Research Highlights

THE AUSTRALIAN NATIONAL UNIVERSITY

When Quantum Noise is Deafening

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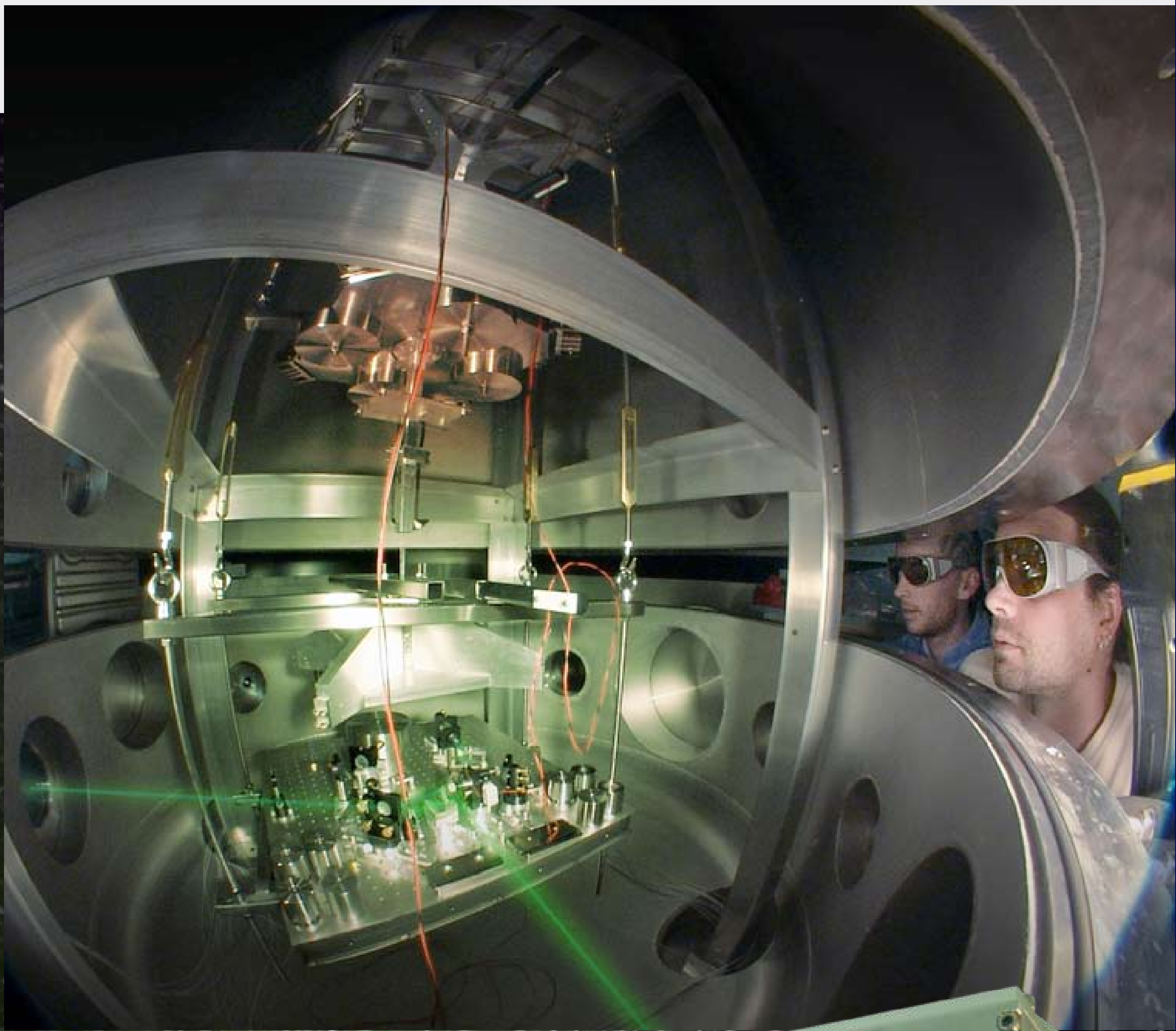
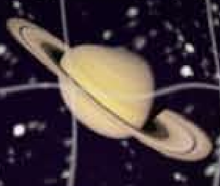
Gravitational waves, or ripples in the curvature of spacetime, were predicted by Einstein 90 years ago. They are emitted by the most violent events in the universe – black hole collisions, supernovae and the Big Bang itself. Their detection would open both a new window for astronomy, and a completely new way of sensing the universe – akin to being able to hear for the very first time.

The reason Gravitational wave detection has prooved so difficult is that their impact on earth based detectors is fantastically small. The change in the shape of space as a wave passes by is smaller than a million, million, millionth of a metre. Instruments currently operational, such as the Laser Interferometer Gravitational Observatory (LIGO), are within a factor of 10 of the required sensitivity. However with conventional detectors, most signals would be be masked by the fundamental inherent quantum noise on the interferometer's laser light. Though totally irrelevant in most sensing applications, such quantum noise is deafening in a gravitational wave detector.

However, new research at the ANU Centre for Gravitational Physics may be set to hush things up a little. Sensors and isolation stacks are being developed, which suppress seismic noise by more than 200 dB. Once these sensors are honed to the point that quantum noise becomes limiting, the scientists intend to bring ANU developed quantum squeezed light techniques into play. This should enable them to twist the Heisenburg uncertainty principle and probe below the quantum noise level. Such a feat was considered impossible not more than ten years ago.



State of the art sensors coupled with quantum noise suppression technology may supply gravity wave detectors such as LIGO (below) with sensitivity boost needed to detect ripples in spacetime caused by violent events in the cosmos.



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