves. We did it."

David Reitze, the head of the Laser Interferometer Gravitational-Wave Observatory (LIGO), could barely contain his pride and excitement as he uttered these words on 11 February 2016 to announce a sensational scientific breakthrough to the world. The gigantic laser interferometers in Hanford (Washington) and Livingston (Louisiana) had found direct evidence of gravitational waves for the very first time.

The existence of gravitational waves had been predicted by Albert Einstein one hundred years earlier (in 1916) from his theory of general relativity. However, his calculations led him to believe that we would probably never be able to detect them, due to their extremely tiny amplitude. At the time, this was entirely reasonable, since the only cosmic objects capable of emitting gravitational waves of non-negligible intensity – highly accelerated neutron stars and black holes – had not yet been discovered.

Even so, it wasn't until a pair of closely orbiting black holes in the process of merging together were found that a gentle, barely noticeable oscillation in space-time was picked up by the interferometers. This achievement was the result of a decades-long battle against the theoretical and experimental obstacles preventing the detection of gravitational waves. This was awarded the 2017 Nobel Prize in Physics in recognition of the three American physicists who made the most significant contributions to gravitational research and the detection of gravitational waves: Rainer Weiss, Barry Barish, and Kip Thorne.

Below, you will find out more about the physical properties of the gravitational wave event known as GW150914[1] – the first event of its kind ever to be observed.

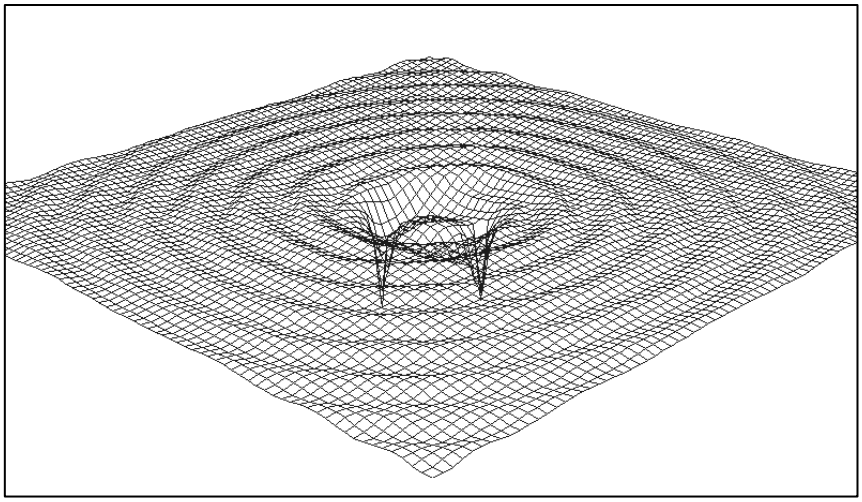

Image source: M. Borchardt

[1] The name GW150914 is derived from the first letters of "Gravitational Waves", together with the date of discovery (14/09/2015).