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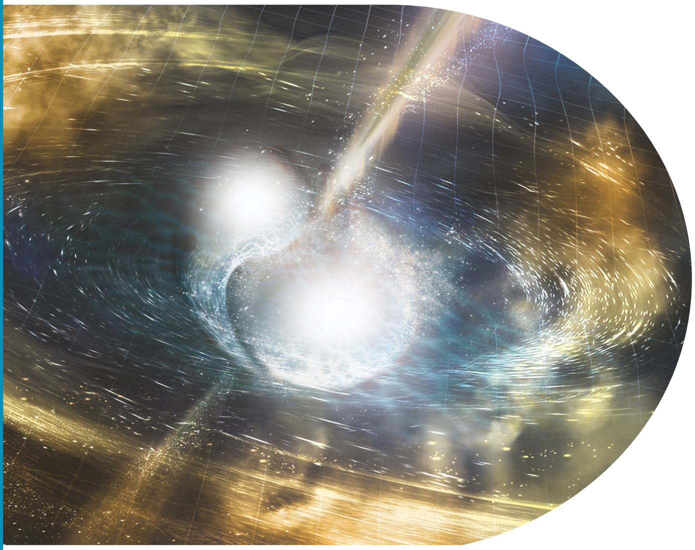
Artist's illustration of two merging neutron stars. Credit: NSF/LIGO/Sonoma State University/A. Simonnet



SUPPORTING SCIENTIFIC DISCOVERY

Platinum in resistance thermometers is helping to shed light on black holes

Resistance temperature detectors (RTDs), also called resistance thermometers, are sensors used to measure temperature. RTDs work on a basic correlation between the electrical conductivity of a metal and its temperature. As the temperature of a metal increases, the metal's resistance to the flow of electricity increases. Platinum's stability at high temperatures and its high melting point of c.1,769°C make it well suited as a component in an RTD as it enables an accurate resistance/temperature relationship.

Precision and reliability count

RTDs are mass produced and widely used in numerous industrial applications. However humble they are, their usefulness is such that platinum-based RTDs are used as a component in one of the most sophisticated measuring devices ever created – the Laser Interferometer Gravitational-Wave Observatory (LIGO).

Located in the US, LIGO is the world's largest gravitational wave observatory and a marvel of precision engineering, built to detect and understand the origins of gravitational waves. LIGO is, in fact, comprised of two separate laser interferometers some 3,000 miles apart. Each interferometer has two arms, 4 km in length, arranged in an 'L' shape.

The interferometers work in unison, using mirrors to direct the paths of laser beams as they travel down each arm. It is minute changes in the length of the paths of the laser beams that indicate the presence of a gravitational wave.

Within the two interferometers, platinum-based RTDs are used to monitor the temperature of the mirrors to ensure they are sufficiently heated to maintain their carefully calibrated curvature before the laser beams are directed down each arm.

LIGO is operated by the California Institute of Technology (Caltech) and the Massachusetts Institute of Technology; both also led the design and construction of the project which started in 1994, with an upgrade taking place in 2014.

The Virgo Interferometer based in Italy is similar to LIGO in construction. Credit: The Virgo collaboration/CCO 1.0

Rich Abbott, an engineer from Caltech who has worked on the LIGO project for 25 years, says:

"LIGO is an extremely precise measuring device capable of resolving very small changes in length, as this is the way a gravitational wave manifests itself as it passes through earth. To get an idea of the precision necessary, I liken LIGO to a weighing scale that could weigh all the sand on all the beaches on earth and yet be sensitive enough to detect when one grain of sand had been removed."

LIGO has had amazing success in recent years. In 2015, it directly observed gravitational waves that resulted from merging black holes approximately 1.3 billion light-years away and 1.3 billion years ago, confirming a major prediction of Albert Einstein's General Theory of Relativity and opening an unprecedented new window onto the cosmos.

In 2017, the observatory recorded another first with the detection of a collision of two neutron stars, which enabled the simultaneous detection of optical signals using conventional telescopes. Earlier this year, LIGO and its European counterpart Virgo detected what is thought to be a collision between a neutron star and a black hole, an event not witnessed before.

Caltech engineer Rich Abbott has worked on the LIGO project for 25 years

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