

Catching Einstein's waves

Gabriela González

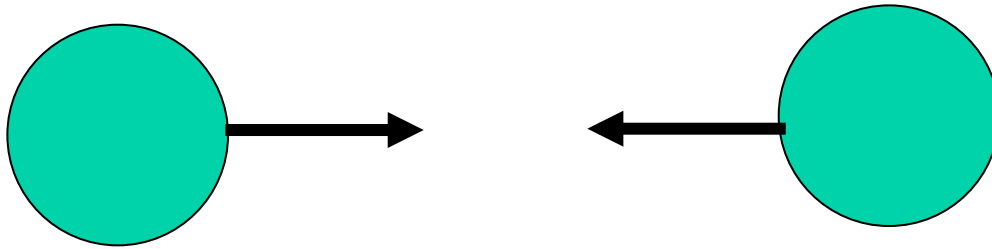
Louisiana State University



Science Unwrapped
Utah State University
October 7, 2011



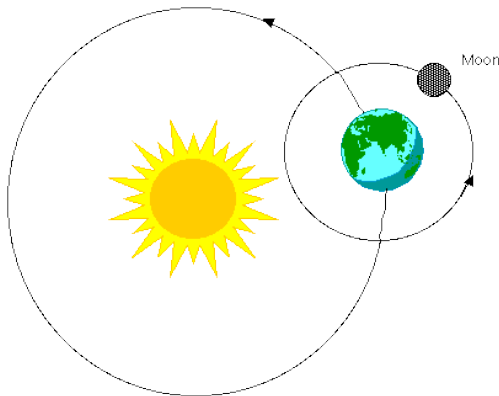
Newton's' gravity



“Newton’s law”: $F = Gm_1m_2/r^2$

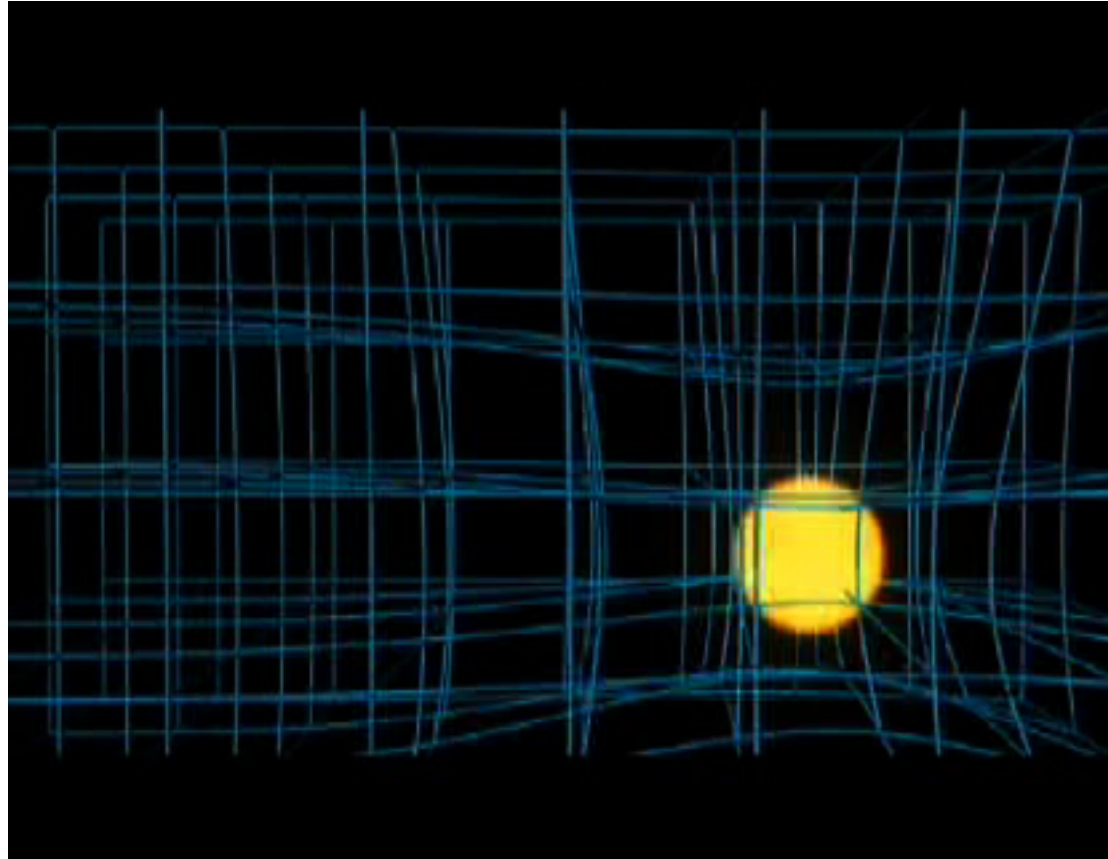
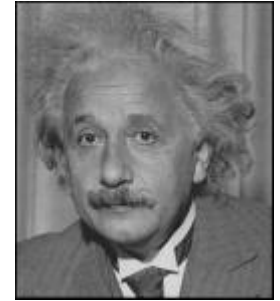


Explains why apples fall, why the planets move around the Sun,...





Einstein's gravity



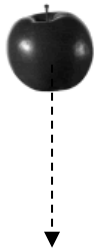
sciencebulletins.amnh.org
And in YouTube!



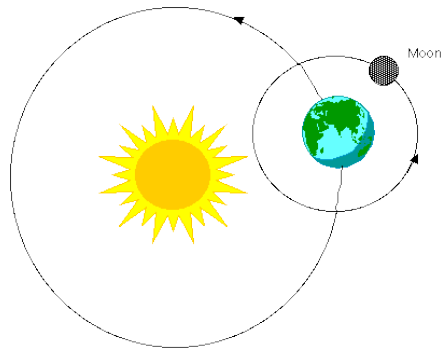
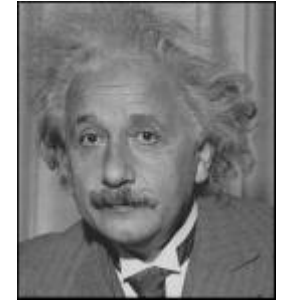
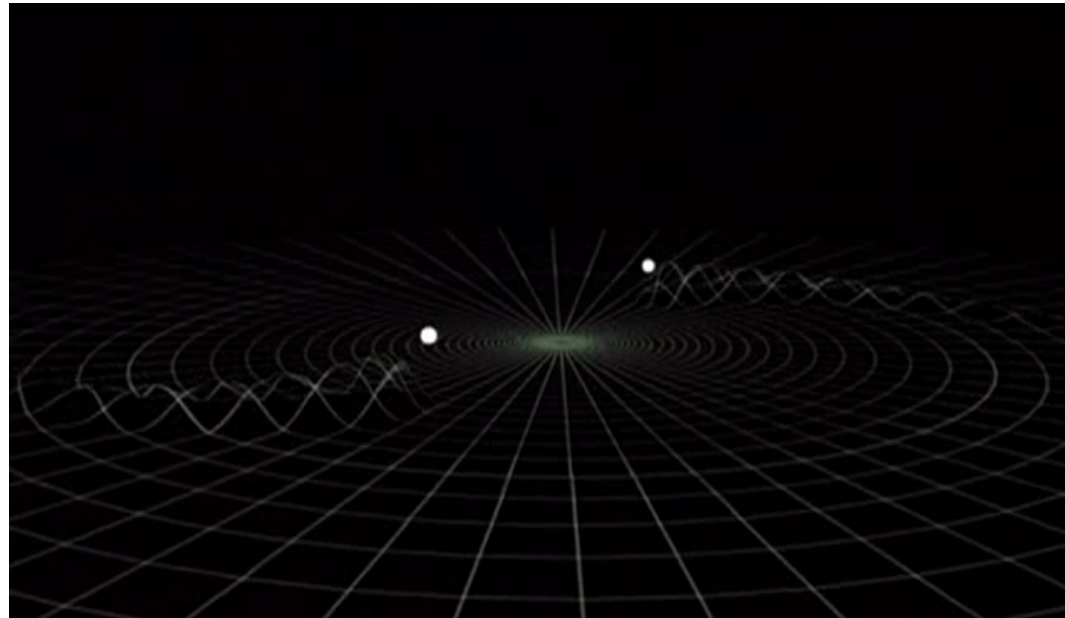
Einstein's gravitation



When masses move, they wrinkle the space time fabric, making other masses move...



Explains just as well as Newtons' why things fall and planetary motion...



Einstein's messengers,
National Science Foundation video
www.einsteinsmessengers.org

.. but it also predicts **gravitational waves** traveling away from moving masses!



From stars living in galaxies...



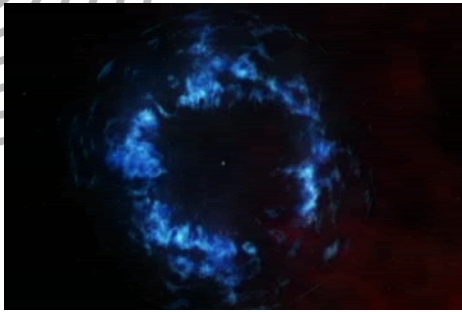
**Where do gravitational
waves come from?**

From stars living in galaxies...



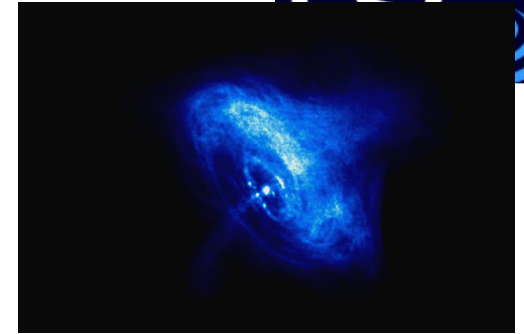
Supernova explosions

Where do gravitational waves come from?



Supernova explosions

From stars living in galaxies...

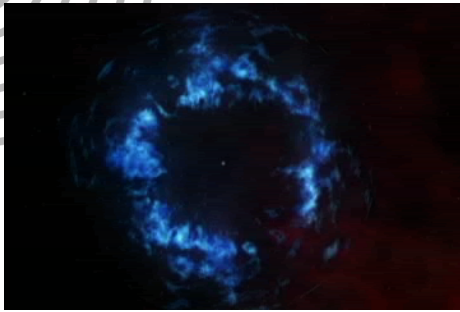


Rotating stars (pulsars)

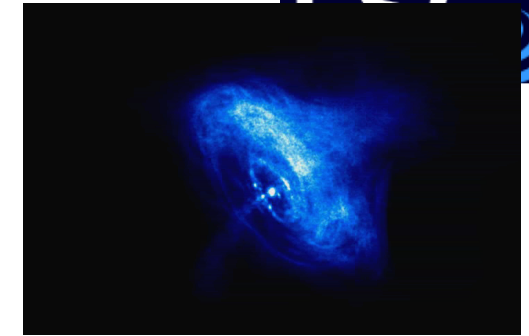
Where do gravitational waves come from?



From stars living in galaxies...

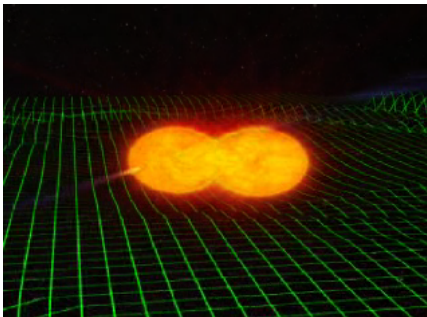


Supernova explosions

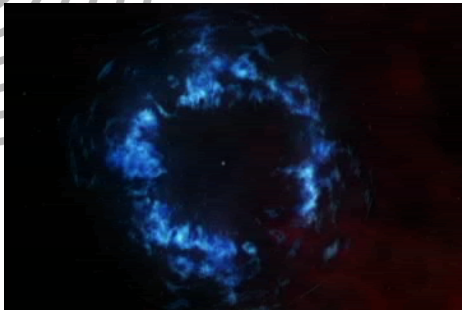
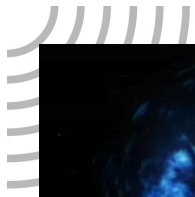


Rotating stars (pulsars)

Where do gravitational waves come from?

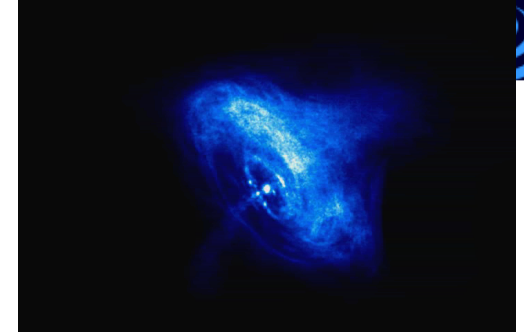


Binary systems
(black holes, neutron stars)



Supernova explosions

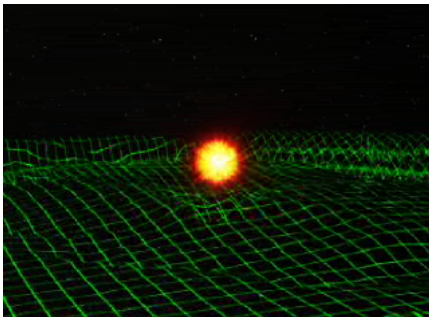
From stars living in galaxies...



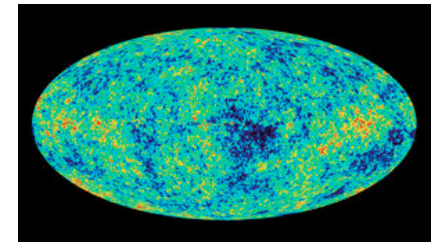
Rotating stars (pulsars)

Where do gravitational waves come from?

..and from the beginning of the Universe!



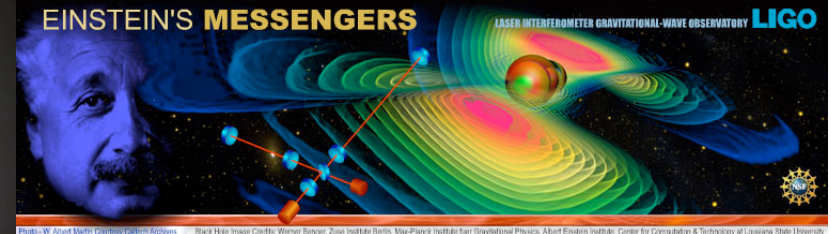
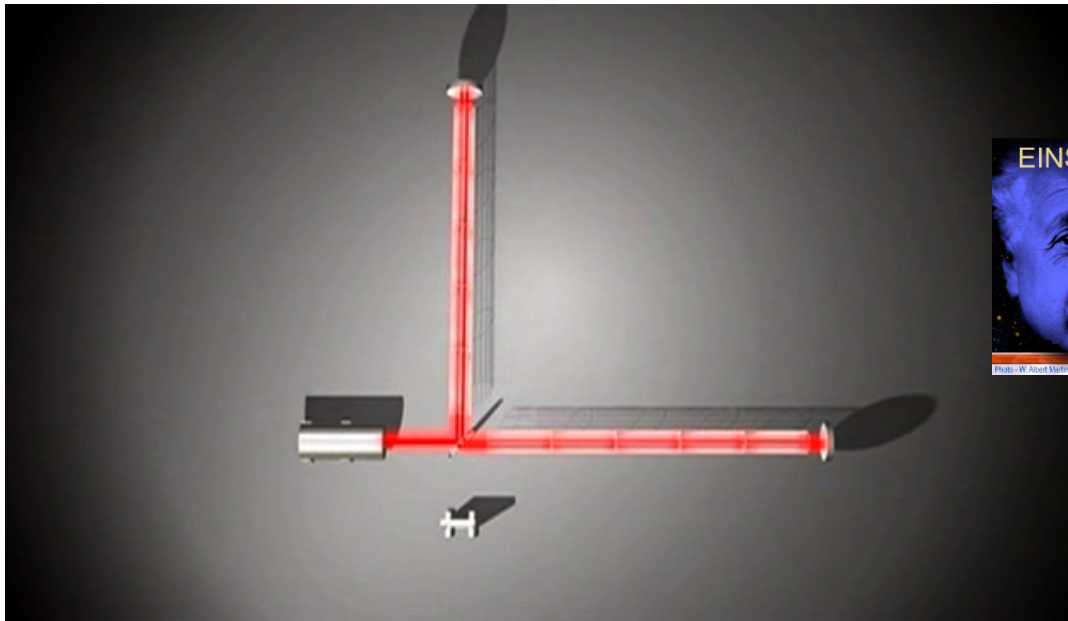
Binary systems
(black holes, neutron stars)



Credit: NASA/WMAP



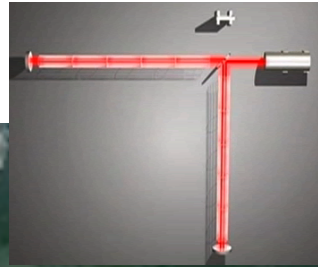
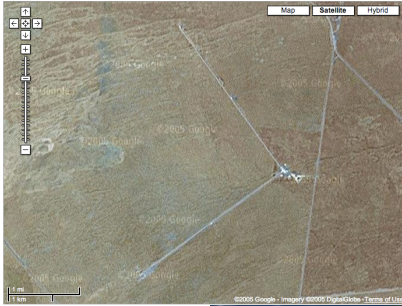
How to detect gravitational waves with an interferometer



Einstein's messengers,
National Science Foundation video
<http://www.einsteinsmessengers.org/>



The LIGO Observatories



Hanford, WA

Rai Weiss



Peter Saulson

Lunch time at LSC Summit

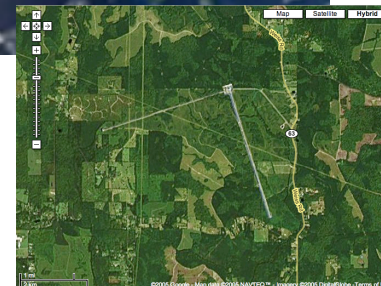


Livingston, LA

Hundreds of people in 15 countries working on the experiment and looking at the data:

LIGO Scientific Collaboration

www.ligo.org

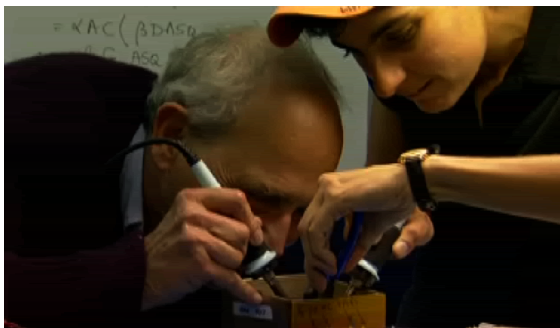
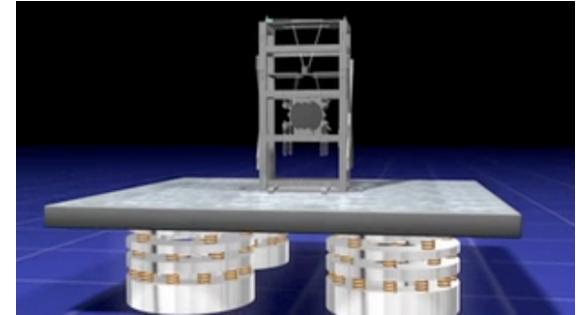
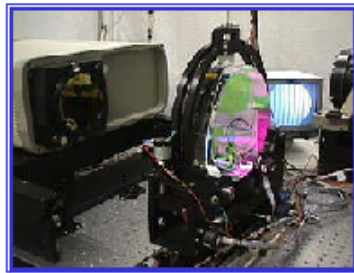
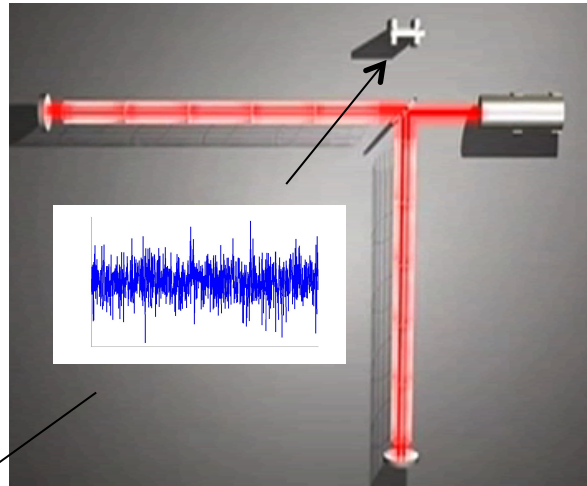




GW Detection:



a difficult and fun experiment





Building LIGO

Vacuum system



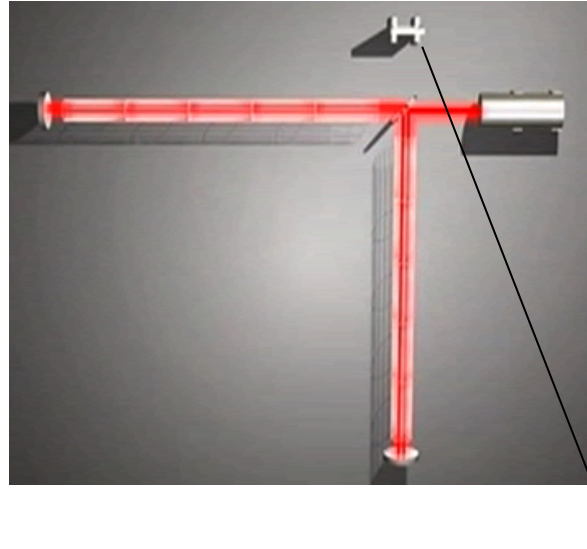
Your taxes at work!



Detecting GWs



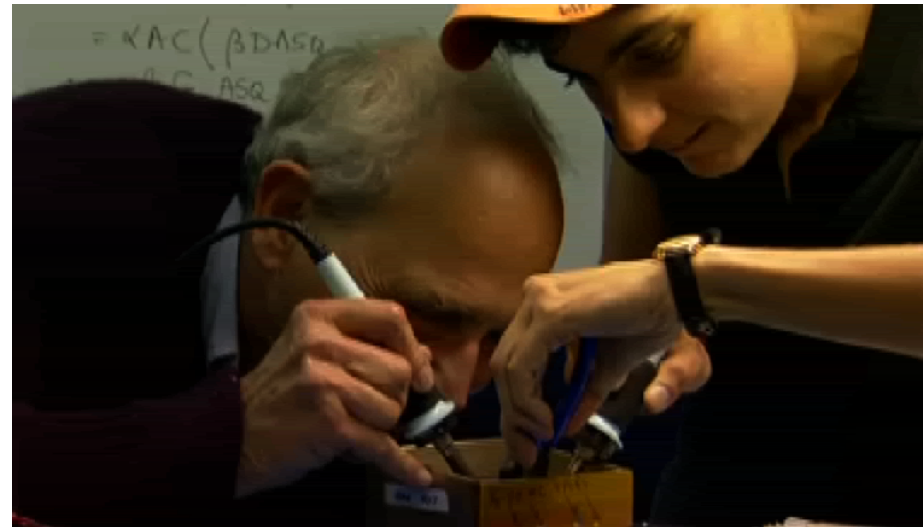
a difficult and fun experiment



Nergis Mavalvala



Rai Weiss

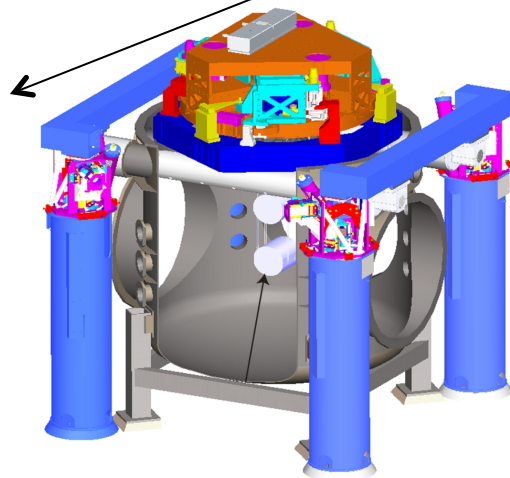
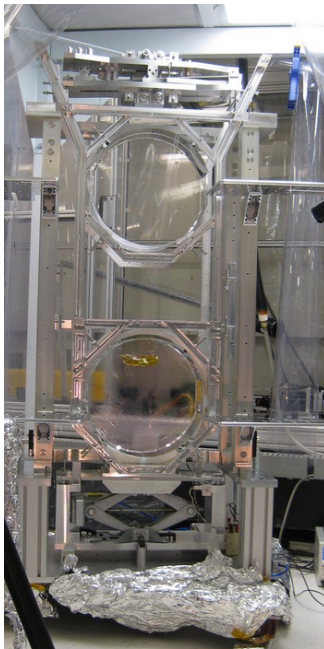
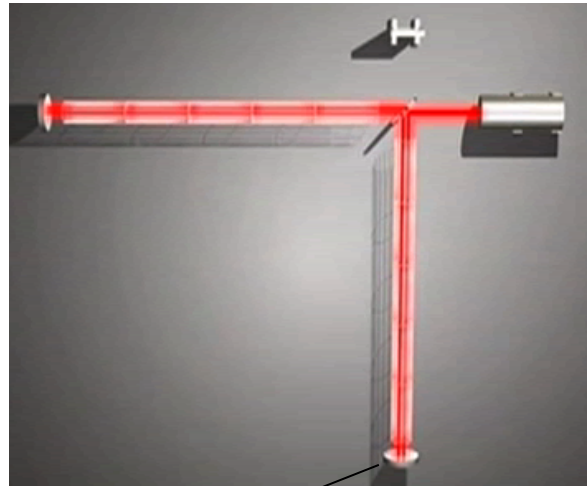




Detecting GWs



a difficult and fun experiment



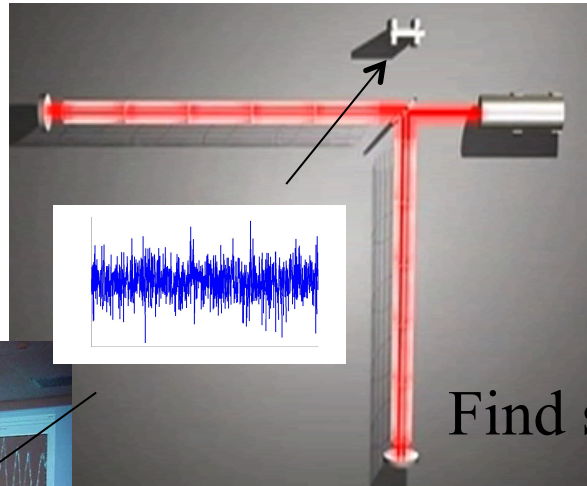
Jeff Kissel, 2008
SEI="seismic isolation"



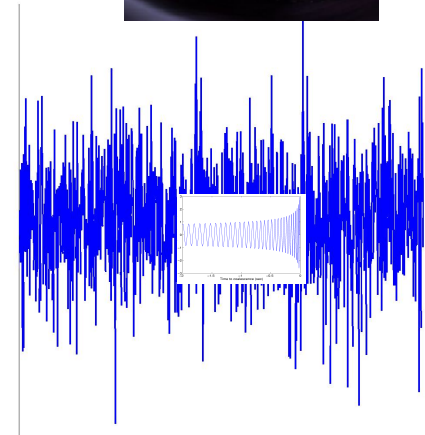
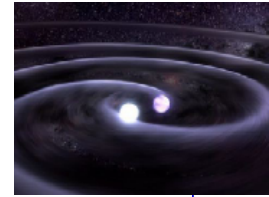
GW Detection:



a difficult and fun experiment



Find signal:



In noise:



You can try after the talk!

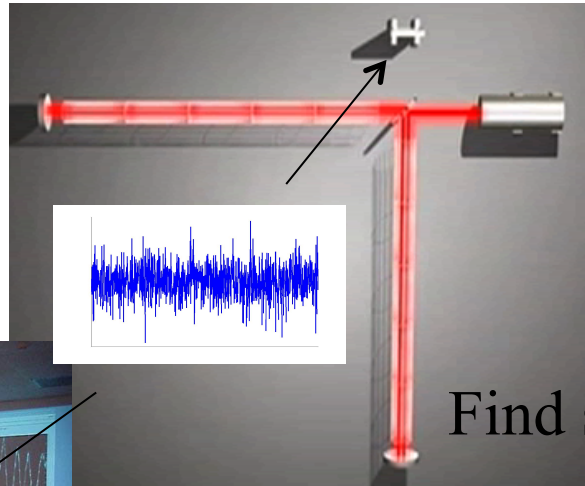
Black Hole Hunter game



GW Detection:

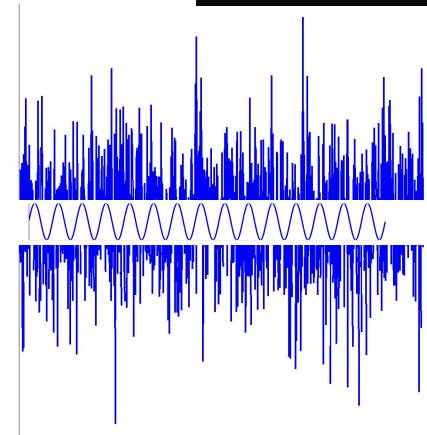
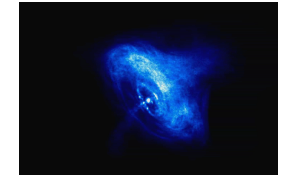


a difficult and fun experiment



Find signal:

In noise:



You can help!



<http://www.einsteinathome.org/>



Gravitational waves are coming... are you ready?

