Increasing the relevance of high school studies to cutting-edge gravitational wave research

Chris North, School of Physics and Astronomy, Cardiff University, Cardiff, UK

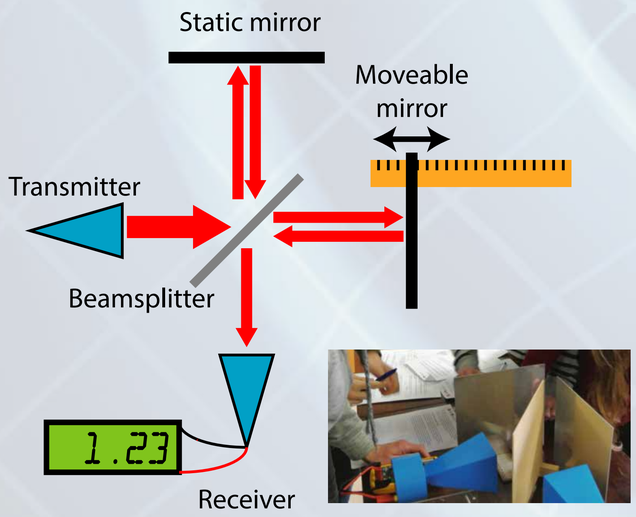
We have developed an educational workshop aimed at students age 16-18 years. The goal is to let them investigate the technology and principles behind gravitational wave detectors and the science that can be extracted from gravitational wave measurements.

The workshop has been delivered to 300 students around the UK, with pre- and post-workshop evaluations conducted with students and teachers.

Workshop Design

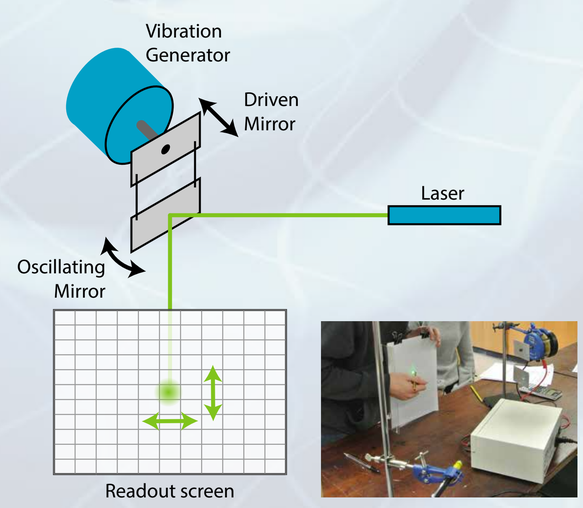
- Based on material covered in school curriculum
- Developed with teachers and educational consultants from National Space Academy
- Students perform two 45-minute activities: one hands-on experiment and one mathematical investigation.
- Presentations or videos at the start and end provide context about gravitational wave science and technology

Microwave Michelson Interferometer



- Calculate wavelength of microwave transmitter
- Estimate strain accuracy
- Relate to gravitational wave detectors

Seismic Isolation (Driven Pendulum)

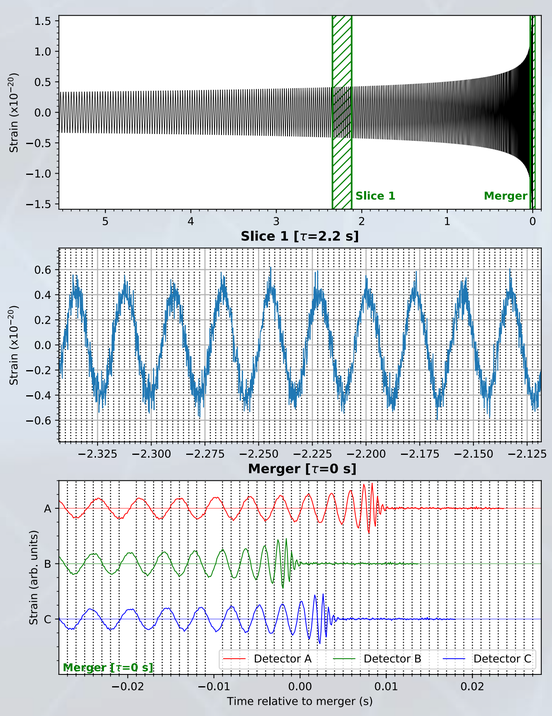


- Find resonant frequency
- Calculate amplitude reduction at higher frequencies
- Relate to gravitational wave detectors

Gravitational Wave Data Analysis

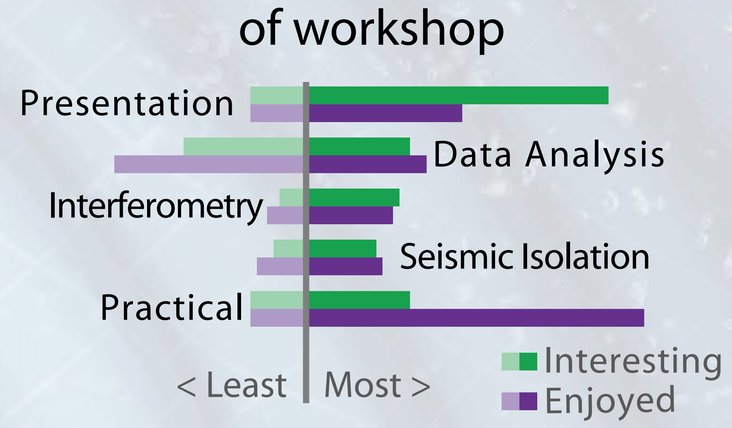
- Measure amplitude (h), frequency (f) and time (τ) based on graphs
- Calculate distance (r) and chirp mass (M_{ch})
- Using detector timing to calculate location of source, and identify redshift
- Use distance and redshift to measure Hubble constant (H_0)

$$h\,\tau\,f^2 = \frac{K}{r} \quad ; \quad M_{ch}^5 = K_0\, f^{-8}\, \tau^{-3}$$



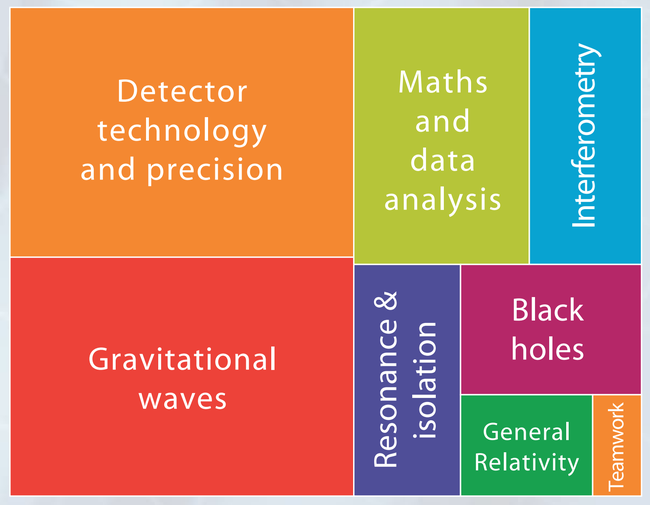
Workshop evaluation

Interest and Enjoyment of parts of workshop

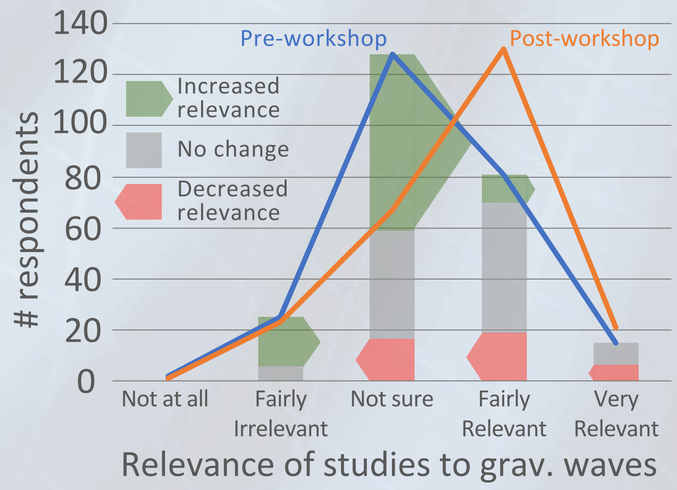


Student involvement and level of workshop

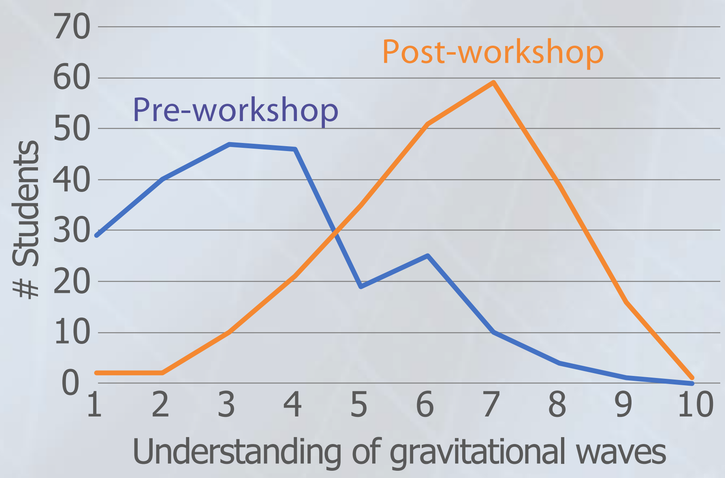
Learning outcomes of workshop



Relevance of students' studies to gravitational wave research



Self-evaluation of understanding of gravitational waves



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Further work

- Extend to younger ages (14-16)
- Include real data in data analysis

http://workshops.cardiffgravity.org