An interactive science exhibit based on a real-life gravitational-wave detector

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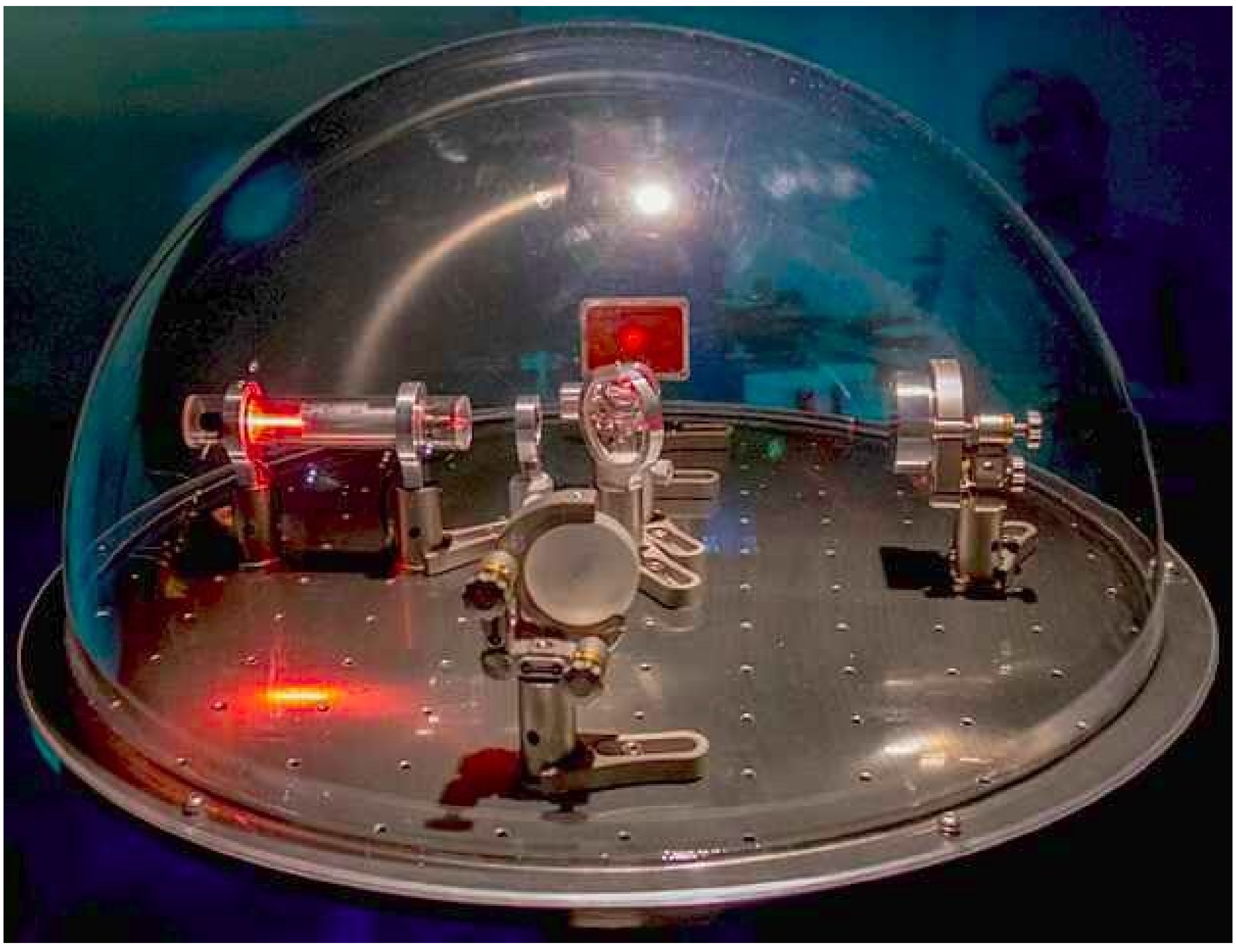

The Michelson interferometer installed at the Thinktank Birmingham Science Museum. Credit: [image supplied from the paper]

Gravitational wave scientists have designed and built an interactive science exhibit modeled on a real-life gravitational-wave detector to explain gravitational-wave science. It was developed by an international team, which includes researchers now at the OzGrav ARC Centre of Excellence for Gravitational Wave Discovery (OzGrav).

The recently published research paper is now featured in the *American Journal of Physics* and the exhibit, which is called a Michelson interferometer, is on long-term display at the Thinktank Birmingham Science Museum in the UK. The project has a lasting international impact with online instructions and parts lists available for others to construct their own versions of the exhibit.

Observations of gravitational waves—ripples in the fabric of space and time—have sparked increased public interest in this area of research. The effect of gravitational waves is a stretching and squashing of distances between objects. Real-life observatories are large complex devices based on the Michelson interferometer that use laser light to search for passing gravitational waves.

In a Michelson interferometer, laser light is split into two perpendicular beams by a beam-splitter; the beams of laser light travelling down the detector arms reflect off mirrors back to the beam-splitter where they recombine and produce an interference pattern. If the relative length of the arms changes, the interference pattern will change. The exhibit model cannot detect gravitational waves, but it's extremely sensitive to vibrations in the room!

The Michelson interferometer installed at the Thinktank Birmingham Science Museum. The touch screen provides access to videos, images and text and the four arcade buttons allow users to input a simulated gravitational wave to the interferometer. Credit: [image supplied from the paper]

The Michelson interferometer exhibit has an attractive high-shine design, using lab-grade optics and custom-made components, drawing people in to take a closer look. A list of all the parts used in the intricate design is available on the official website—the creators are continuing to investigate low-cost designs using laser pointers and building blocks.

At science fairs, experts are normally present to explain the items on display; however, this is not the case in a museum. "Exhibits need to be easily accessible with self-guided learning," explains OzGrav postdoc Dr.

Hannah Middleton, one of the project leads from the University of Melbourne.

"We've developed custom interactive software for the exhibit through which a user can access explanatory videos, animations, images, text, and a quiz. Users can also directly interact with the interferometer by pressing buttons to input a simulated gravitational wave, and produce a visible change in the interference pattern."

The gravitational-wave exhibit provides a lasting engagement in the city of Birmingham's family science museum and was exhibited in London at the 2017 Royal Society Summer Science Exhibition. The project led to further engagement opportunities including Gravity Synth, a musical instrument based on a Michelson interferometer. The Gravity Synth was developed through a collaboration between Birmingham-based audio-visual artist Leon Trimble and gravitational-wave researchers, including OzGrav researchers Dr. Aaron Jones (University of Western Australia) and Dr. Hannah Middleton (University of Melbourne).

Dr. Jones explains: "After this project, I was inspired to break down traditional barriers between arts and science and develop an art-science experience for our mutual benefit." The Gravity Synth EP is available here and the project was included as part of the LIGO Magazine's special feature on art, music and gravitational waves.

More information: S. J. Cooper et al, An interactive gravitational-wave detector model for museums and fairs, *American Journal of Physics* (2021). DOI: 10.1119/10.0003534

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