



The GWIC Roadmap and the Need for AIGO

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Why Gravitational Waves?

End of a Long Quest

- Gravitational waves predicted by Einstein as a part of his General Theory of Relativity (1916)
 - Completely new aspect of gravity
 - A crucial test of relativity
- No one even thought them detectable until the 1960's
 - Require measurements of almost unimaginable sensitivity
 - First direct detection will cap a 50 year long campaign
- UWA a key player in this quest since the 70's



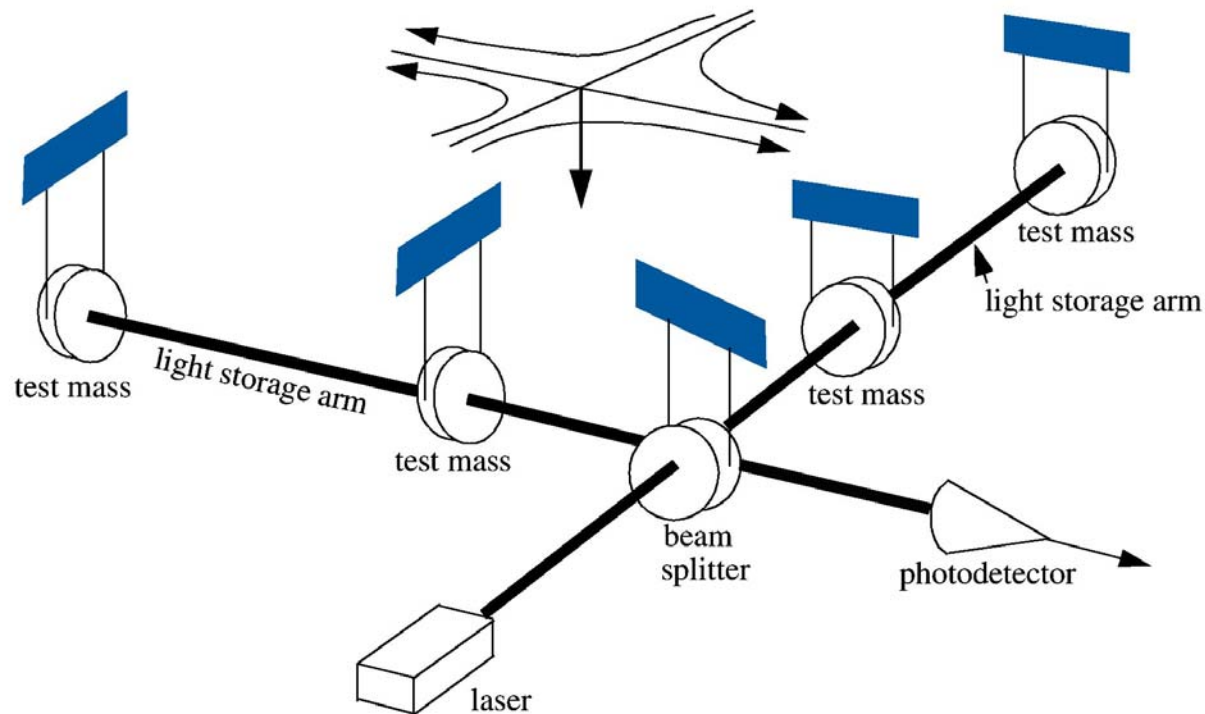
Why Gravitational Waves?

Beginning of a Great Adventure: Gravitational-wave Astronomy

- Entirely new way to study the cosmos
 - Carry totally different information about sources than electromagnetic waves (light, radio, etc)
- Sources include the most energetic events in our universe
 - Black holes
 - Neutron stars (pulsars)
 - Supernova explosions
 - Big Bang and early universe



Interferometer Detectors for Gravitational Waves



- Based on a well-known concept: Michelson interferometer
- Must sense arm length changes **smaller than $1/1000^{\text{th}}$ of the diameter of an atomic nucleus**



Status of Gravitational Wave Detectors around the world

- Kilometer scale devices have been built and operated in Japan, Germany, US, and Italy
 - Over 1000 scientists and engineers world-wide
- Advanced detectors (typically 1000 times more powerful in terms of their science capability) are under construction
 - Next generation detector technologies developed, tested, and ready to be deployed
- Widespread collaboration to reap the best scientific results
 - Recognition that full benefit of GW observations requires collaboration



GWIC

Gravitational Wave International Committee



GEO600



LIGO



TAMA



LIGO



Virgo

LIGO-G1000111-v1



What is GWIC? and why does it need a roadmap?

Gravitational Wave International Committee

- Formed in 1997 to facilitate international collaboration in the construction and use of gravitational wave detectors world-wide
 - Affiliated with the International Union of Pure and Applied Physics (IUPAP)
- Roadmap Committee charter:
 - Develop roadmap to **optimize the global science in the field** with 30-year horizon
 - Identify relevant science opportunities and the facilities needed to address them

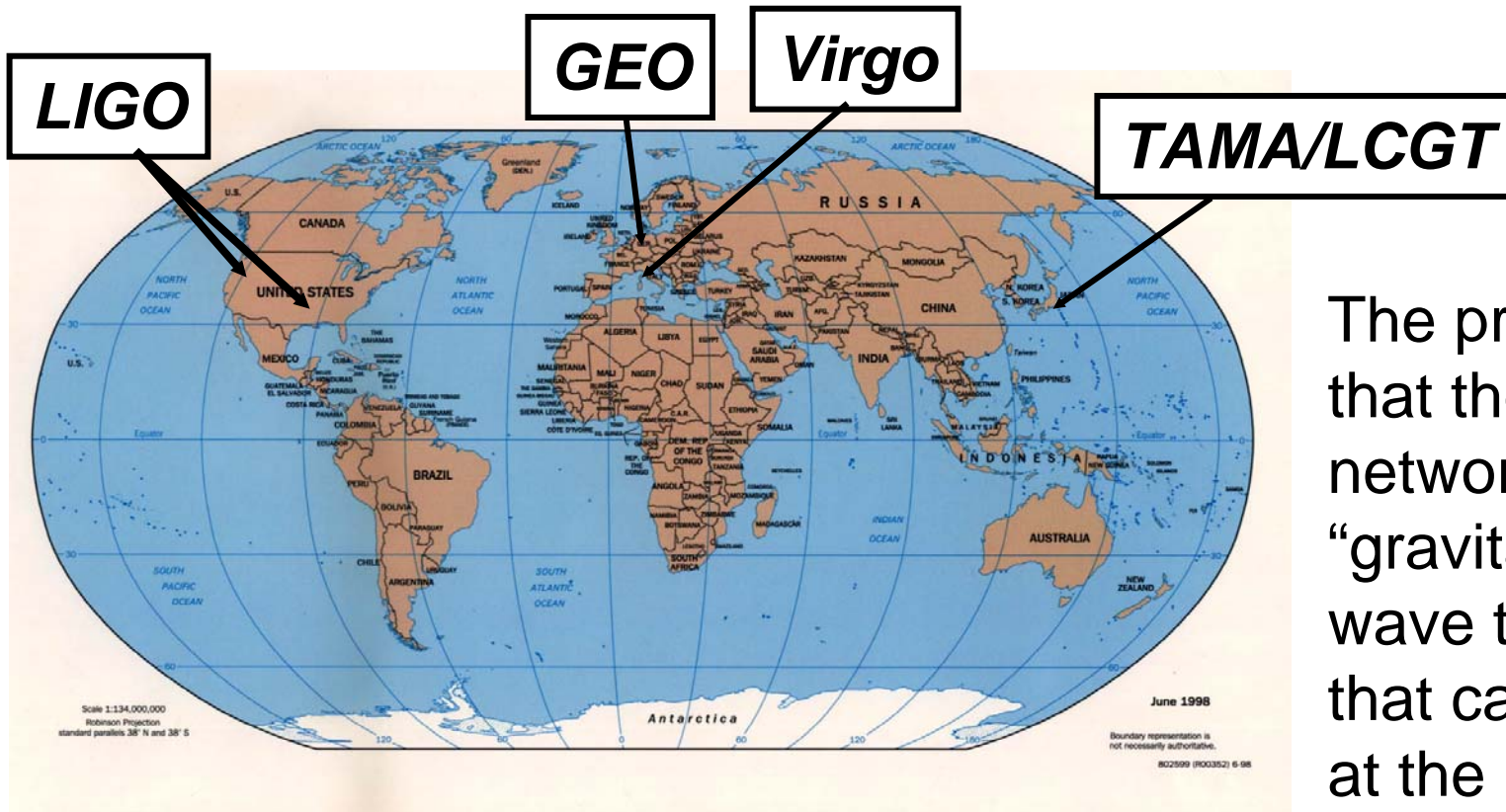


From the GWIC Roadmap:

- ... the first priority for ground-based gravitational wave detector development is to **expand the network, adding further detectors with appropriately chosen intercontinental baselines** and orientations to maximize the ability to extract source information.



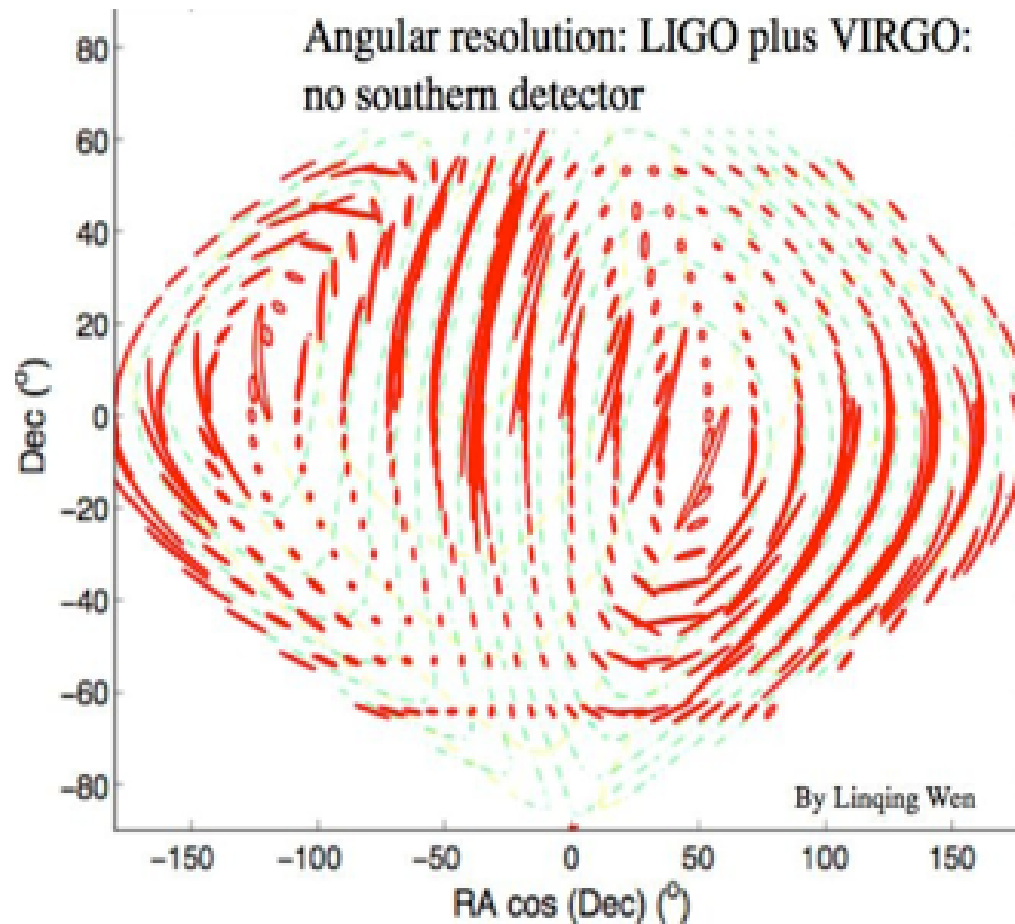
A Global Network of GW Detectors



The problem is that the current network forms a “gravitational wave telescope” that can only point at the north and south poles!



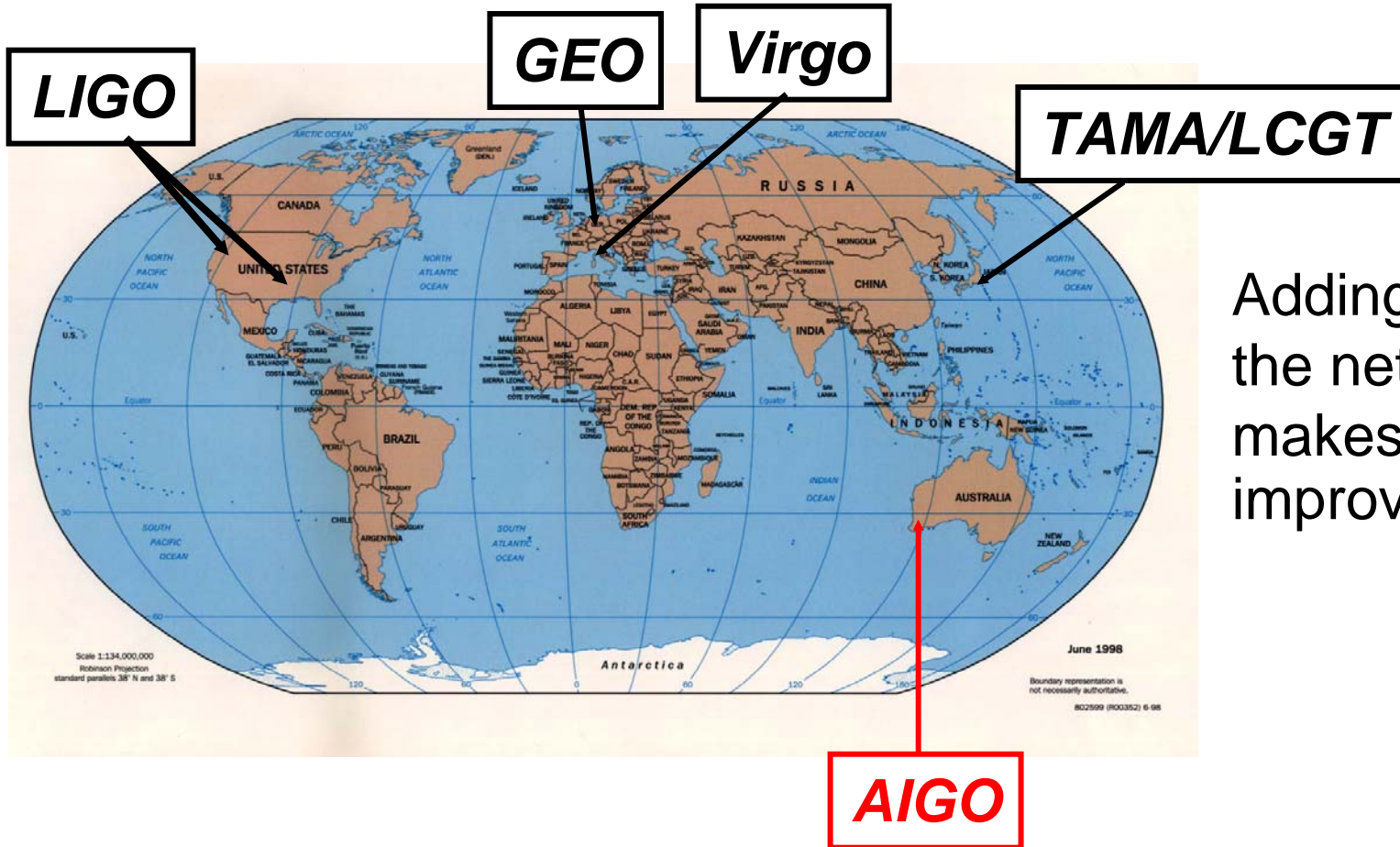
LIGO and Virgo Alone



Northern hemisphere detectors have limited ability to locate sources particularly near the celestial equator



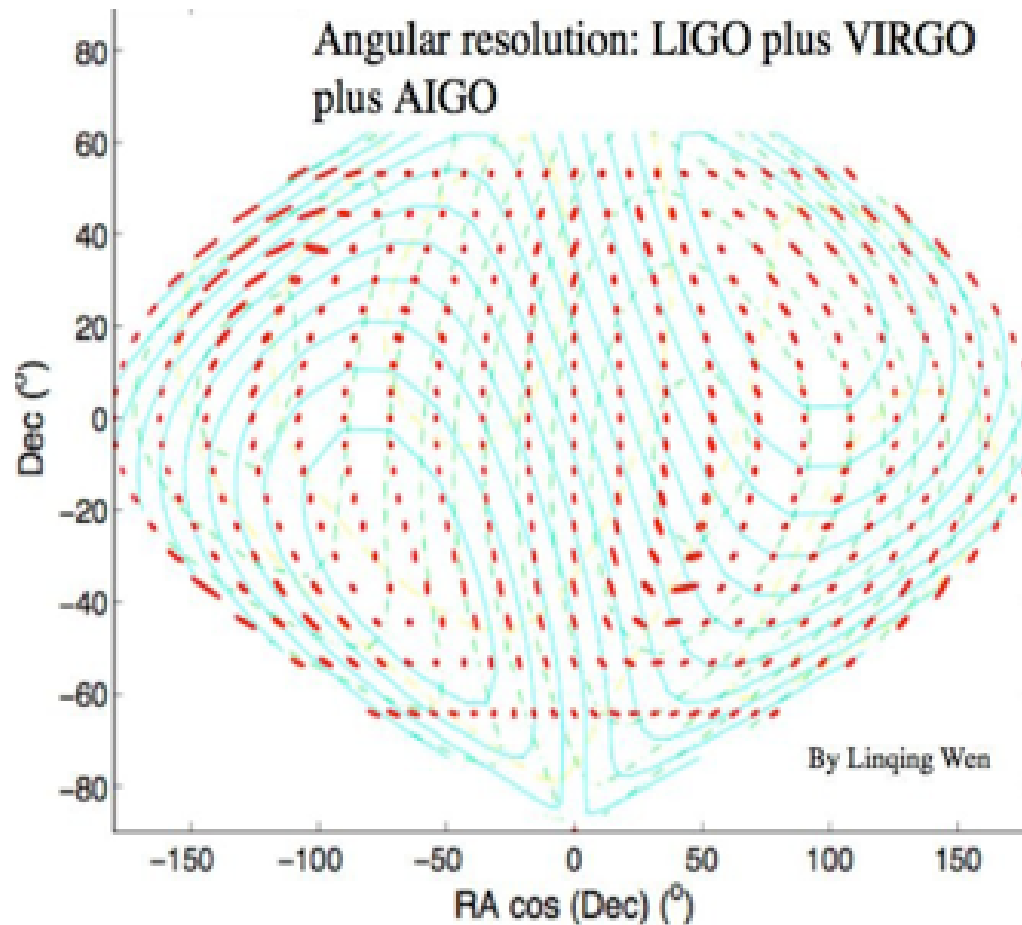
A Global Network of GW Detectors



Adding AIGO to the network makes a major improvement



LIGO and Virgo Plus AIGO



Adding AIGO to existing network gives nearly all-sky coverage



Summary

- Gravitational waves represent a major challenge for Physics, and a major opportunity for Astronomy
- Strong international effort underway to build a world-wide network capable of opening a new field
- Australia is in a unique position (literally) to contribute to this transformational science