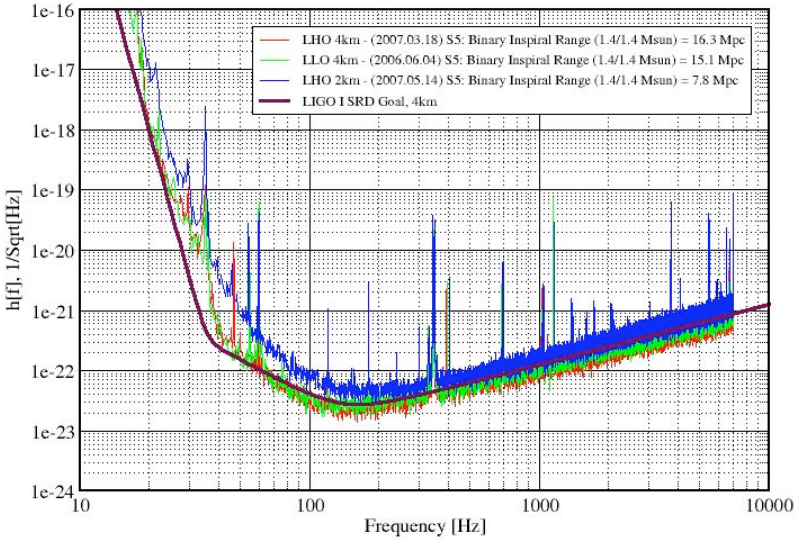
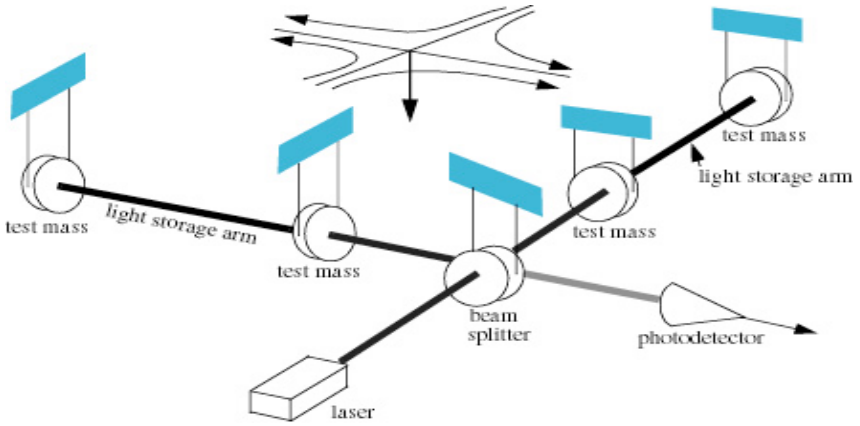
Status of LIGO

- International Network
- LIGO and sister detectors
- The LIGO Roadmap
- LIGO Scientific Collaboration and Virgo Collaboration
- Searches

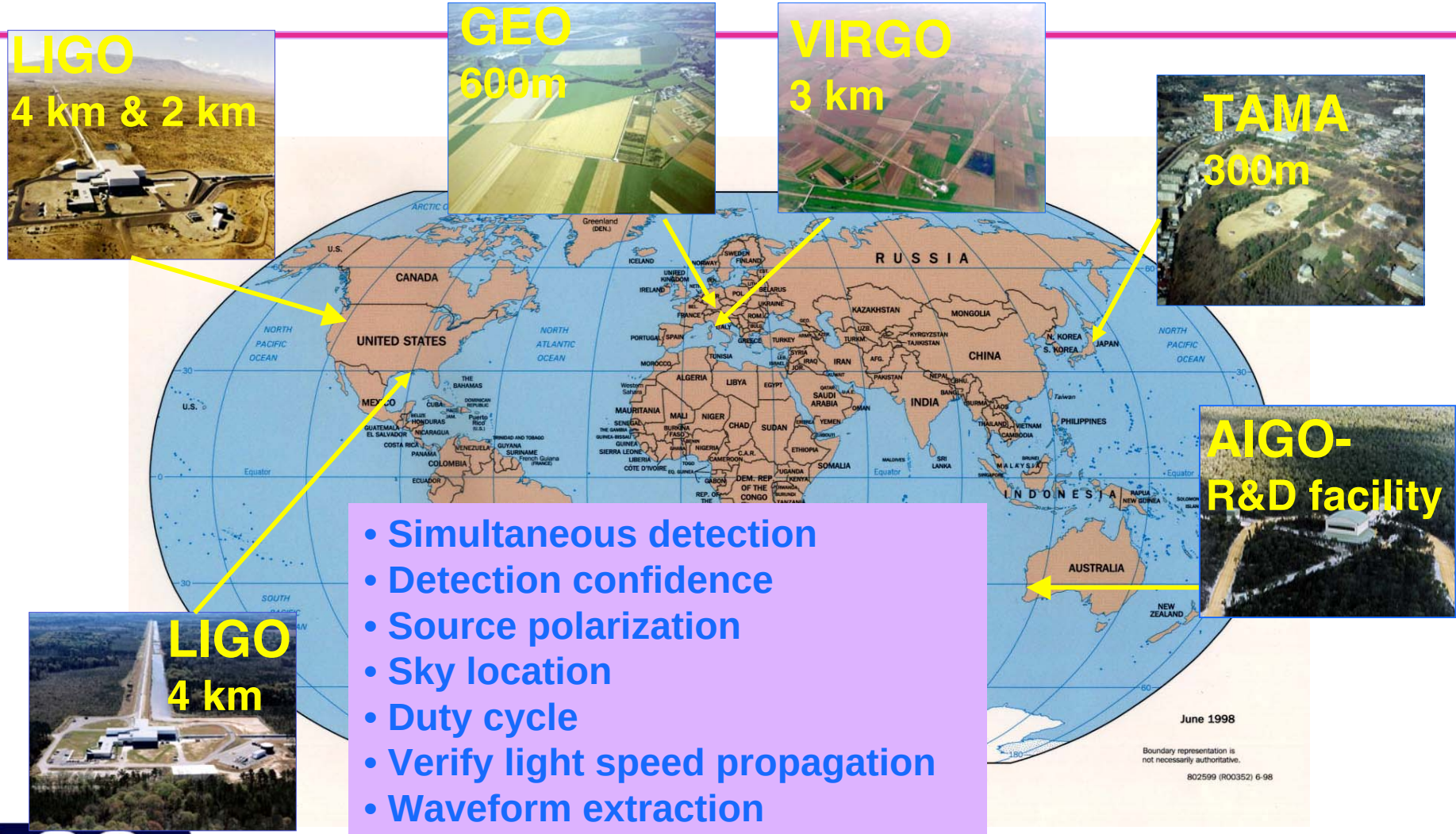




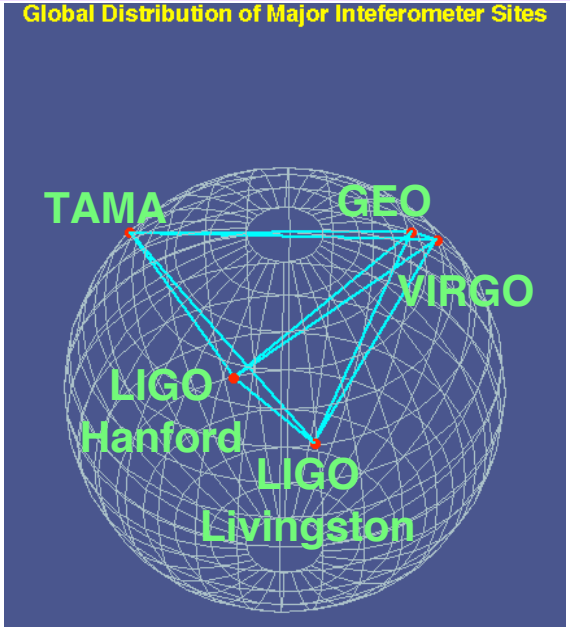
No discovery to report here!

Alan Weinstein, Caltech and LIGO Lab

Global network of interferometers

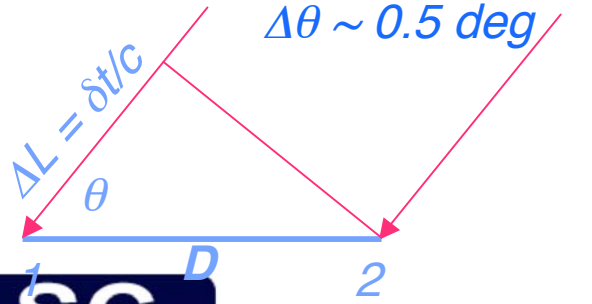


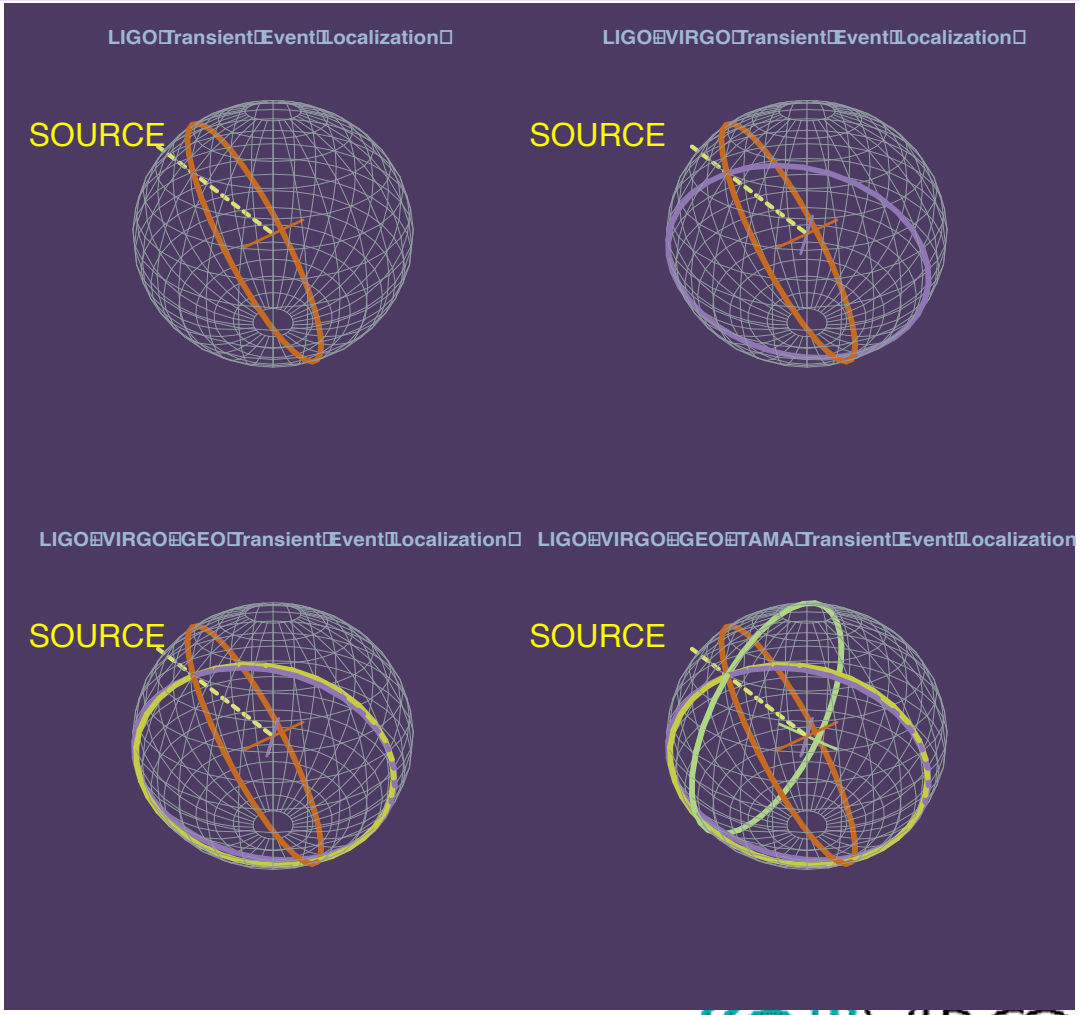
Event Localization With An Array of GW Interferometers



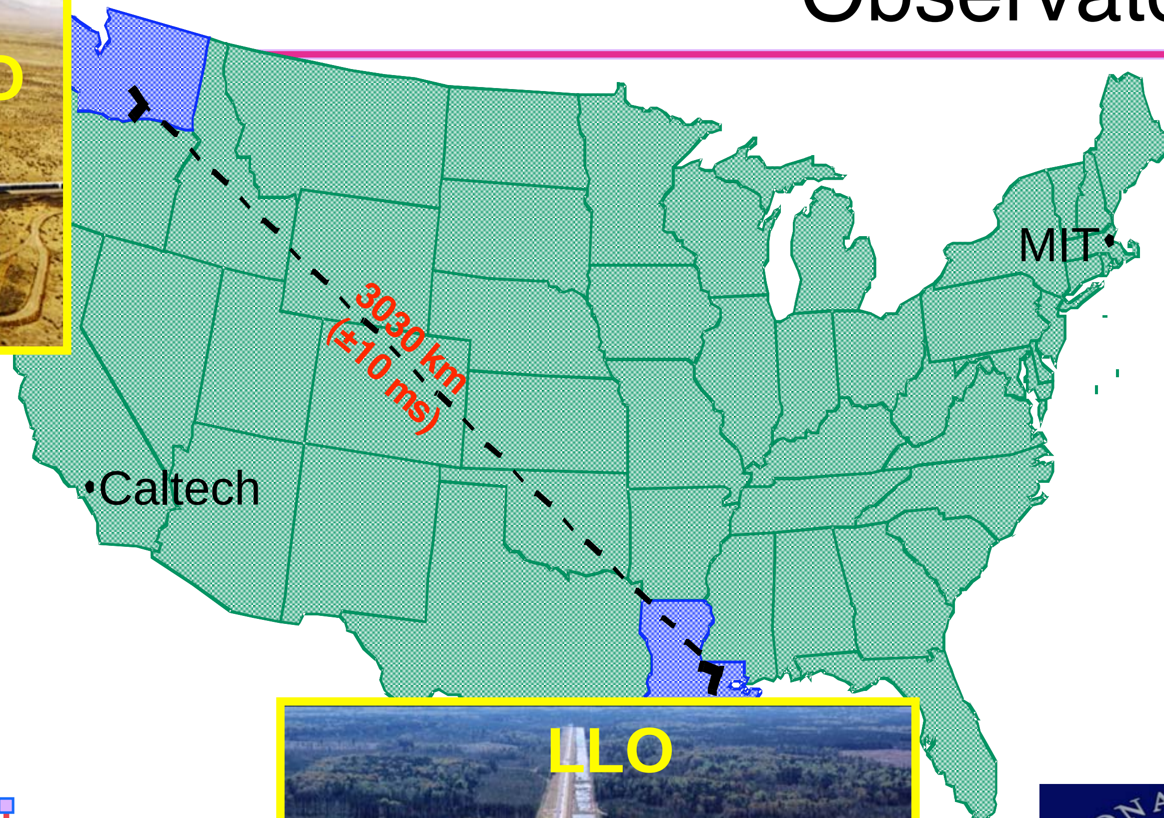
$\cos\theta = \delta t / (c\, D_{12})$

$\Delta\theta \sim 0.5$ deg

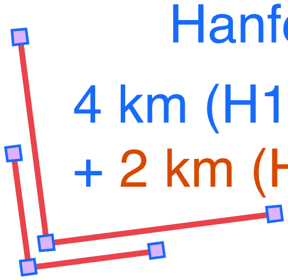




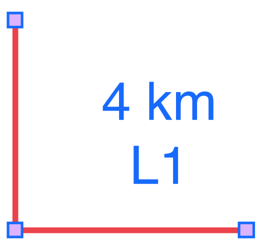
LIGO: Laser Interferometer Gravitational-wave Observatory



Hanford, WA



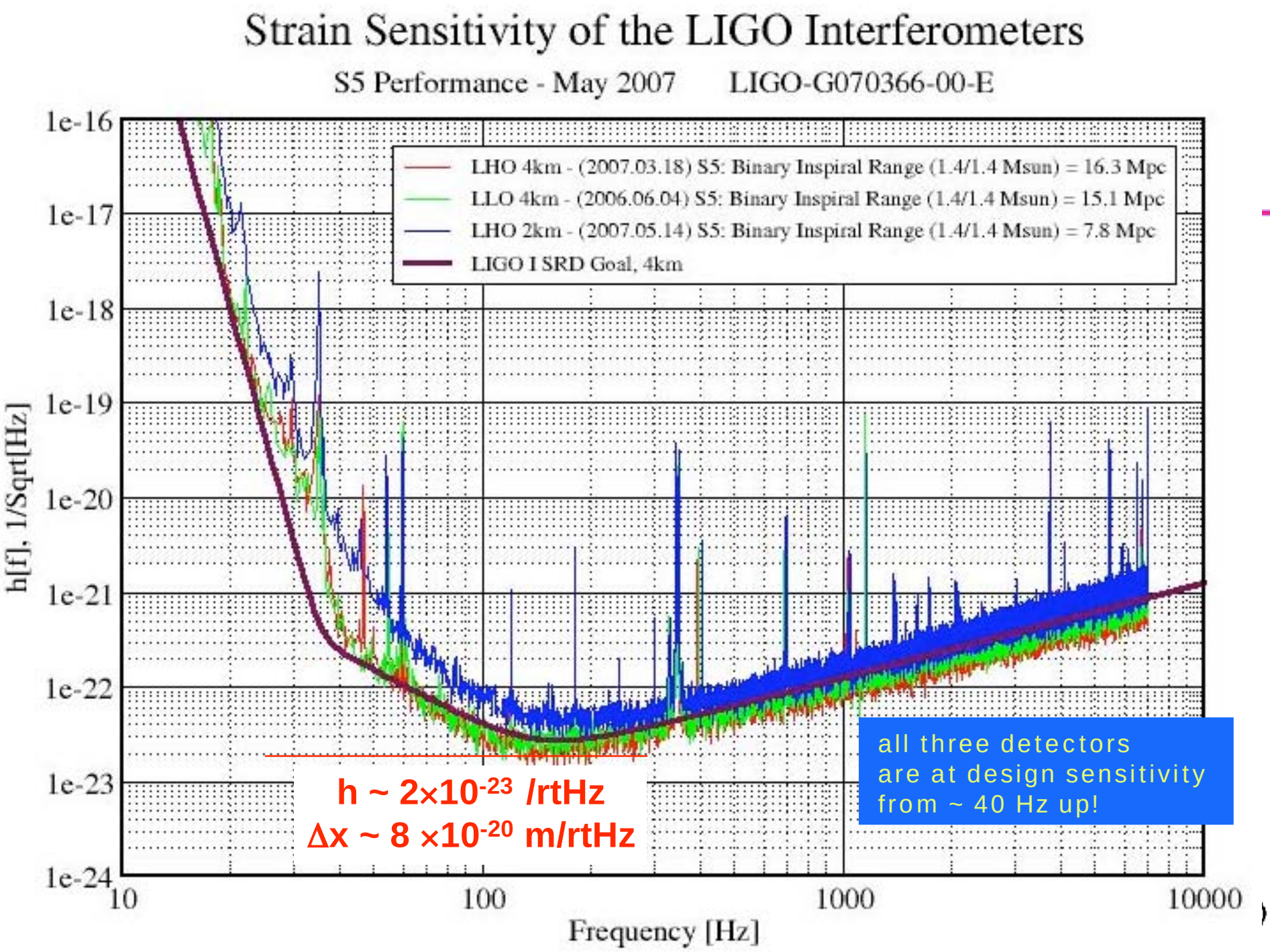
4 km (H1)
+ 2 km (H2)



4 km
L1

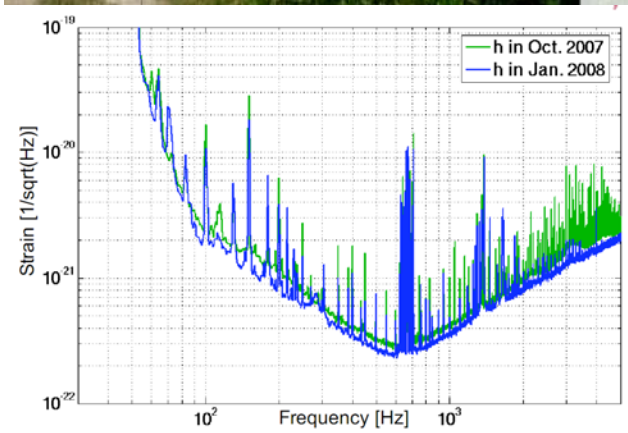
Livingston, LA

A. Weins


Strain Sensitivity of the LIGO Interferometers
S5 Performance - May 2007
LIGO-G070366-00-E
LHO 4km - (2007.03.18) S5: Binary Inspiral Range (1.4/1.4 Msun) = 16.3 Mpc
LLO 4km - (2006.06.04) S5: Binary Inspiral Range (1.4/1.4 Msun) = 15.1 Mpc
LHO 2km - (2007.05.14) S5: Binary Inspiral Range (1.4/1.4 Msun) = 7.8 Mpc
LIGO I SRD Goal, 4km
h[f], 1/Sqrt[Hz]
1e-16
1e-17
1e-18
1e-19
1e-20
1e-21
1e-22
1e-23
1e-24
10
100
1000
10000
Frequency [Hz]
h ~ 2×10-23 /rtHz
Δx ~ 8 ×10-20 m/rtHz
all three detectors
are at design sensitivity
from ~ 40 Hz up!

LIGO Scientific Collaboration

GEO 600



Leibniz Universität Hannover

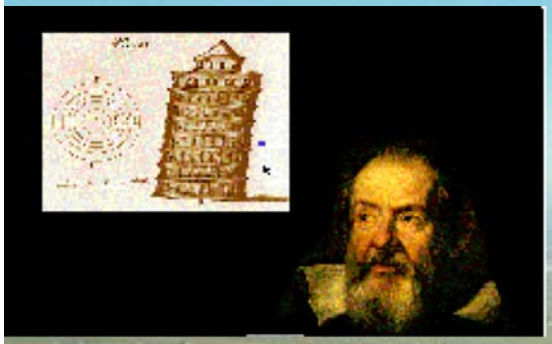
CARDIFF UNIVERSITY

LSC

Universitat de les Illes Balears

VIRGO

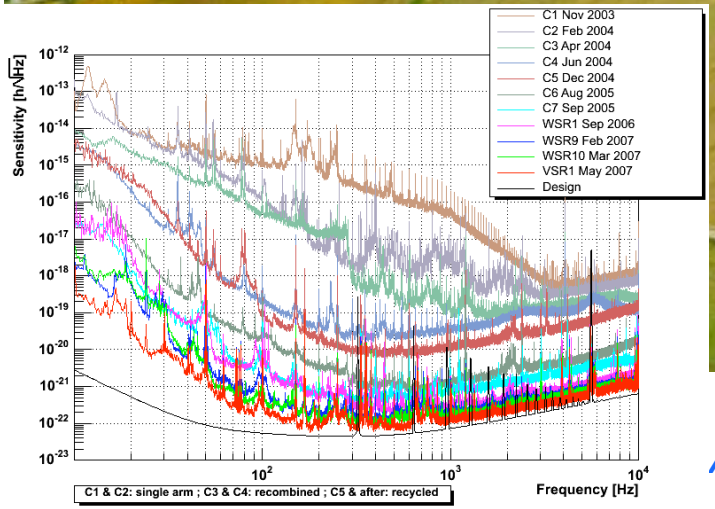
EGO



- LAPP - Annecy
- INFN - Firenze/Urbino
- INFN - Frascati
- IPN - Lyon
- INFN - Napoli
- OCA - Nice
- ESPCI - Paris
- LAL - Orsay
- INFN - Perugia
- INFN - Pisa
- INFN – Roma

NIKHEF – Amsterdam (joining)

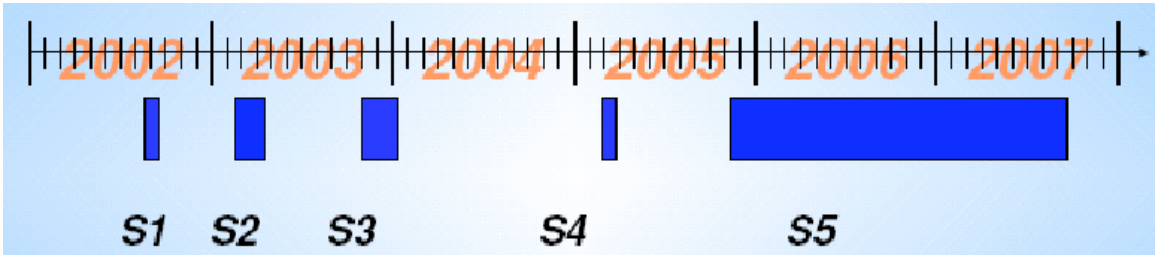
Inaugurated July 2003

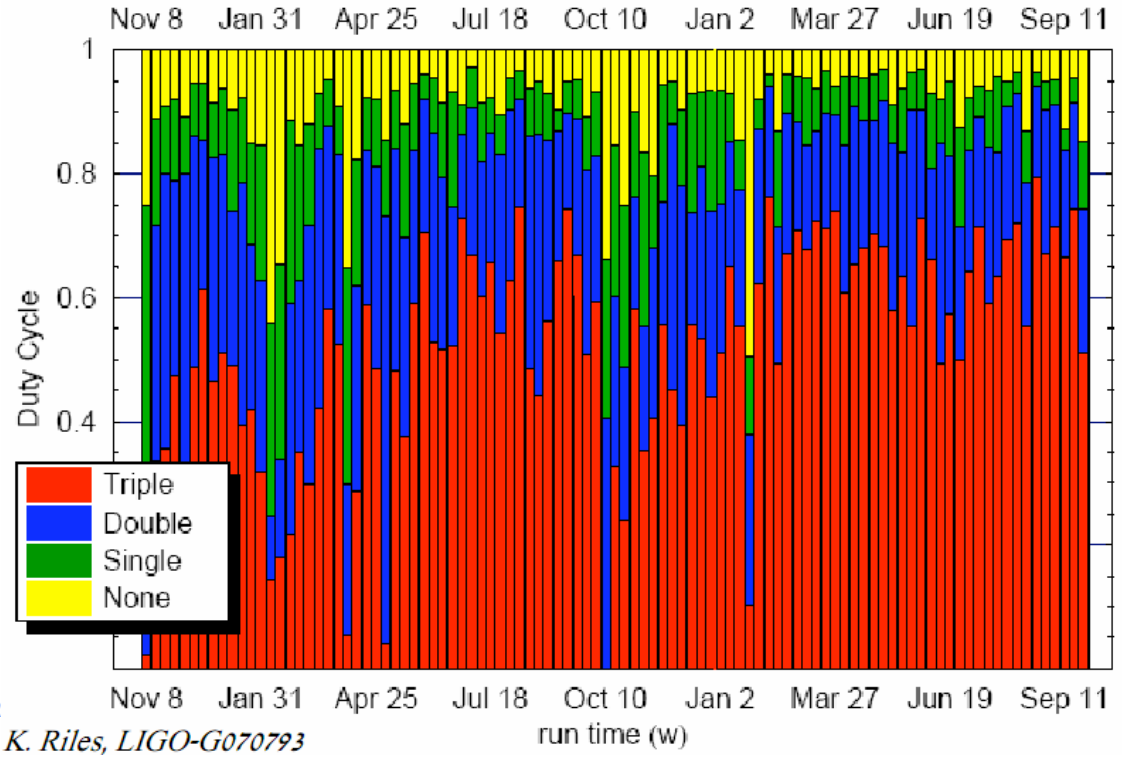


VIRGO

LIGO S5 Run

- Nov 2005 – Oct 2007, 23 months
- One year of triple coincident data from H1, H2, L1
- Virgo joined in June 2007 for 7 months

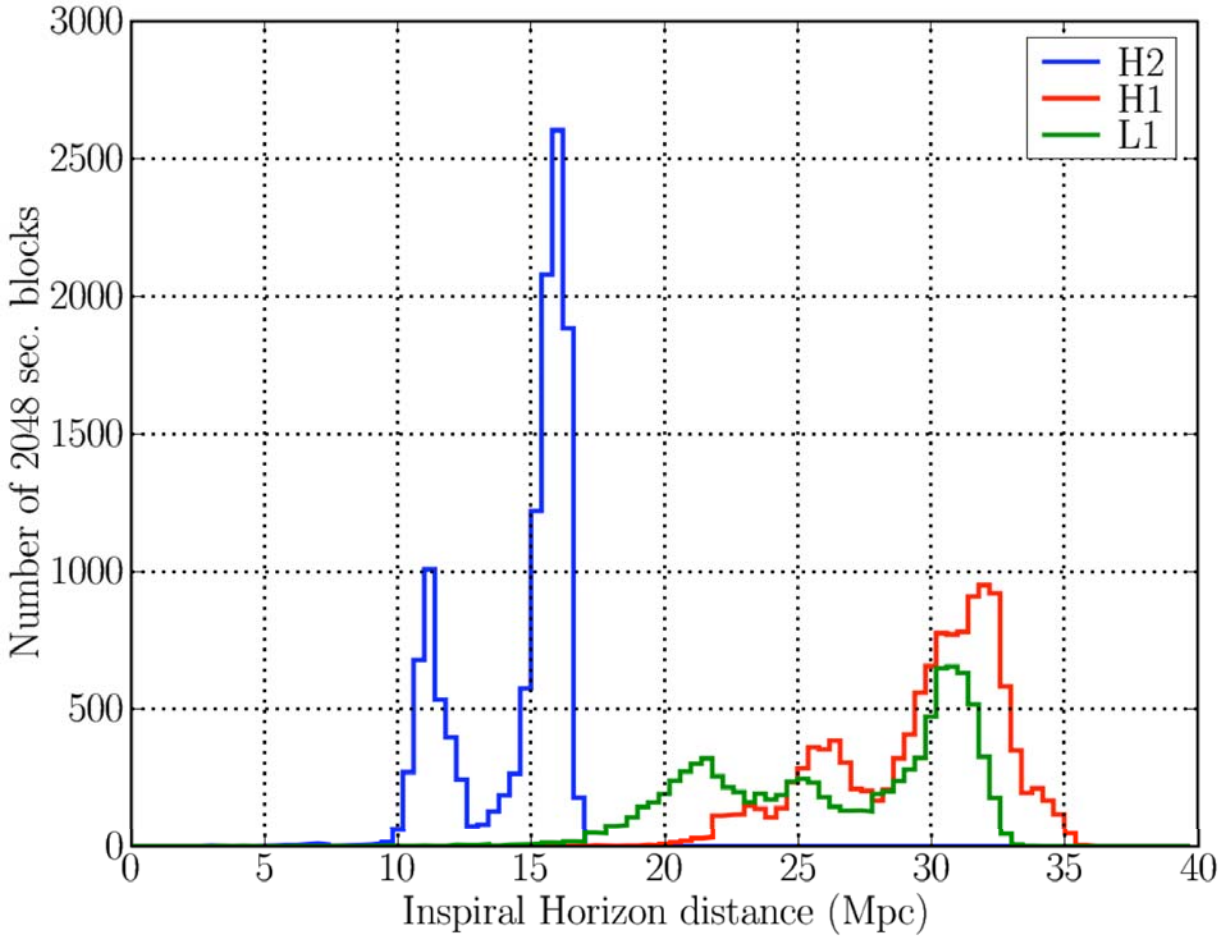




K. Riles, LIGO-G070793

Inspiral Horizon Distance

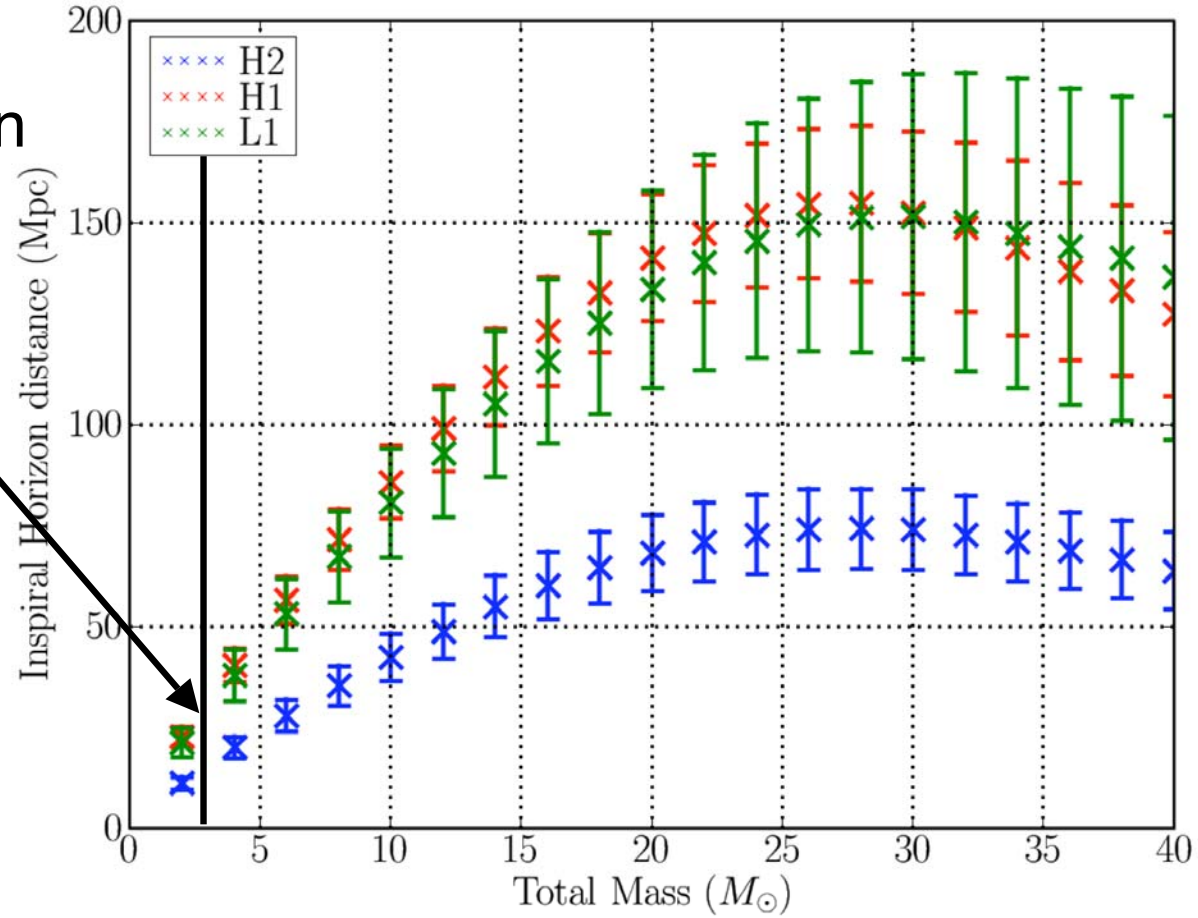
Distance to optimally oriented 1.4,1.4 solar mass BNS at SNR = 8



First Year
S5 Science Run
Nov 4, 2005 -
Nov 14, 2006

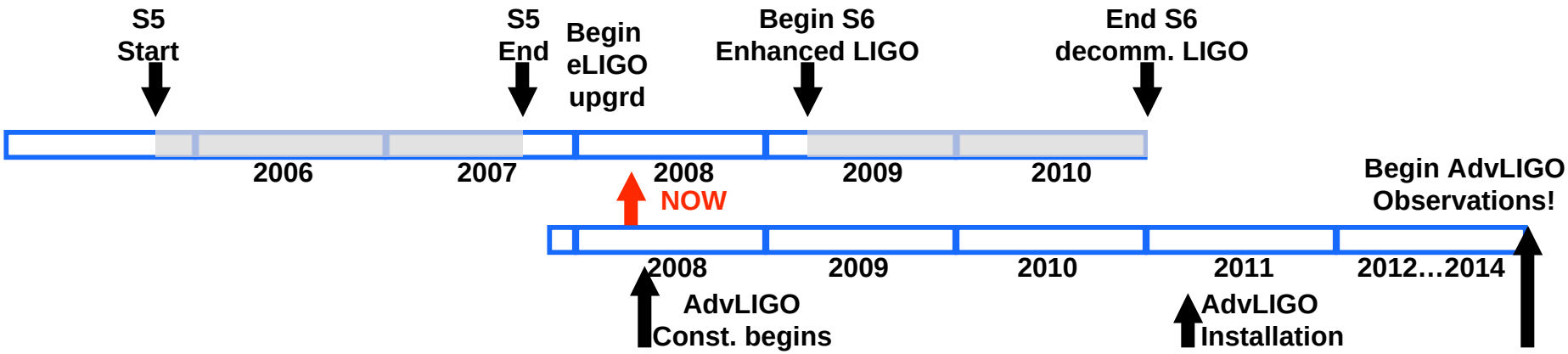
Horizon Distance vs. Total Mass

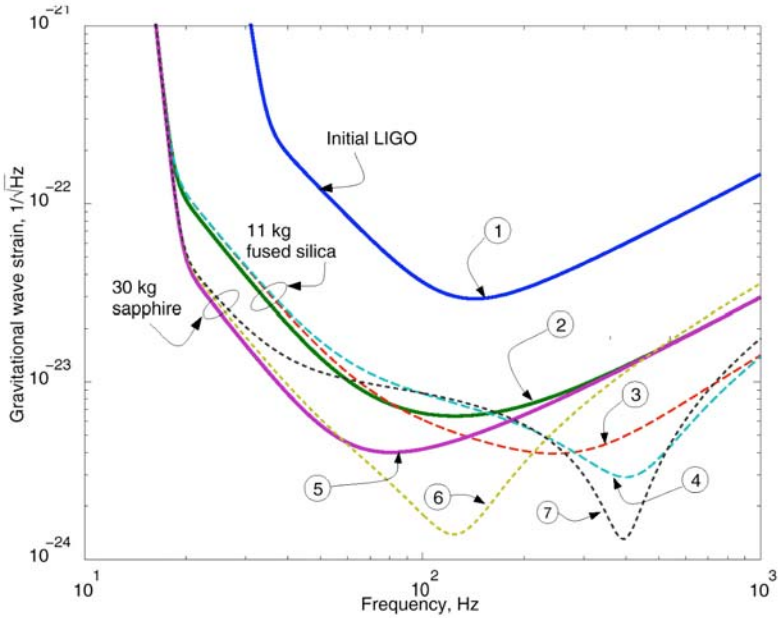
Binary Neutron Stars



S5 → Enhanced LIGO → S6 → Advanced LIGO → S7+

Astrowatch

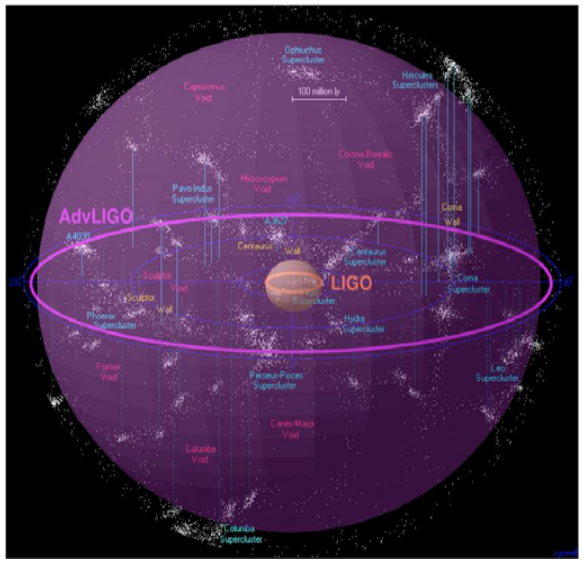




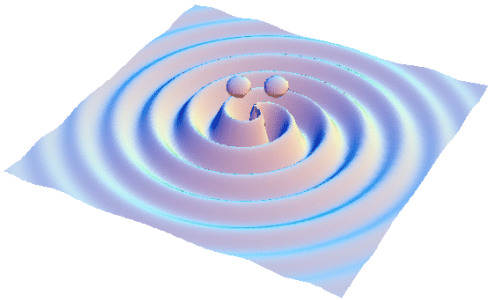
Improve amplitude sensitivity by a factor of 10x, and…

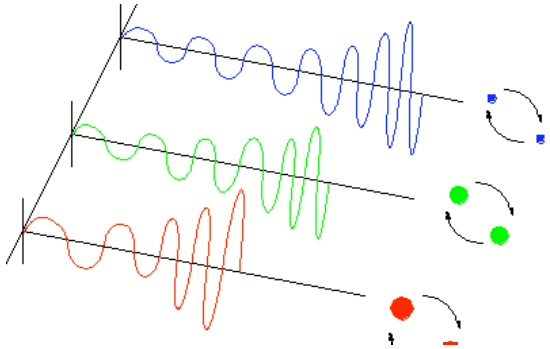
⇒ Number of sources goes up 1000x!

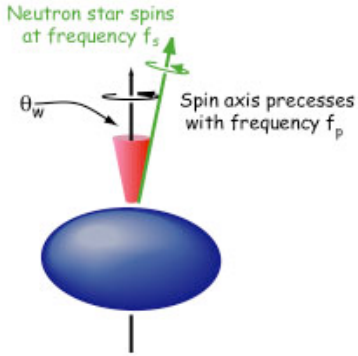
…stein, PCGM, Mar 21, 2008



What will we see?

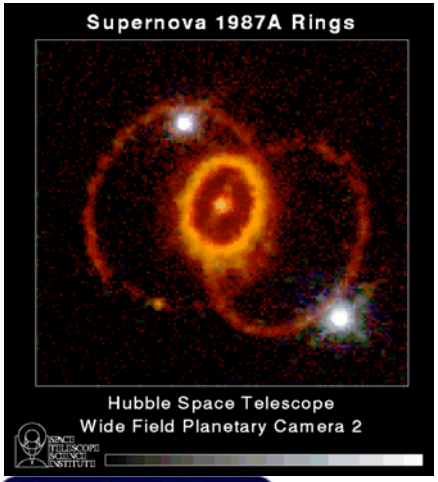


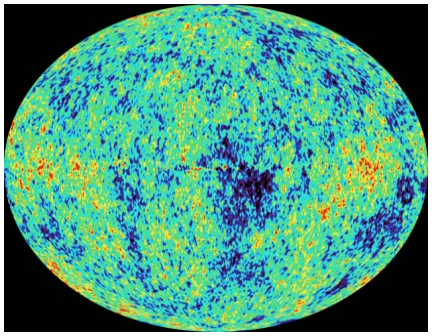




GWs from the most energetic processes in the universe!

- black holes orbiting each other and then merging together
- Supernovas, GRB engines
- rapidly spinning neutron stars
- Vibrations from the Big Bang





Analog from cosmic microwave background -- WMAP 2003

A NEW WINDOW ON THE UNIVERSE WILL OPEN UP FOR EXPLORATION.

Coming up

- S5 searches for CBCs with total masses up to 100 Msun.
- All-sky burst searches.
- GRB- and SGR-triggered CBC and burst searches.
- NR → hybrid → phenomenological IMR waveforms.
- Searches for CWs from Crab, ~200 isolated and binary pulsars, and all-sky searches.
- Stochastic searches:
  all-sky, radiometer, multipoles $\ell \leq 30$
- S6 (2009-10) and AdvLIGO (2014+)!