The Royal Society of Western Australia

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The Universe has Spoken

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Einstein's gravitational waves have been directly detected, one century after his original prediction. The waves are ripples of space and time that travel through empty space at the speed of light. The discovery, which was heard as a brief chirp, confirms our ability to obtain new understanding of the universe from the gravitational wave sounds it creates. More and more sounds will become audible to gravitational wave detectors as the detectors are improved in the next few years.

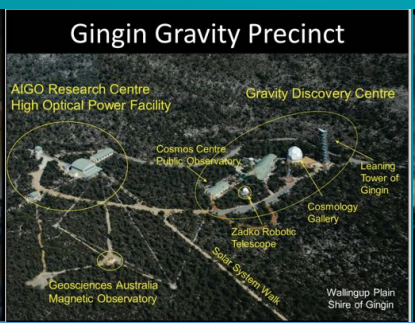
Over a span of one century, gravitational wave detection faced numerous obstacles. The first was the question of the reality of the waves. The next was the extreme weakness of proposed sources of gravitational waves, which made Einstein say that they were of only of academic interest. Eventually the concept of the black hole, also derived exactly 100 years ago, led to predictions that the coalescence of pairs of black holes would be the most powerful sources of radiation in the universe, with each individual event emitting gravitational wave power that exceeds the combined electromagnetic power output of all of the stars in the visible universe.

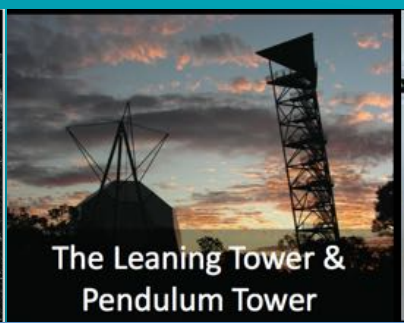
In spite of the vast power of expected signals, it required extraordinary ingenuity and dedication by well over 1000 physicists over many decades to invent detector concepts and then to refine and improve them, to enable designs for practical detectors.

Gravitational wave detectors are pinnacles of technology, the most sensitive instruments ever created. Numerous innovations and massive efforts were needed to bring conceptual designs to reality. Their detection is a triumph of innovation and persistence over skepticism.

The discovery of Einstein's waves confirms that space itself is a continually rippling medium, that geometry itself is fluctuating. It confirms that a substantial amount of matter in the universe has been lost into black holes, and that black holes are growing. Many fundamental questions have now come within reach.

This talk will be an overview of gravitational waves, their momentous discovery, and predictions of future discoveries.





Biography

Prof. David Blair

David Blair is an experimental physicist. He developed the first southern hemisphere gravitational wave detector NIOBE, and the Sapphire Clock. In 1998 he led the development of a 50km2 site at Gingin, near Perth, Western Australia, for a proposed southern hemisphere laser interferometer gravitational wave detector. He also led the creation of the Gravity Discovery Centre, which is a major public outreach centre for teaching Einsteinian Physics to schools and the general public. The Australian International Gravitational Research Centre at Gingin includes an 80m high optical power laser interferometer and the 1m Zadko Robotic Telescope used for multi-messenger astronomy and gamma ray burst follow-up.

The Gingin Gravity Precinct is part of Australia's contribution to the LIGO Scientific Collaboration, an international collaboration in gravitational wave detection that includes more than 1000 physicists. Blair leads the Science Education Enrichment Project and the Einstein-First education projects. This is a collaboration focused on developing Einsteinian physics for the school curriculum.

Blair has strong collaboration links with China and was convenor of the KITPC Program "The Next Detectors for Gravitational Wave Astronomy" in 2015.

In 2013 Blair was elected Fellow of the American Physical Society. In 2007 he won the Western Australian Scientist of the Year Award. In 2005 World Year of Physics, Blair was awarded the ANZAAS Medal[3] as well as a WA Government Centre of Excellence Grant to develop the Australian International Gravitational Research Centre. In 2004 he won the Learning Links award of the Minister for Education and Training. In he was awarded the 2003 National Medal for Community Service, the 2003 Centenary Medal for Promotion of Science and the 2003 Clunies Ross National Medal for Science and Technology. In 1995 Blair was awarded the Walter Boas Medal of the Australian Institute of Physics.