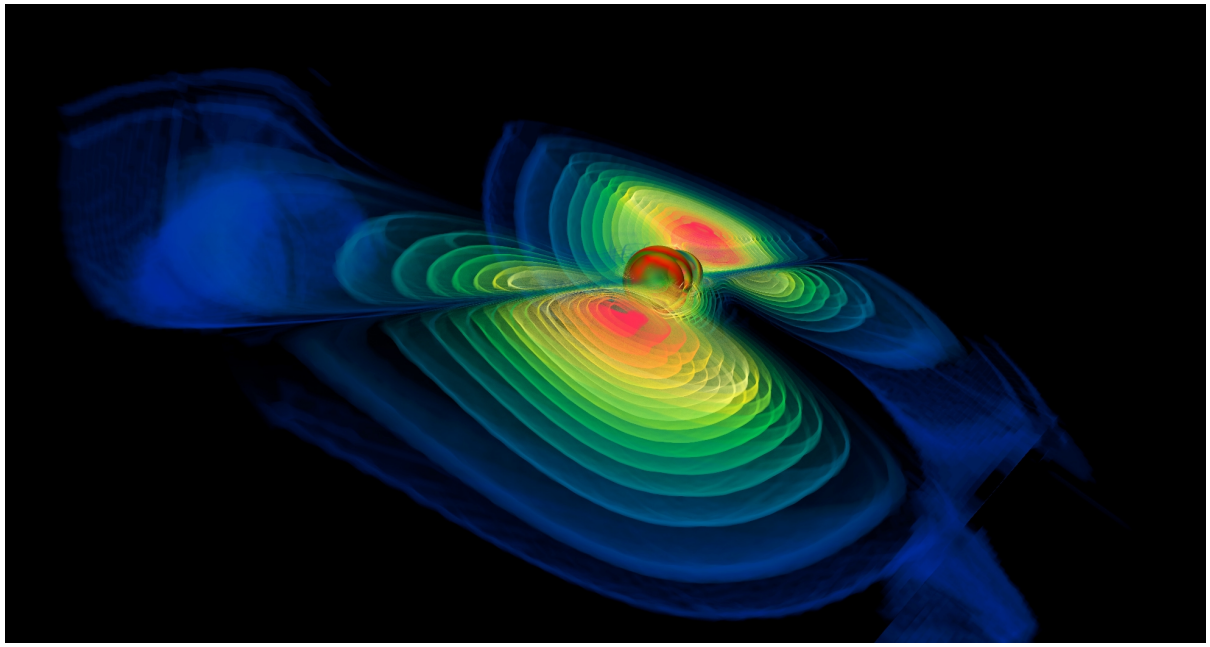
LIGO

Press Conference

Scientific Operation of LIGO



"Colliding Black Holes"

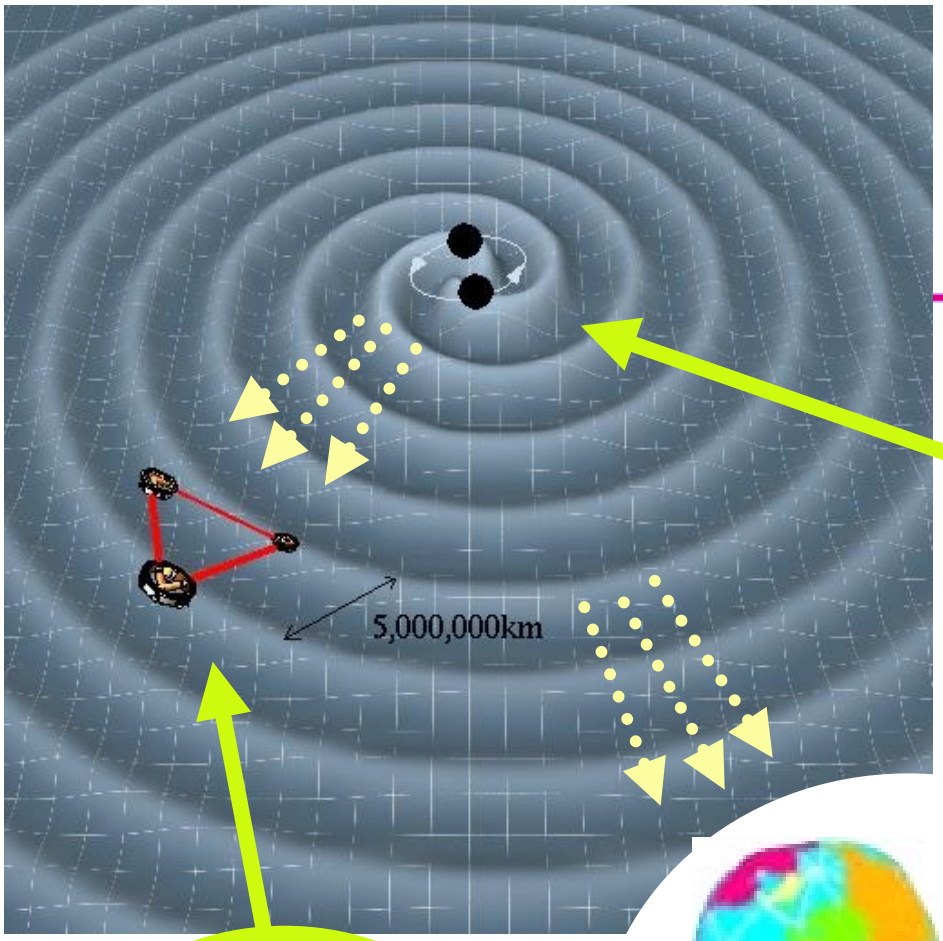
Credit:
National Center for Supercomputing Applications (NCSA)

Gary H Sanders
Caltech
(on behalf of a large team)

APS April Meeting
Philadelphia
6-April-03

LIGO-G030181-03-M

Direct Detection



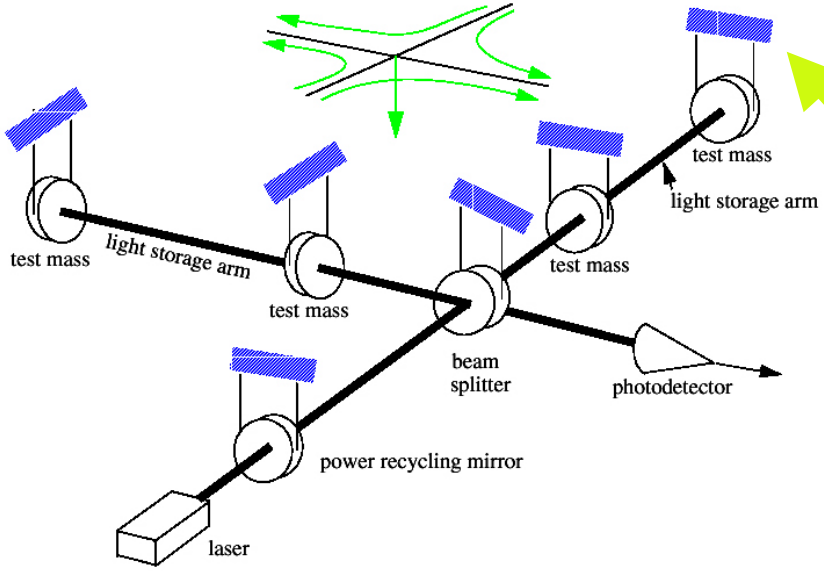
Gravitational Wave
Astrophysical Source

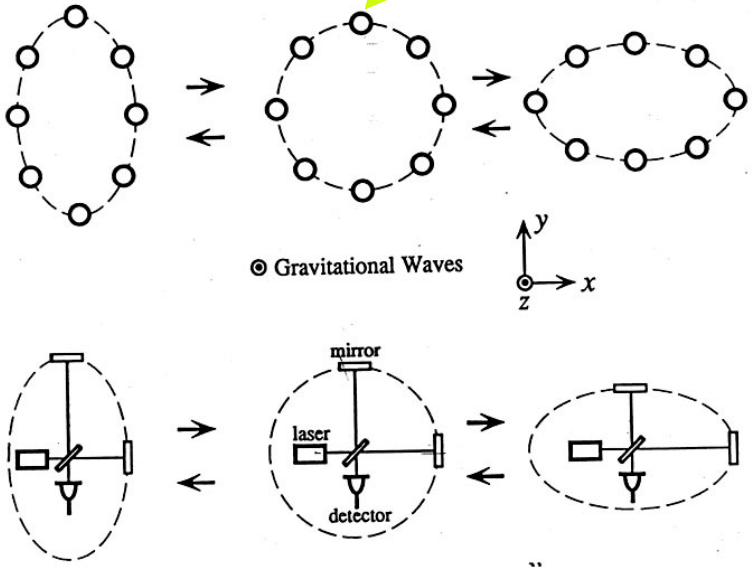
Terrestrial detectors
LIGO, GEO, TAMA, Virgo

Detectors
in space
LISA

Terrestrial Interferometers

International network (LIGO, Virgo, GEO, TAMA) of suspended mass Michelson-type interferometers on earth's surface detect distant astrophysical sources



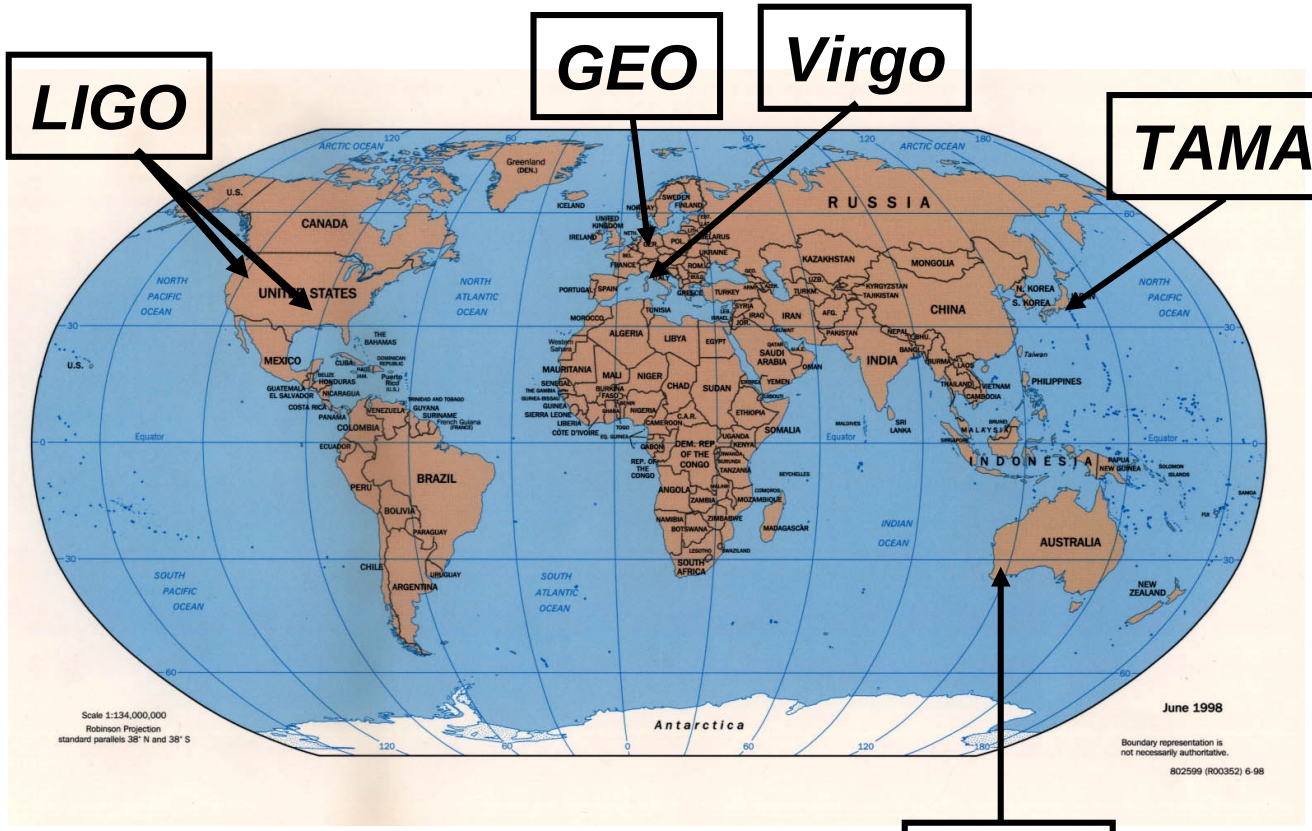


free masses

suspended test masses

An International Network of Interferometers

Simultaneously detect signal (within msec)



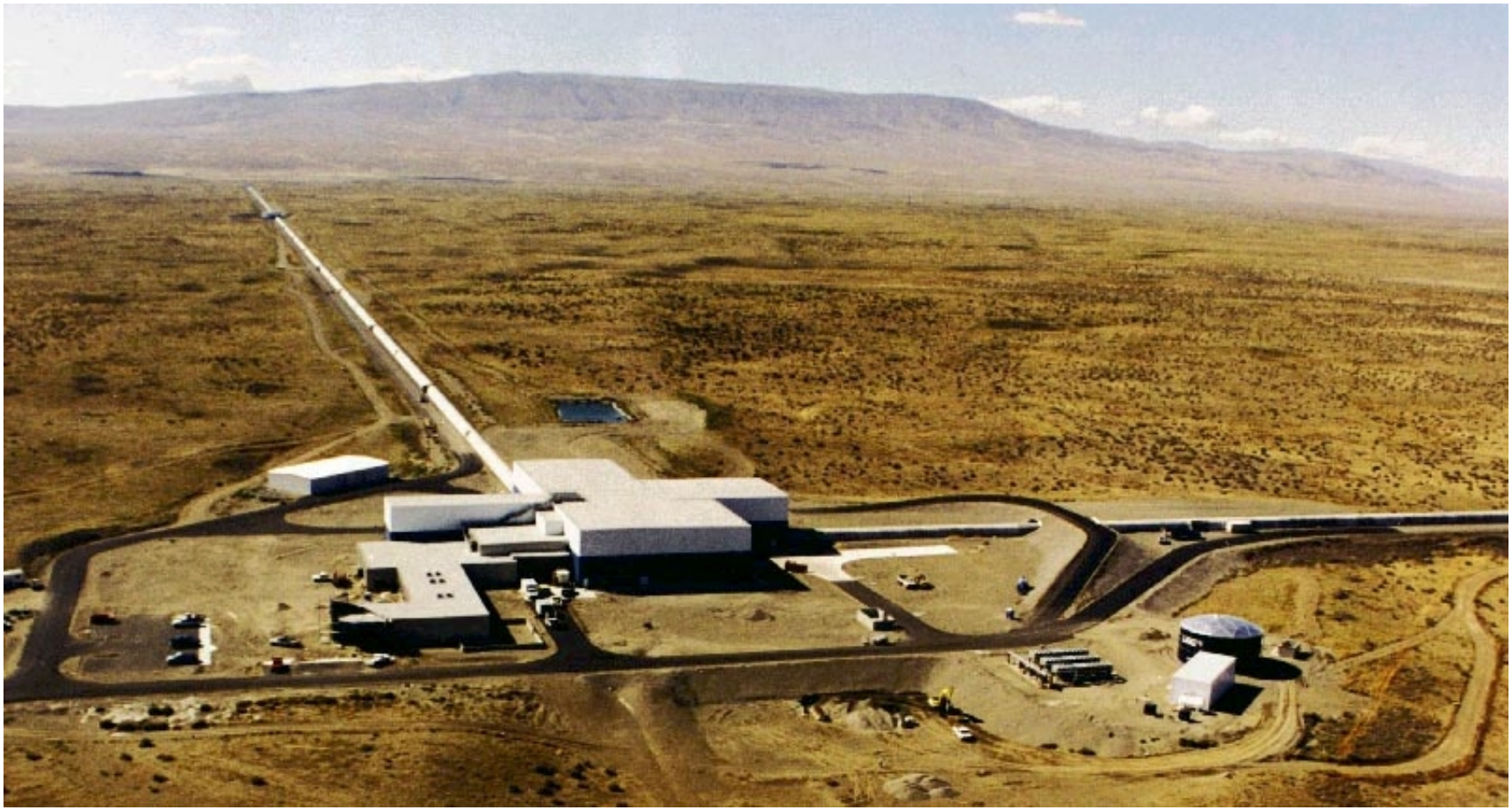
detection confidence

locate the sources

decompose the polarization of gravitational waves

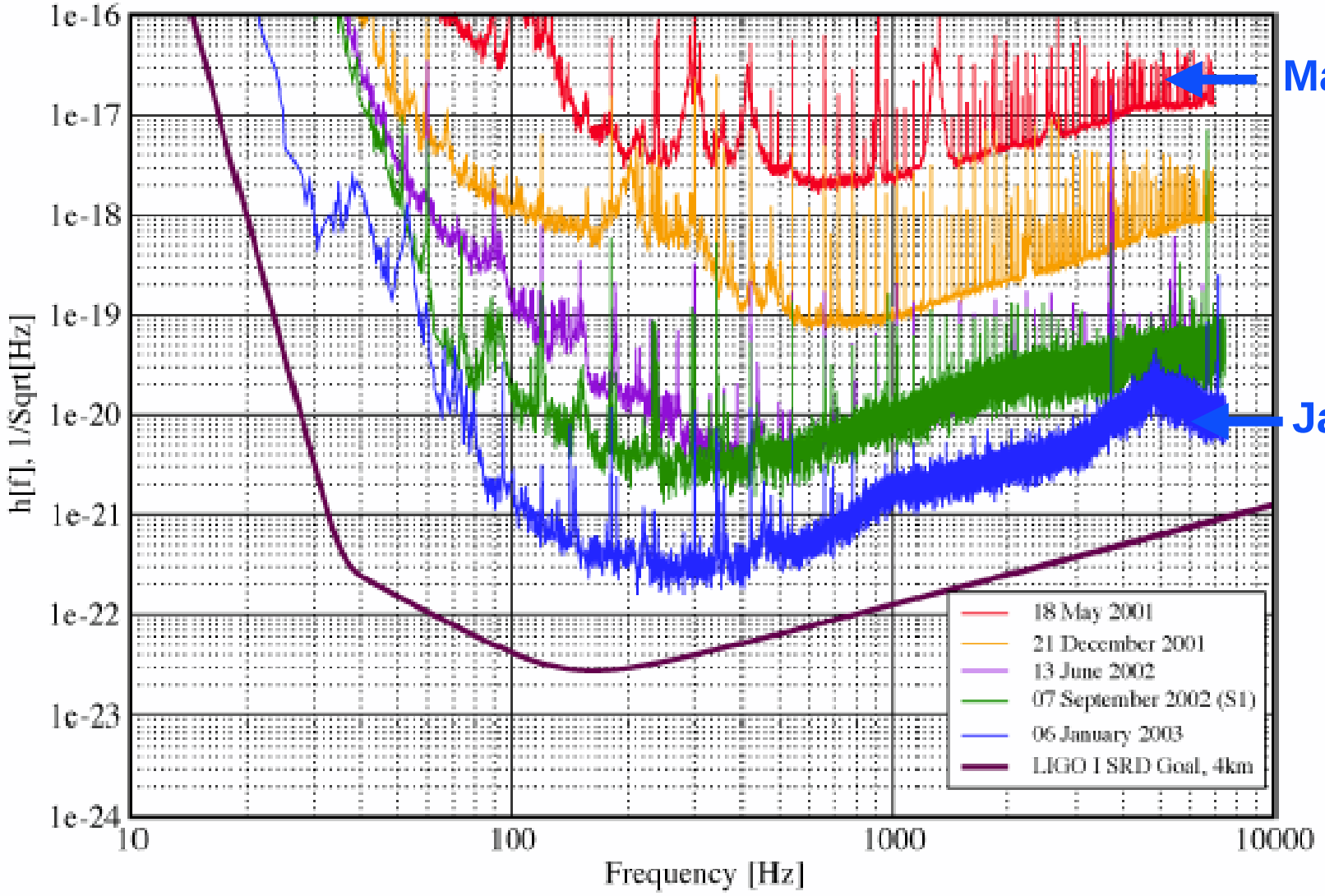
LIGO Livingston Observatory

LIGO Hanford Observatory



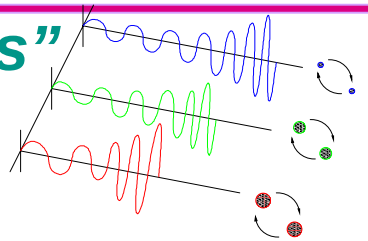
GEO 600

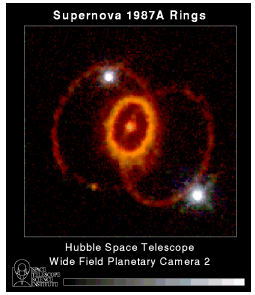
LIGO Sensitivity
Livingston 4km Interferometer

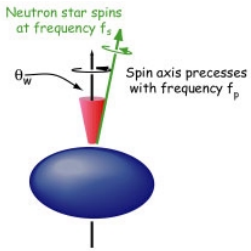


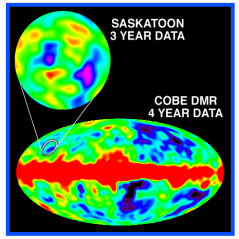
Astrophysical Sources of Gravitational Waves

- Compact binary inspiral: ***"chirps"***
  - » NS-NS waveforms are well described
  - » BH-BH need better waveforms
  - » search technique: matched templates
- Supernovae / GRBs: ***"bursts"***
  - » burst signals in coincidence with signals in electromagnetic radiation
  - » Challenge to search for untriggered bursts
- Pulsars in our galaxy: ***"periodic signals"***
  - » search for observed neutron stars (frequency, doppler shift)
  - » all sky search (computing challenge)
  - » r-modes
- Cosmological Signals ***"stochastic background"***

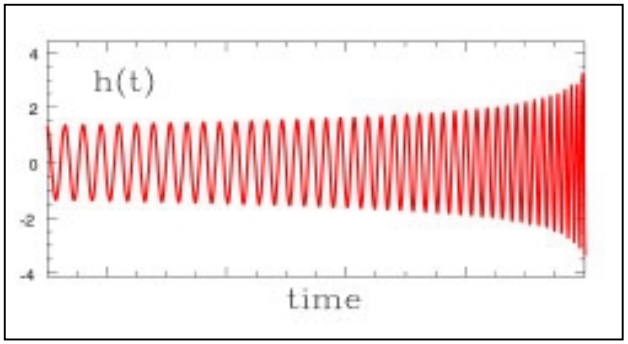








Inspiral Upper Limit

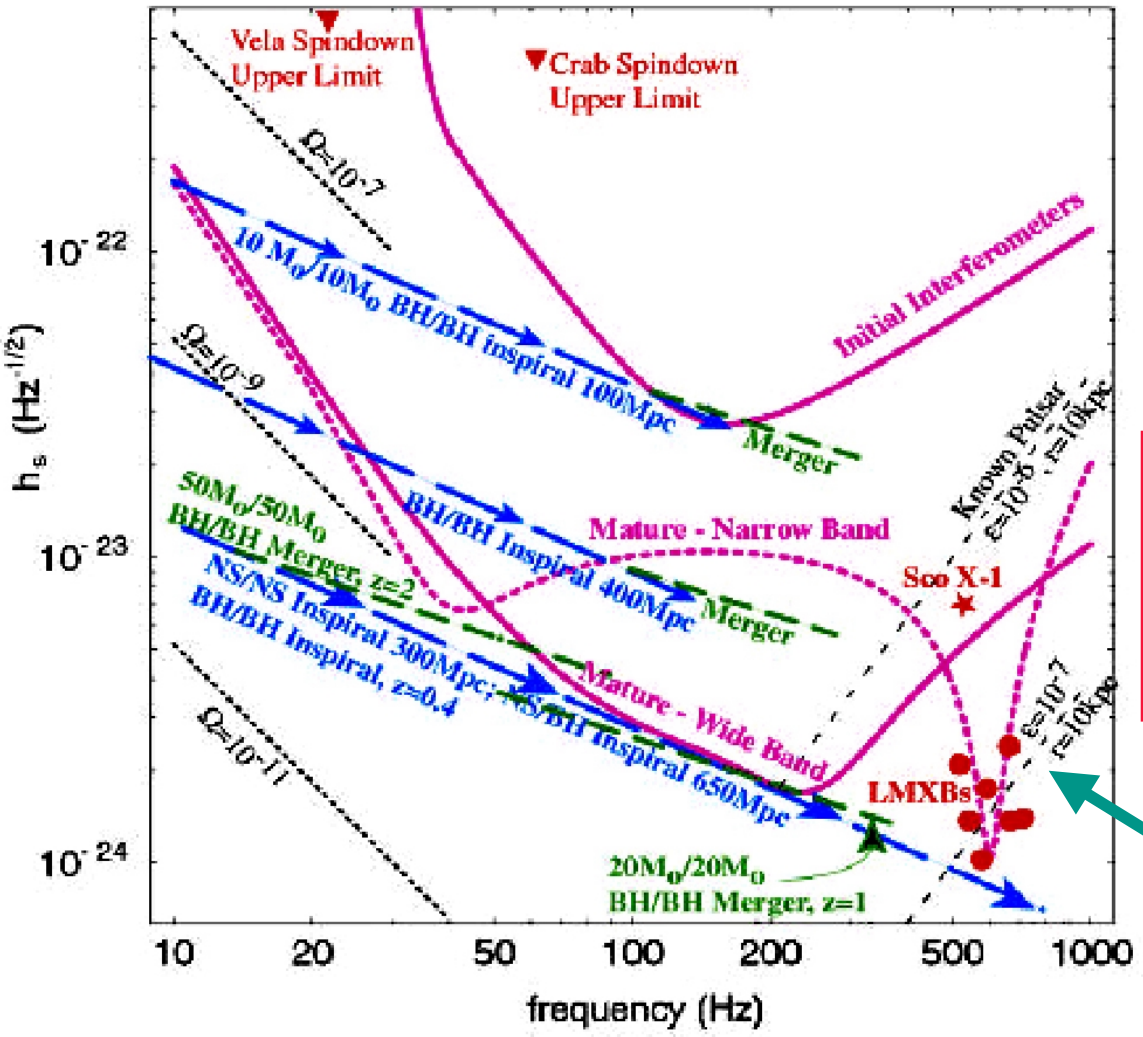


- Template based search
- 1 to 3 solar mass neutron stars
- Hanford 4 km + Livingston 4 km
- Sensitivity in Milky Way, LMC, SMC
- Result:

R < 164 / yr / **M**ilky**W**ay**E**quiv.**G**alaxy (90% confidence level)

Advanced LIGO

2007 +



Enhanced Systems

- laser
- suspension
- seismic isolation
- test mass

Improvement factor in rate

~ 10^4

+

narrow band optical configuration

- LIGO commissioning is well underway
  - » Good progress toward design sensitivity (Raab)
- Science Running is beginning
  - » Initial results from our first LIGO data run (Katsavounidis)
  - » The sources (Creighton)
  - » Talks this afternoon (Brady, Daw, Papa and Romano)
- Our Plan
  - » Improved data run is underway
  - » Our goal is to obtain one year of integrated data at design sensitivity before the end of 2006
  - » Advanced interferometer with dramatically improved sensitivity – 2007+ (Rowan)
- LIGO should be detecting gravitational waves within the next decade !