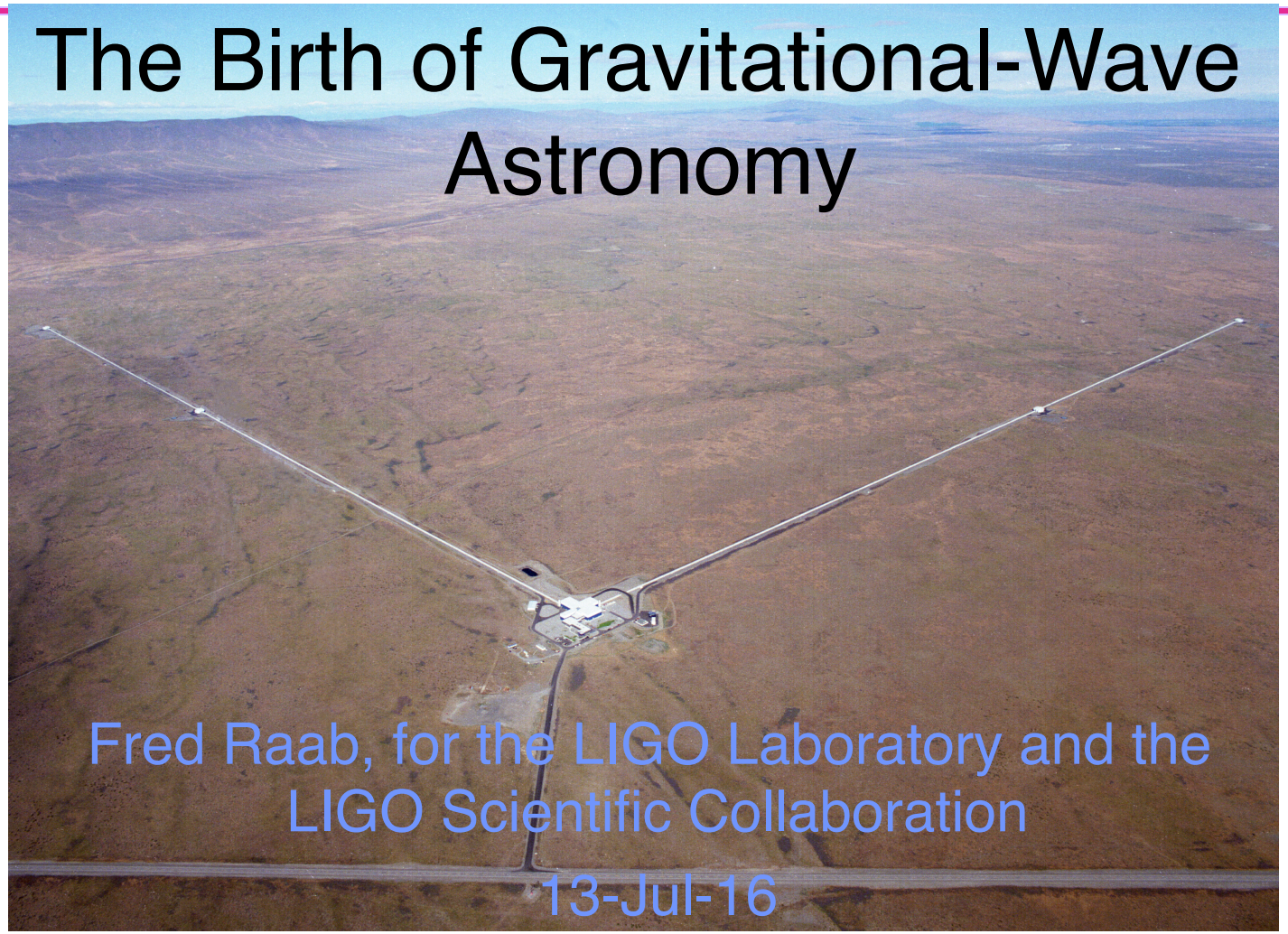


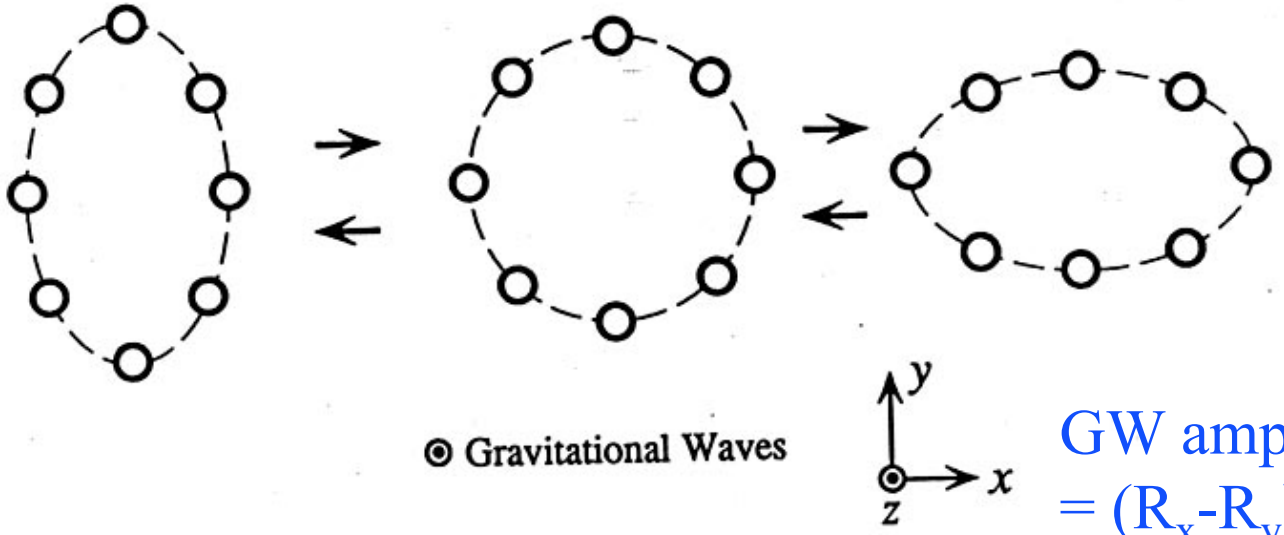
The Birth of Gravitational-Wave Astronomy

Fred Raab, for the LIGO Laboratory and the LIGO Scientific Collaboration

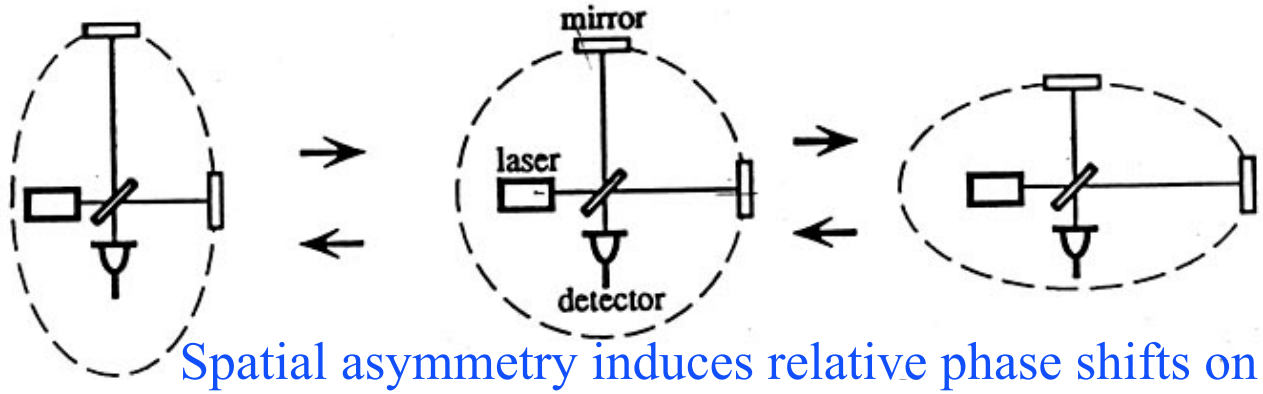
13-Jul-16

LIGO-G1601455

Basic idea is simple

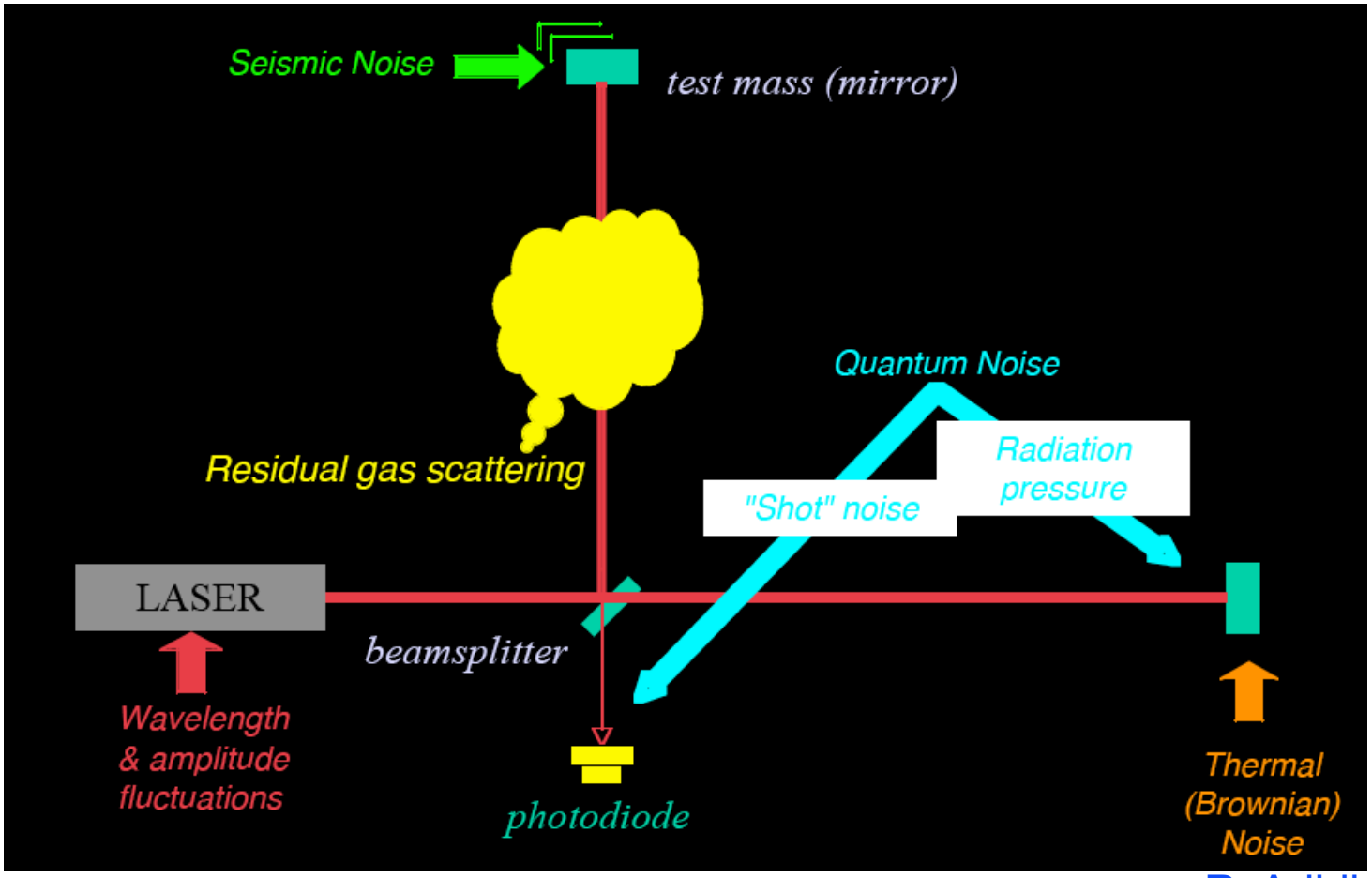


GW amplitude h
$= (R_x - R_y)/R$



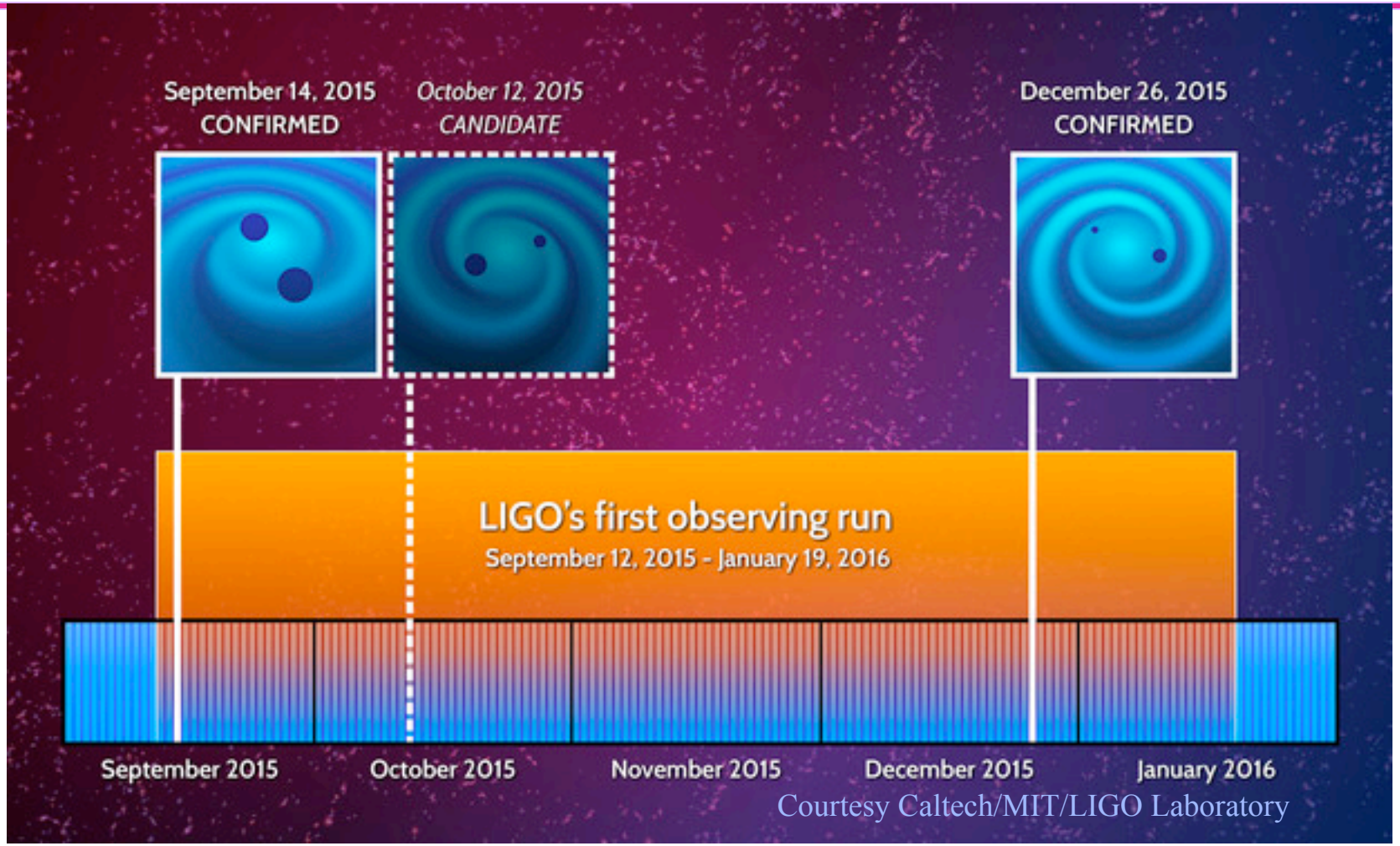
Spatial asymmetry induces relative phase shifts on light in arms

Noise cartoon

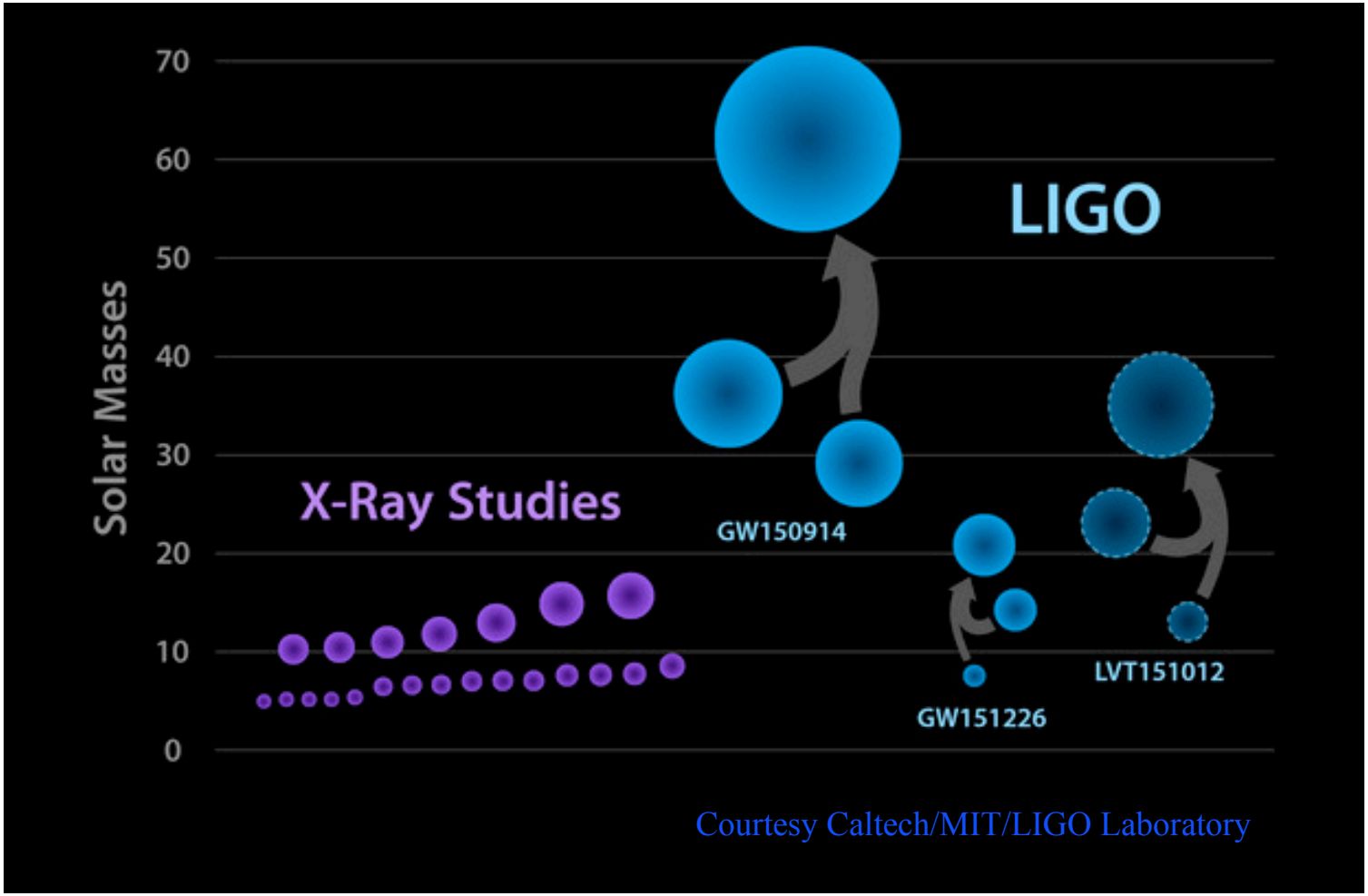


R. Adhikari

Discovery Timeline – Advanced LIGO's 1st Observations



Known Stellar-Mass Black Holes – June 2016



Sky Localization Is Poor With Only Two Detectors

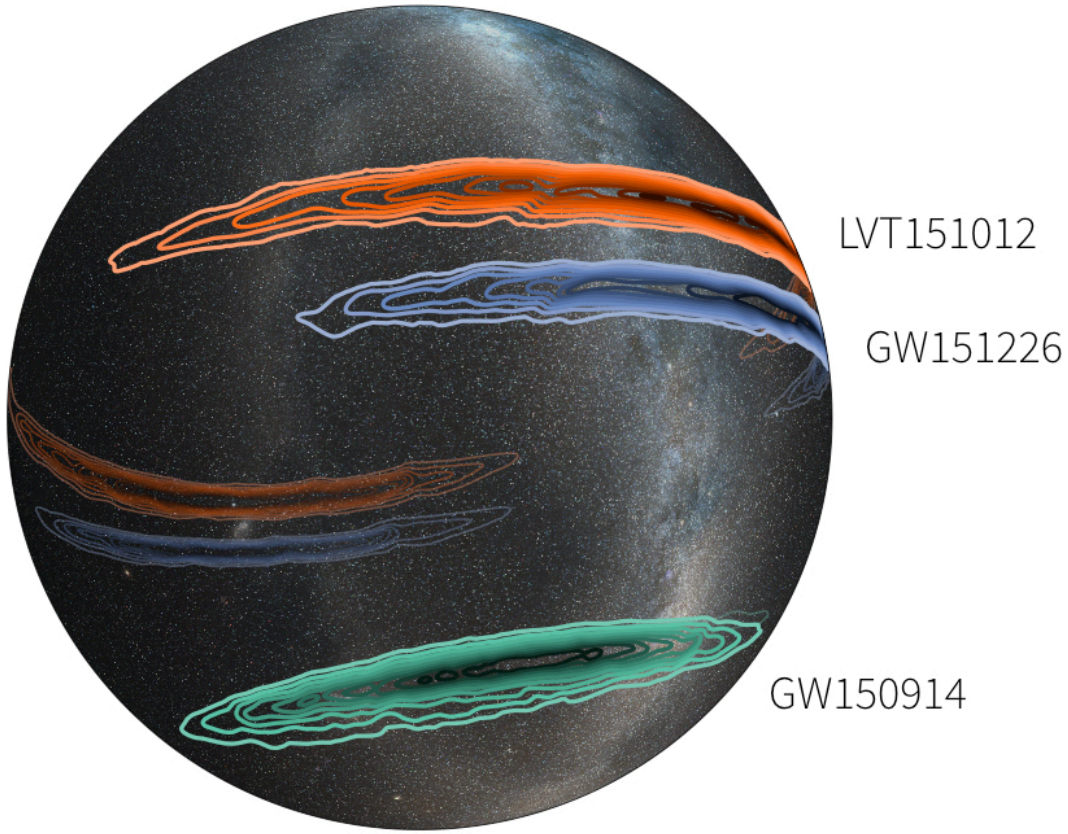
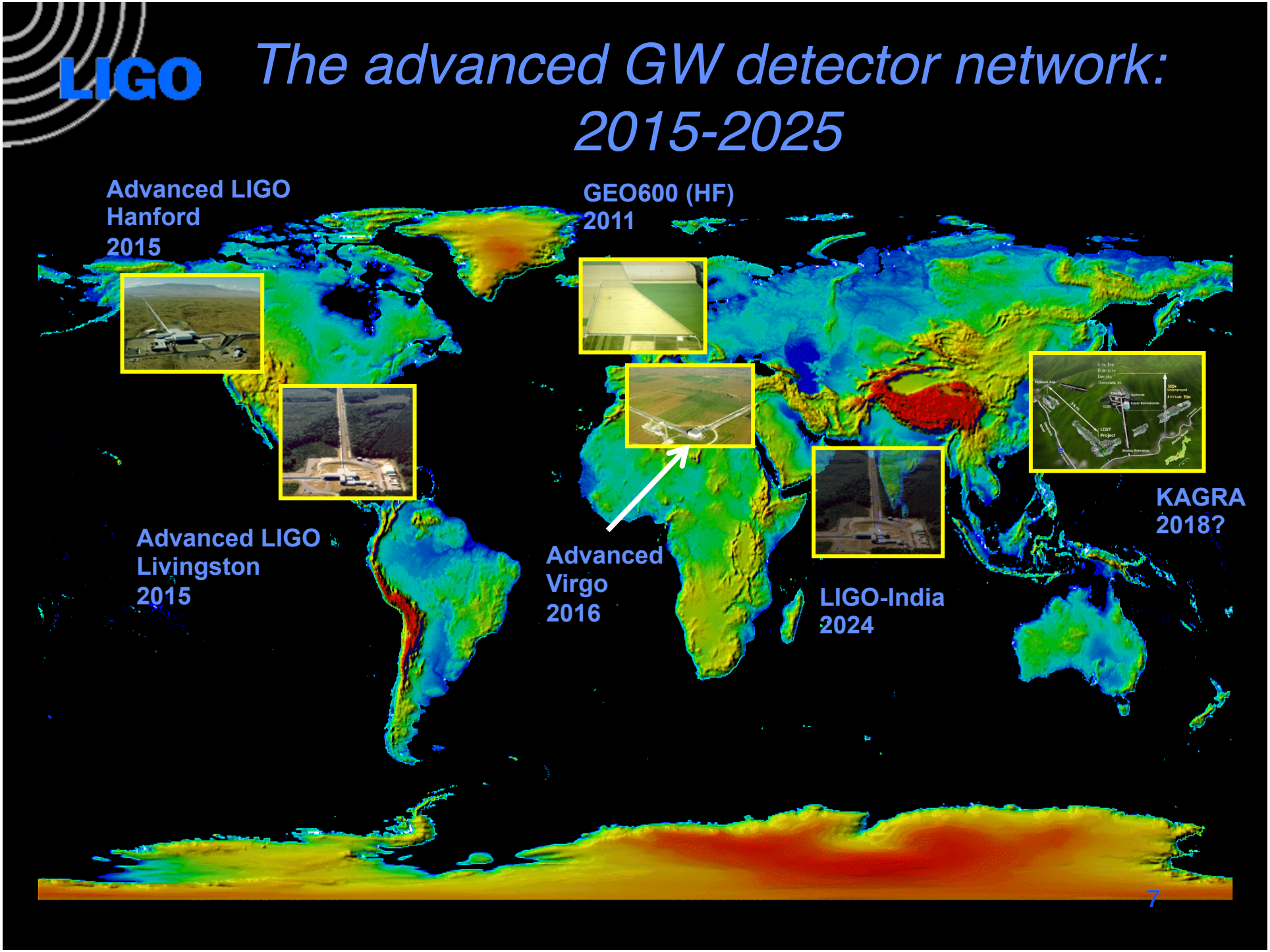
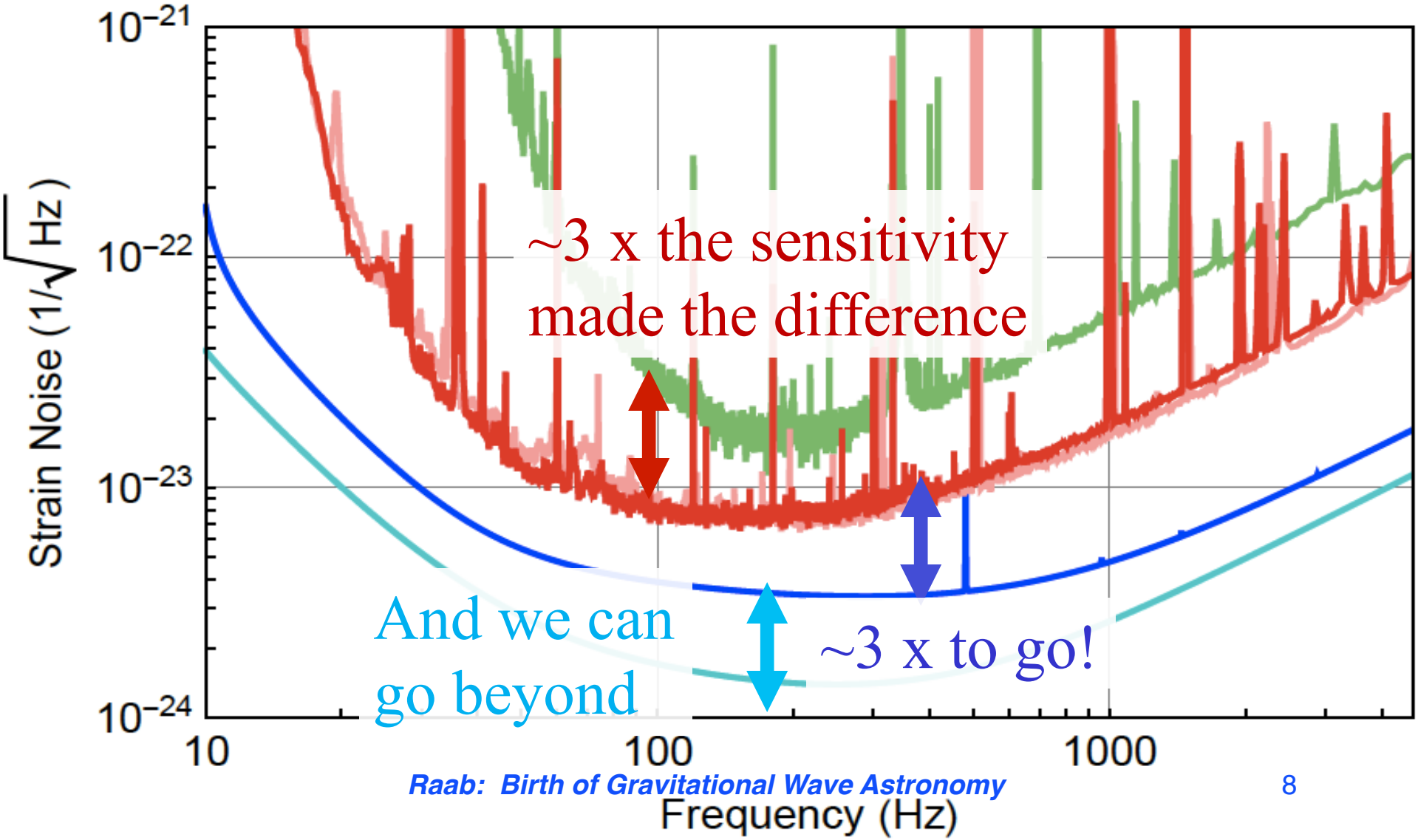


Image credit: LIGO (Leo Singer) /Milky Way image (Axel Mellinger)

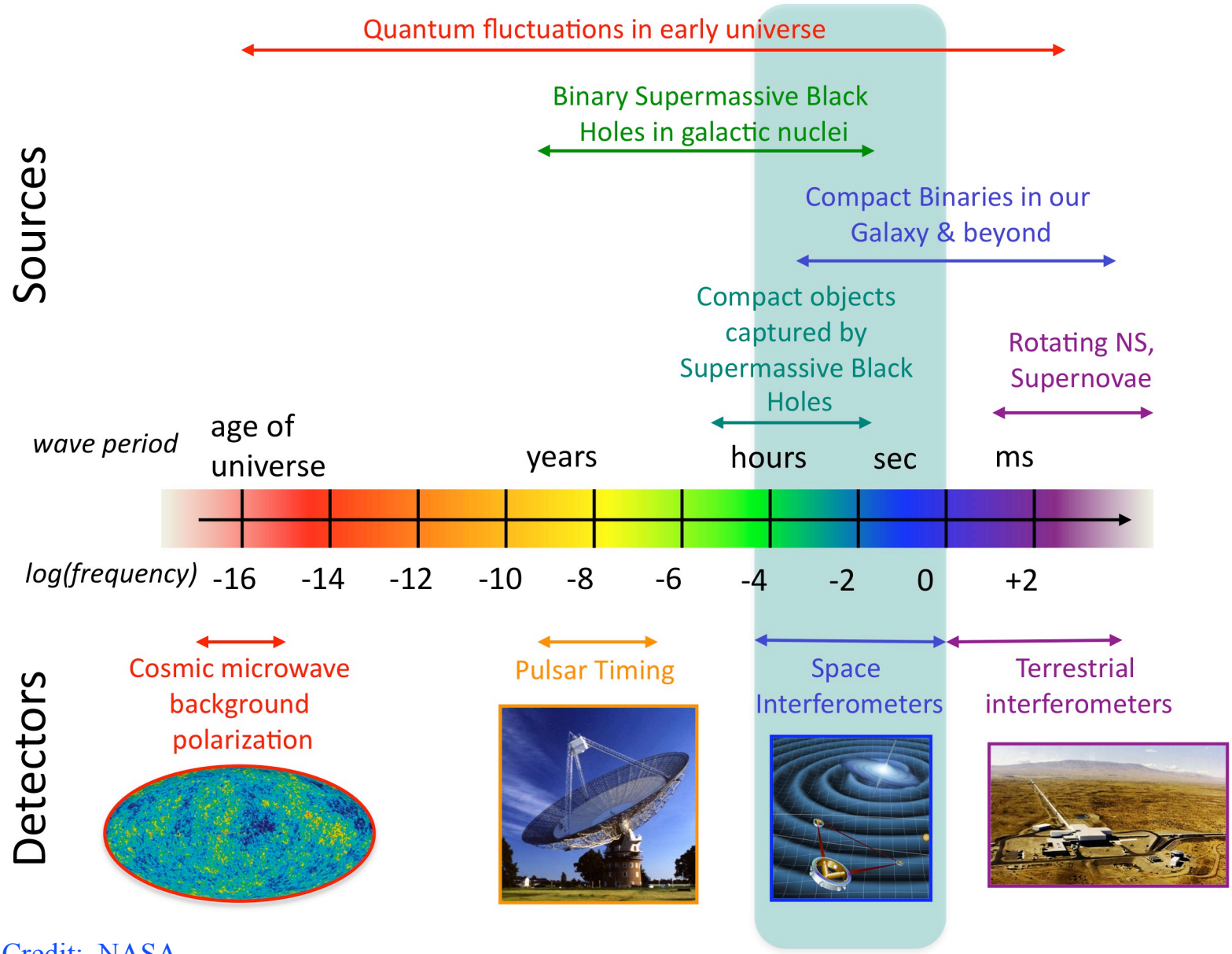
The advanced GW detector network: 2015-2025



Initial S6 / Advanced O1
Design / A+ Upgrade



The Gravitational Wave Spectrum



Credit: NASA

Summary

- 1st observing run of LIGO's 2nd-generation detectors have initiated Gravitational-Wave Astronomy.
- General Relativity provides a powerful framework from Earth-bound physics to mergers of stellar mass black holes at velocities near the speed of light.
- Black Hole Binaries exist and merge hourly somewhere in the universe
- An emerging international network of detectors soon will provide more accurate positions of sources to enable EM follow-ups of GW events.
- There is still room within the laws of physics to develop more powerful generations of detectors and much physics still to be harvested from their observations.