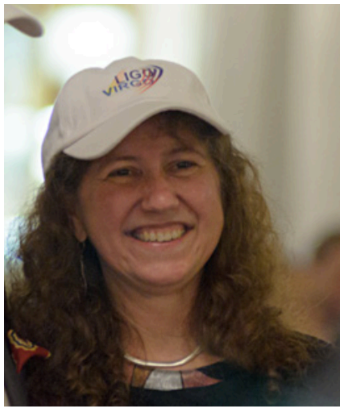
LIGO, gravitational waves and me: a wonderful life in physics with more to come!



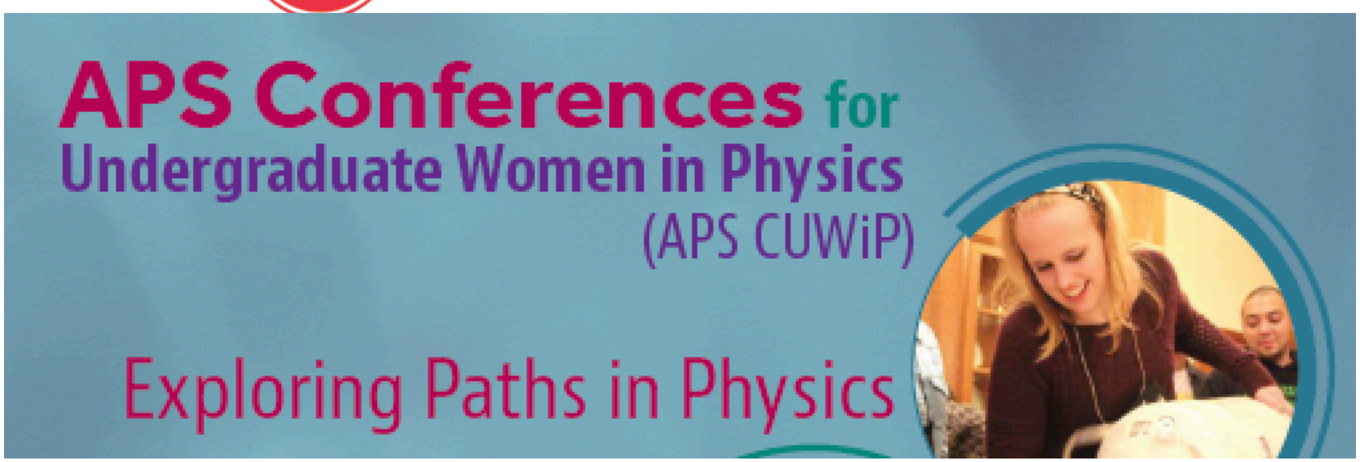
Gabriela González,

Louisiana State University

Jan 18, 2014

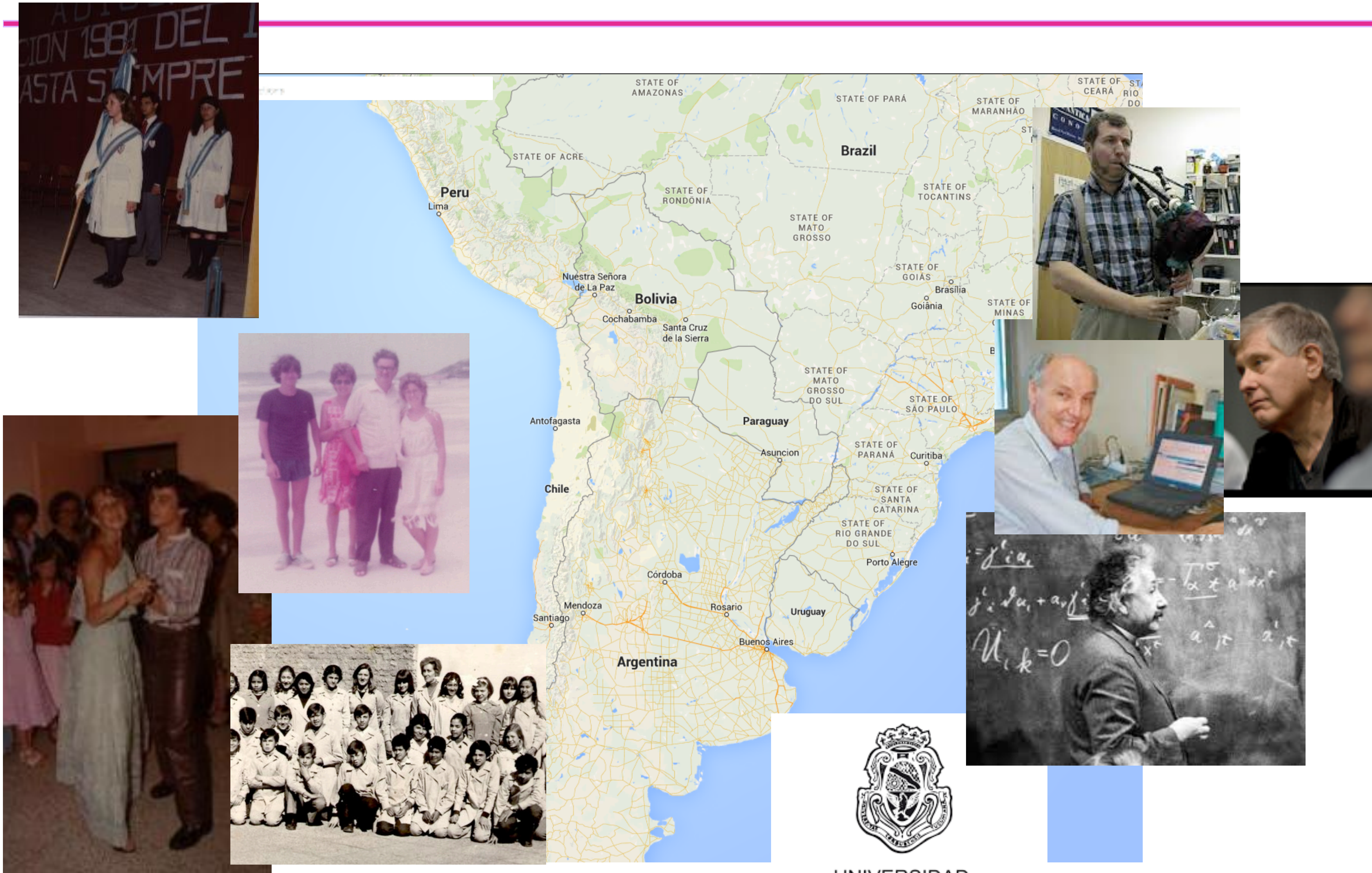
THE UNIVERSITY of MISSISSIPPI

1848



LSU

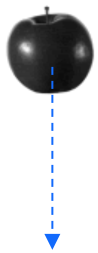
School and college in Argentina

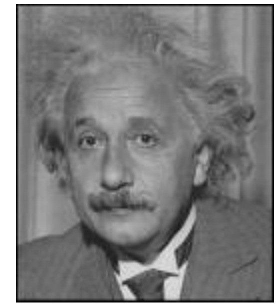


UNIVERSIDAD
NACIONAL DE CORDOBA

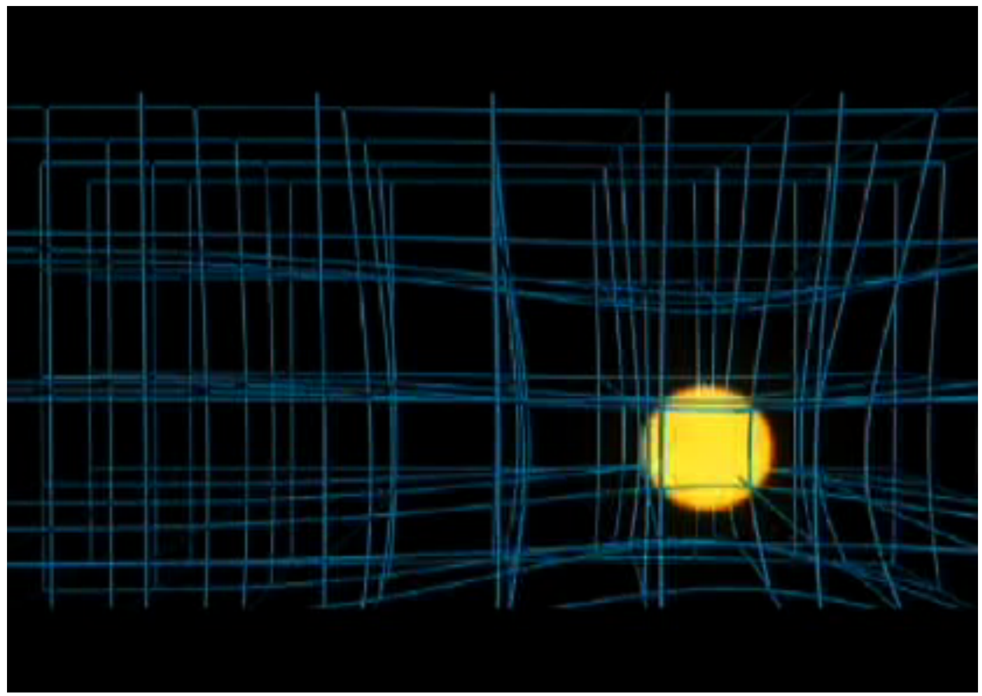
Einstein's gravity

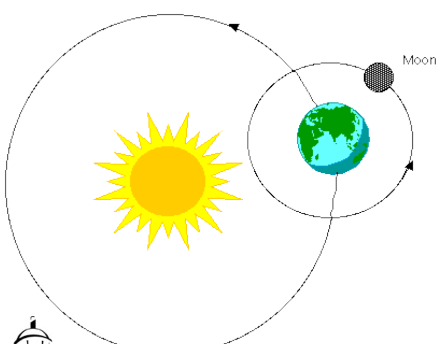
When masses move, they wrinkle the space time fabric, making other masses move…





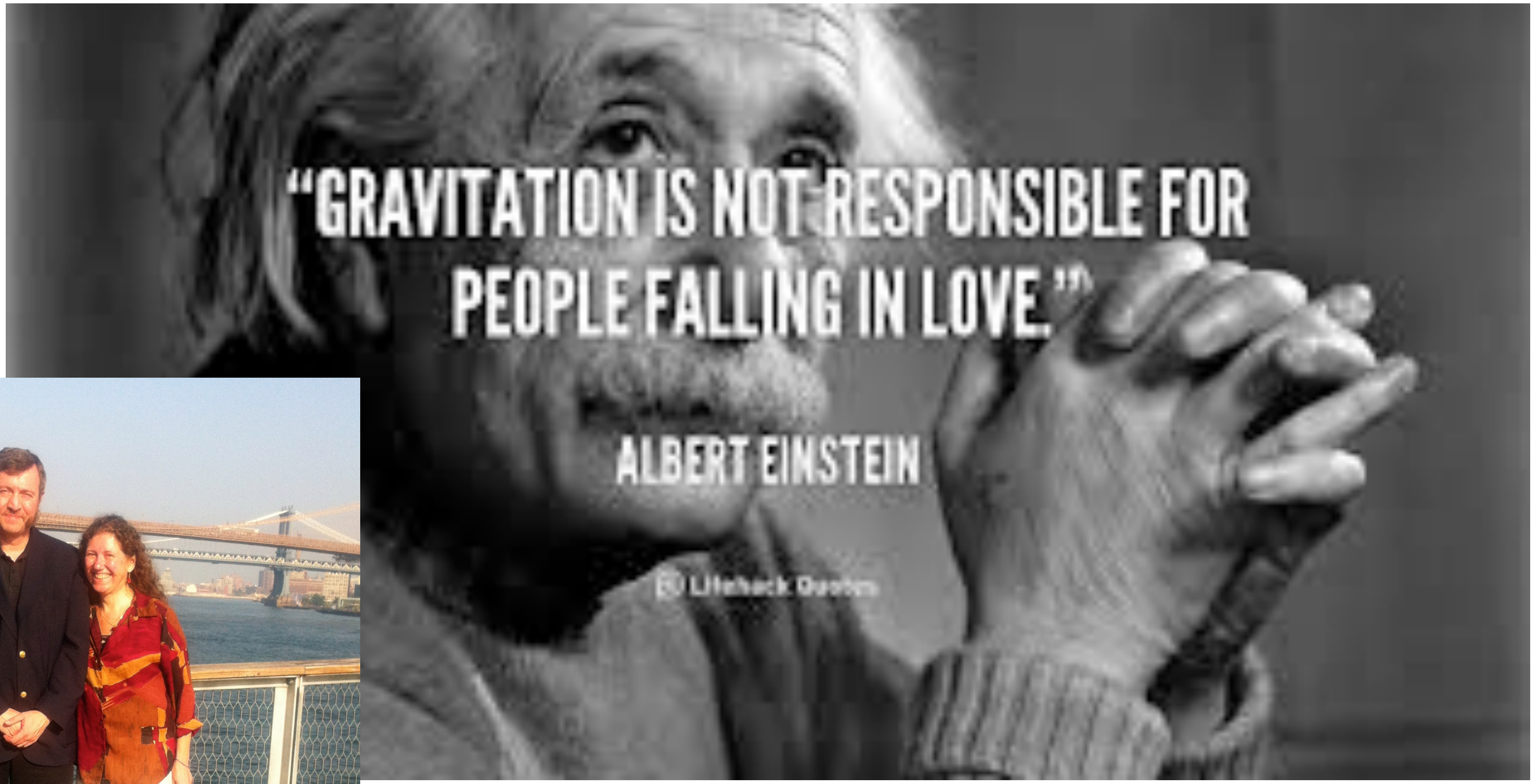
Explains just as well as Newton's why things fall and planetary motion…



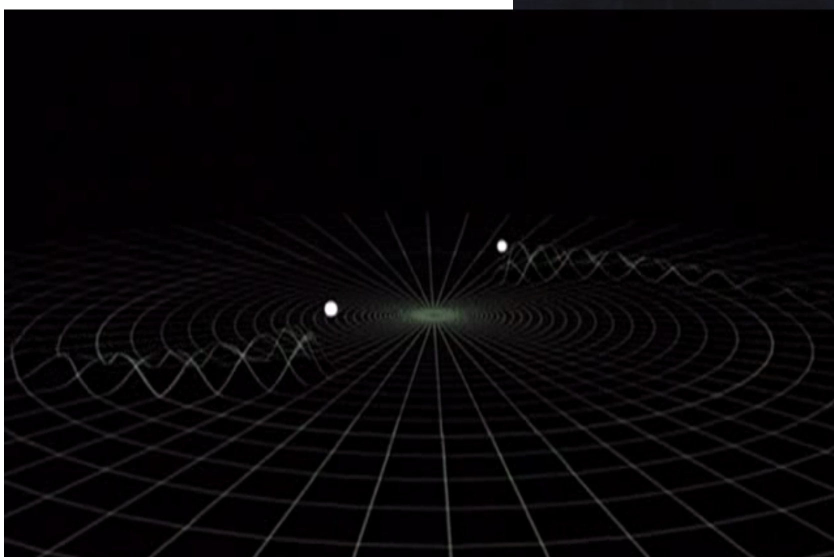


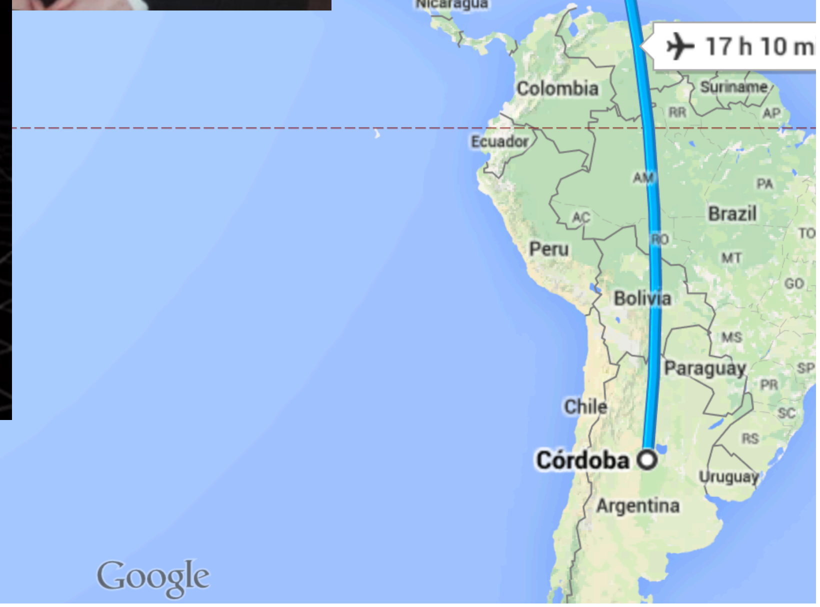
sciencebulletins.amnh.org

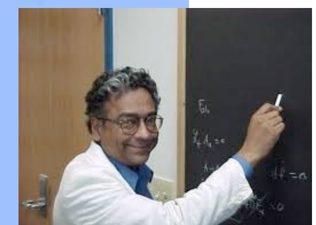
Proving Einstein wrong…



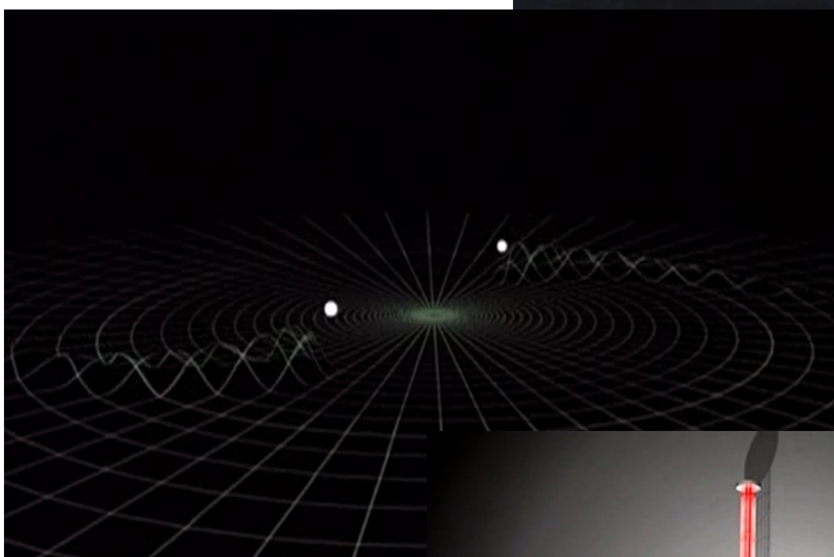
Moving to US, PhD, LIGO

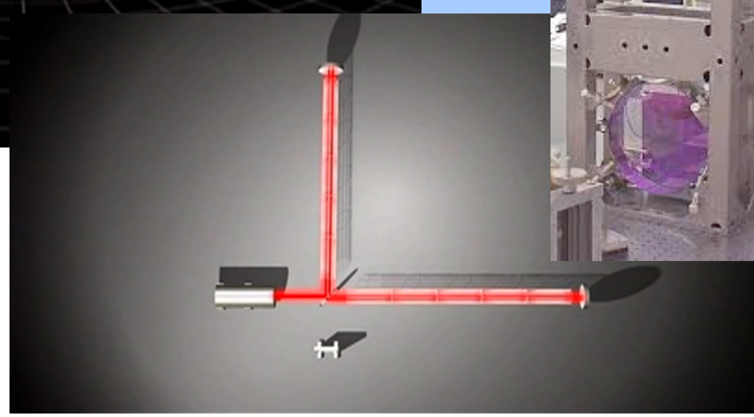






Moving to US, PhD, LIGO





LIGO Observatories


LIGO Livingston, circa 1995


LIGO Hanford, WA

Welcome
to the
Inauguration
of the
National Science Foundation's
LIGO Facilities
held at
LIGO Livingston Observatory
Friday, Nov 12, 1999


LIGO Livingston, LA

From stars living in galaxies…

Where do gravitational waves come from?

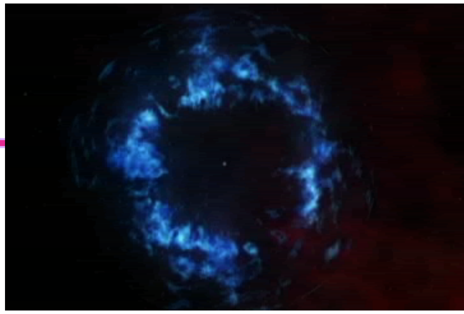
Supernova explosions
(that form a BH or a NS)

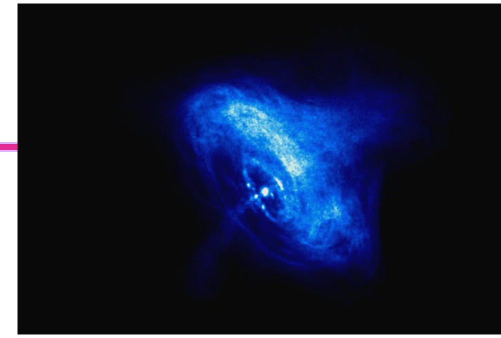
From stars living in galaxies…

Where do gravitational waves come from?

Credits: Animation: NASA/CXC/D.Berry & A.Hobart

From stars living in galaxies…



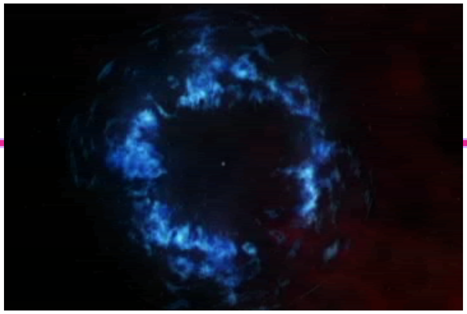


Rotating stars (pulsars)

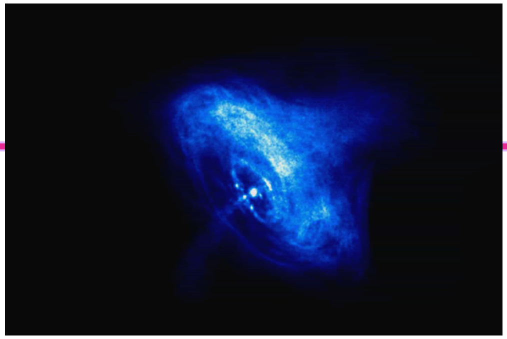
Where do gravitational waves come from?

Credit: NASA/CXC/ASU/J.Hester et al.

From stars living in galaxies…

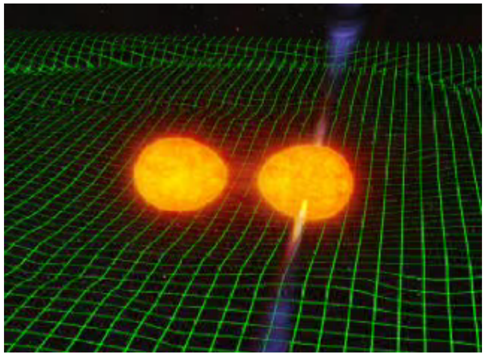


Supernova explosions



Rotating stars (pulsars)

Where do gravitational waves come from?

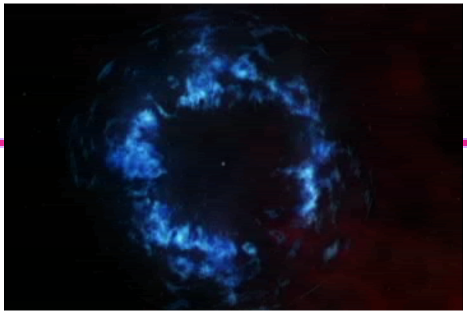


Binary systems coalescing into a black hole

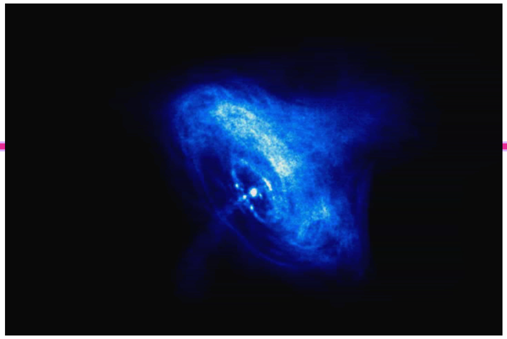
Credit: John Rowe

LSU

From stars living in galaxies…

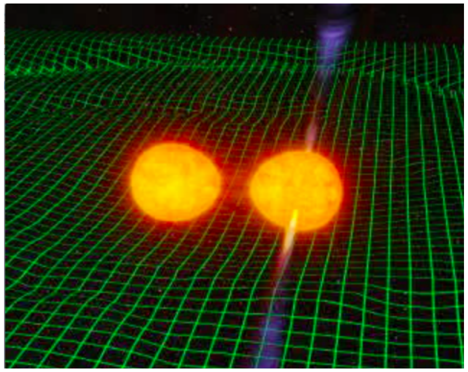


Supernova explosions



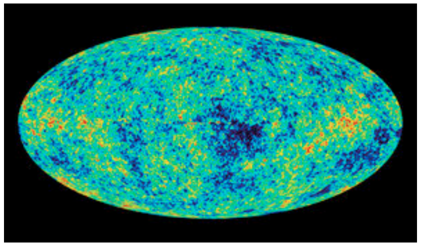
Rotating stars (pulsars)

Where do gravitational waves come from?



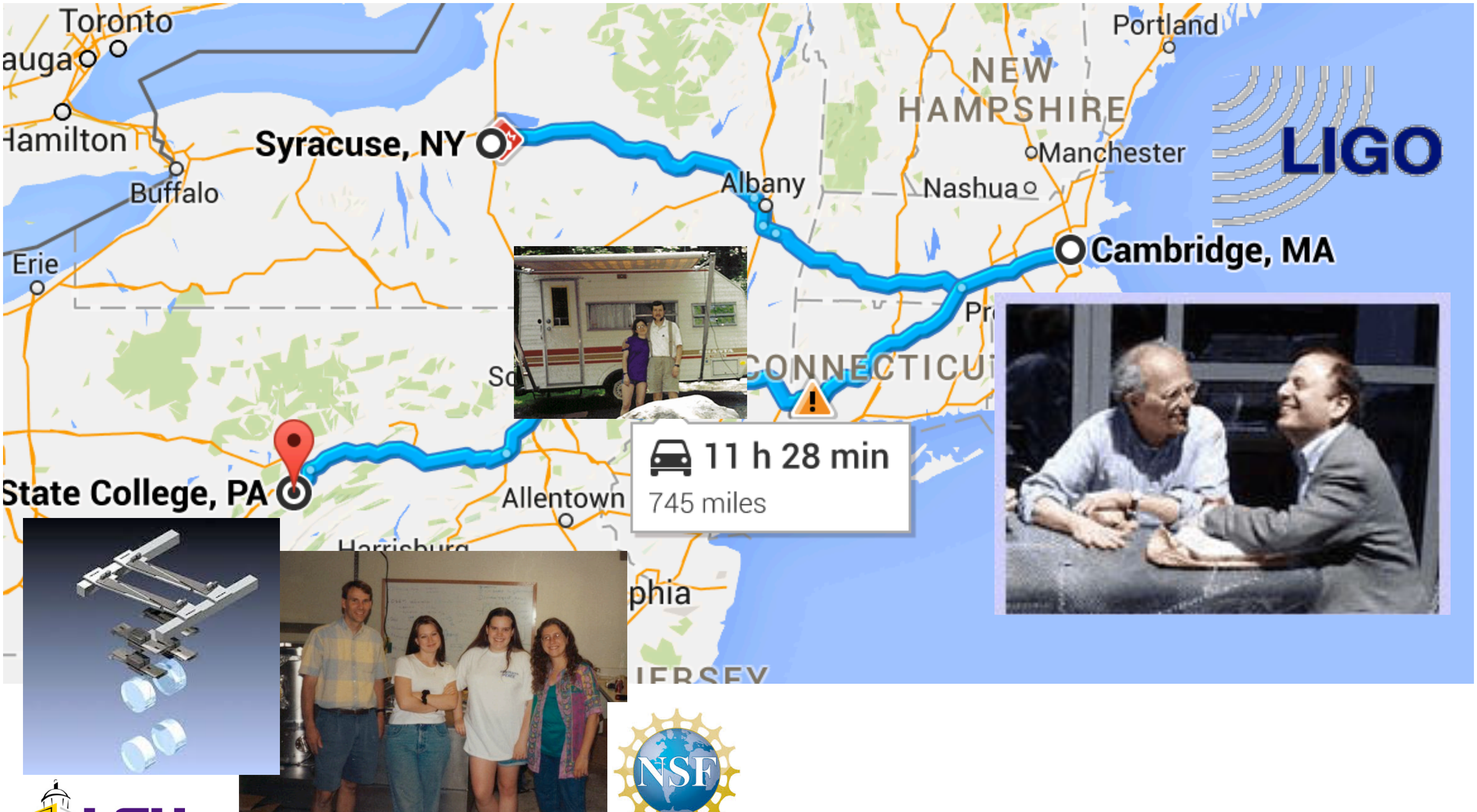
Binary systems coalescing into a black hole

..and from the beginning of the Universe!

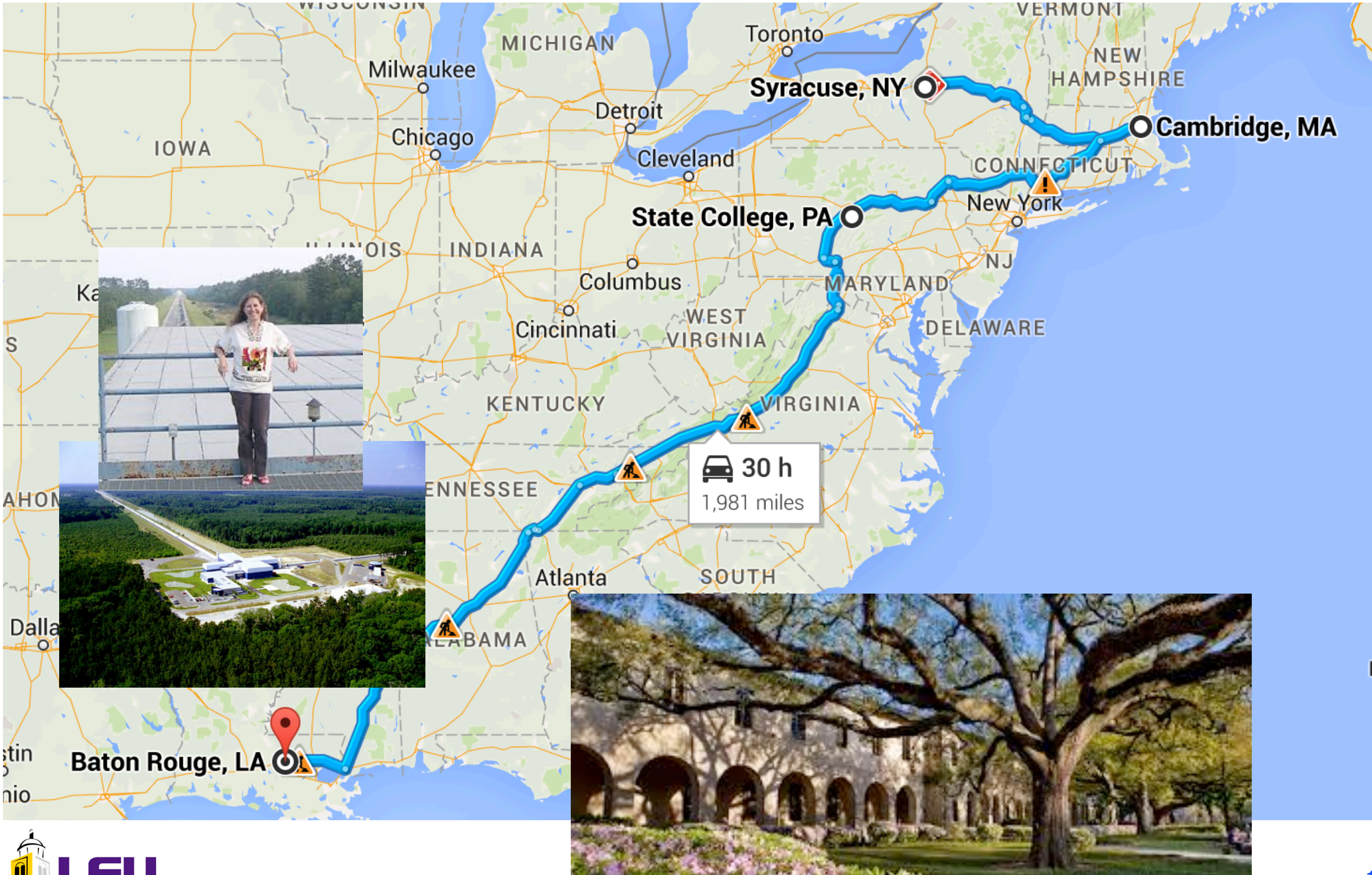


Credit: NASA/WMAP

Moving around

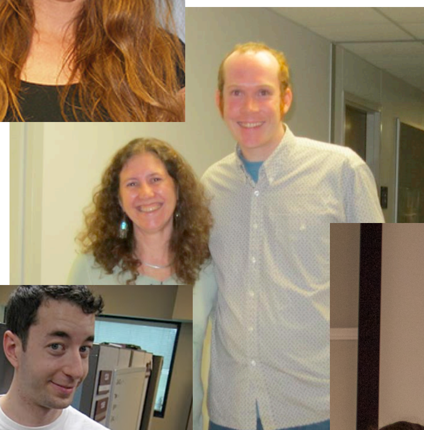


Our home since 2001

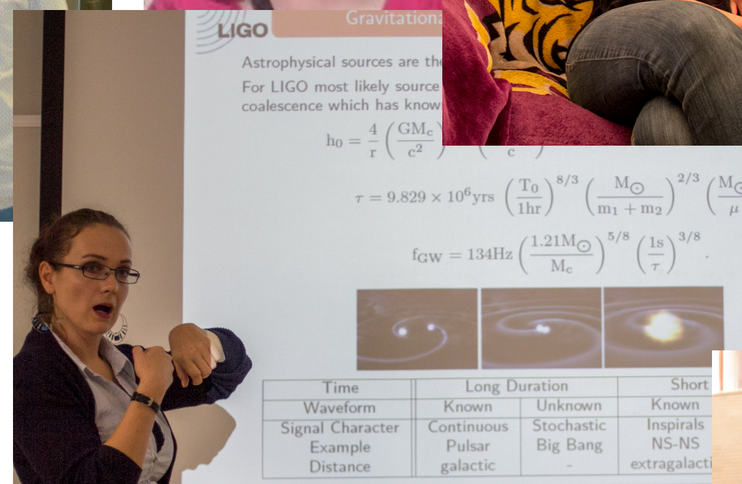


Students, postdocs, friends







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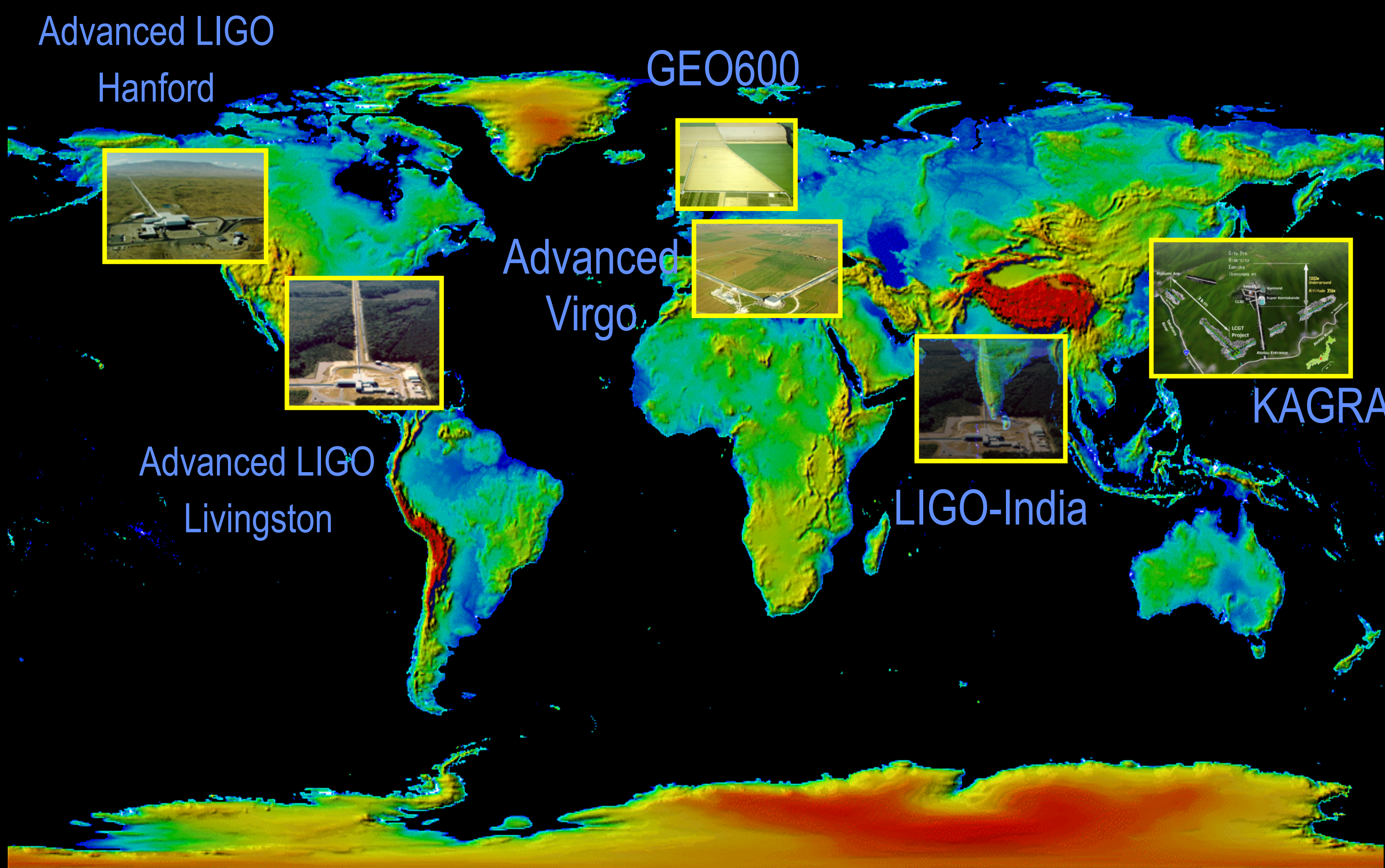
The GW Detector Network~2020

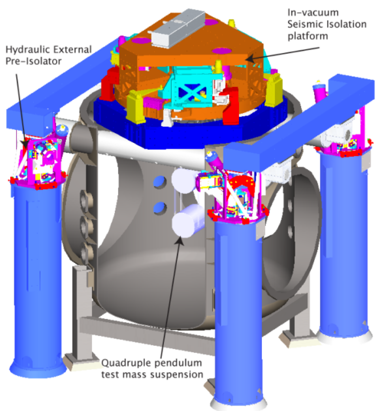


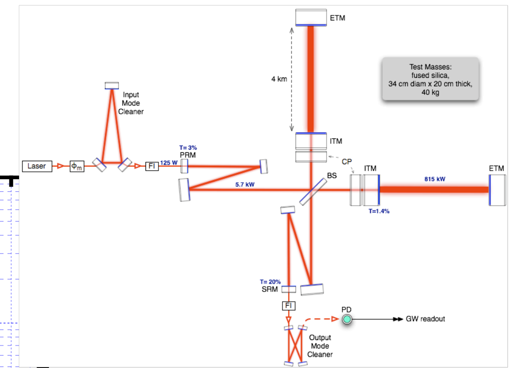
LIGO Scientific Collaboration
www.ligo.org

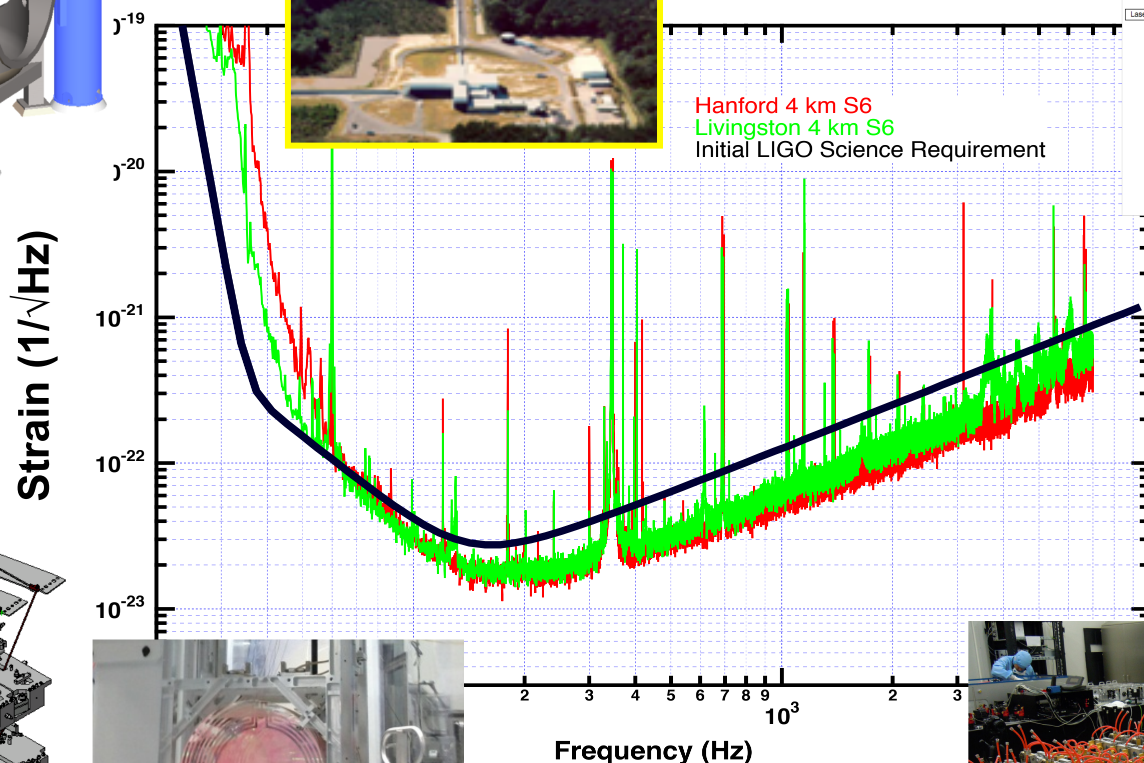
- 900+ members, 85+ institutions, 16 countries

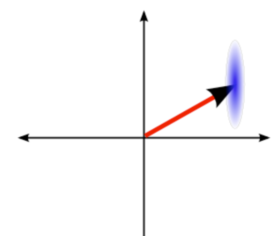
https://www.zeemaps.com/map?group=245330

LIGO Detectors Technology

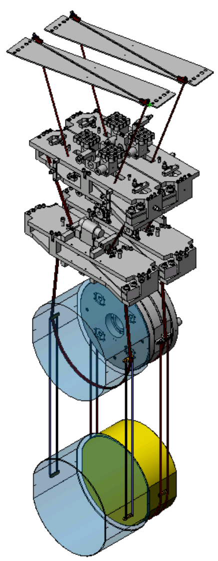


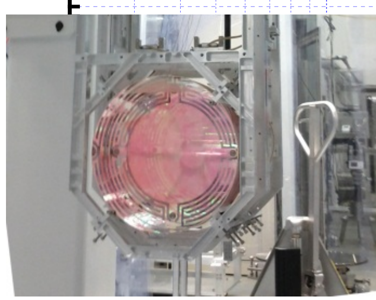






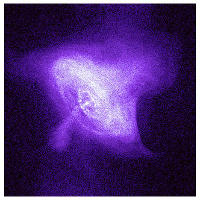
See K. Dooley's talk 3:45pm



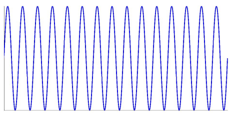


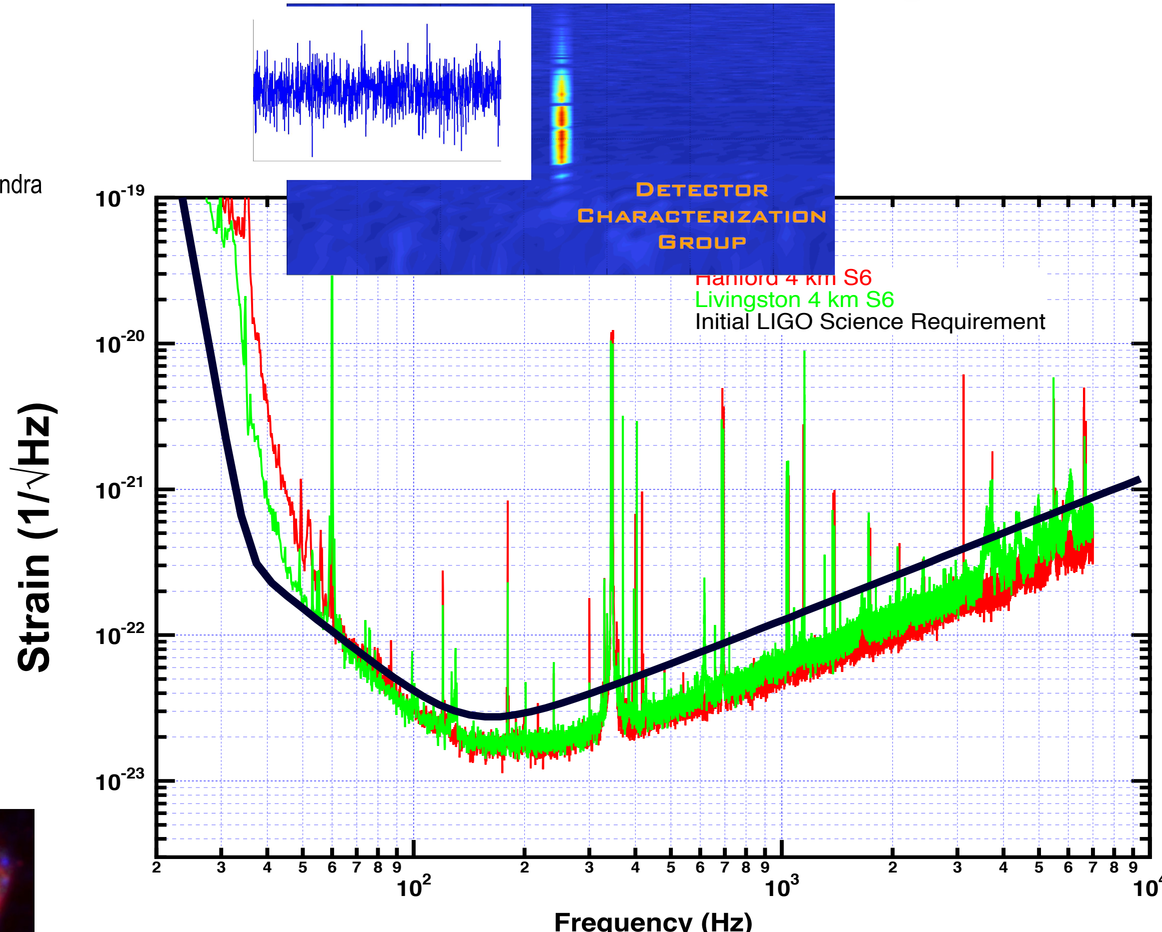
LIGO-T1400316 (dcc.ligo.org).

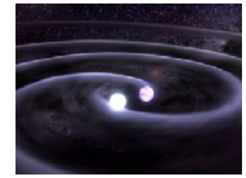
LIGO Data Analysis

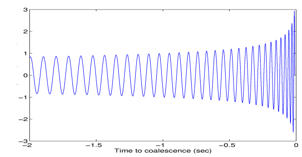


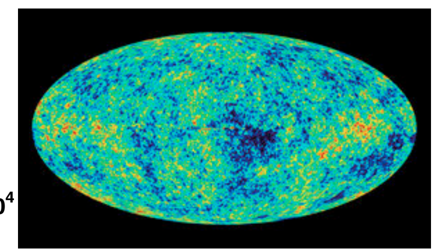
Crab pulsar (NASA, Chandra Observatory)



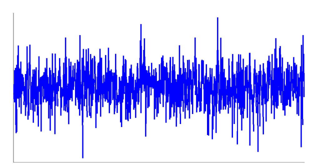


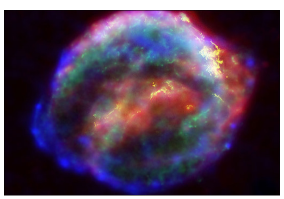


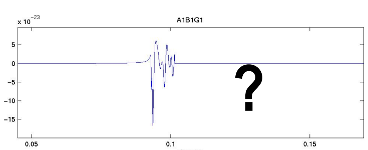




NASA, WMAP

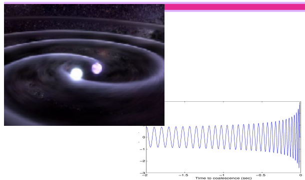




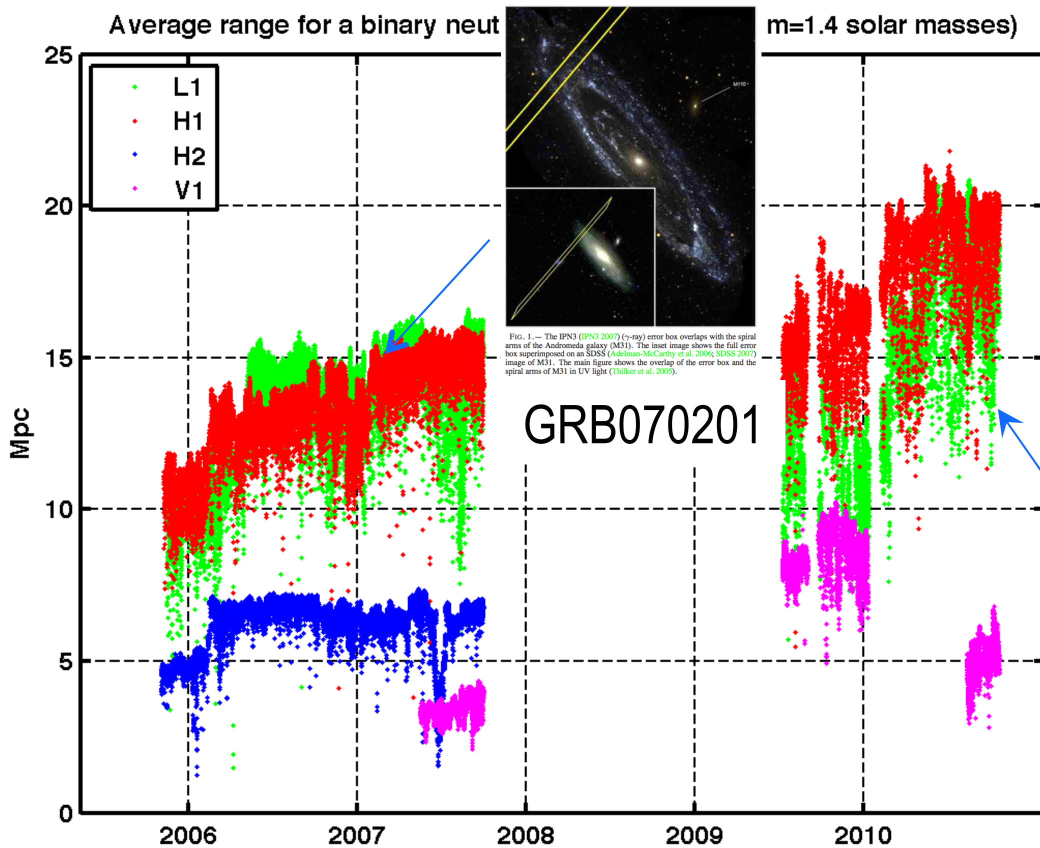


LIGO-T1400054 (dcc.ligo.org).

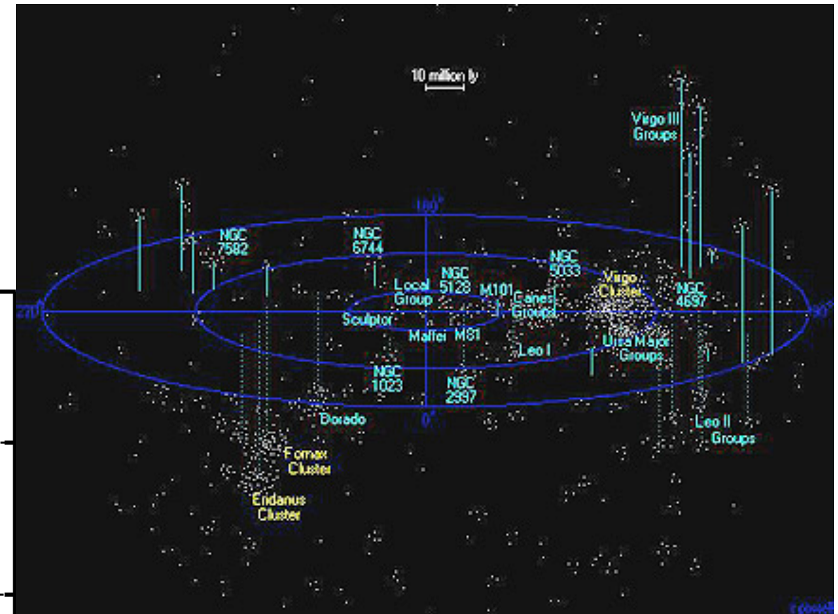
Some interesting results 2005-2011



Astrophys. J. **681** (2008) 1419



GRB070201

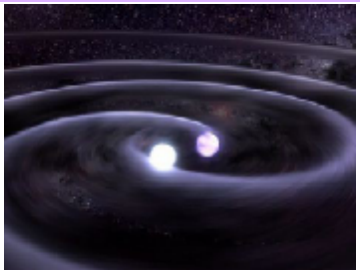


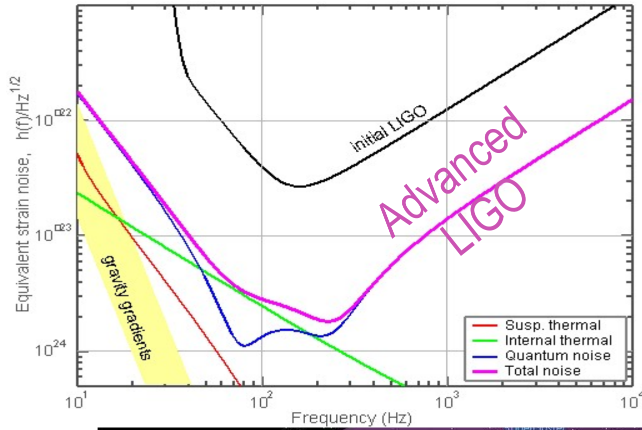
atlasofthe universe.com

GW100916

Phys. Rev D85 (2012) 082002

What will Advanced LIGO see ?





Neutron Star Binaries:

Initial LIGO:

Average BNS reach ~15 Mpc → rate ~1/50yrs

Advanced LIGO: ~ 200 Mpc

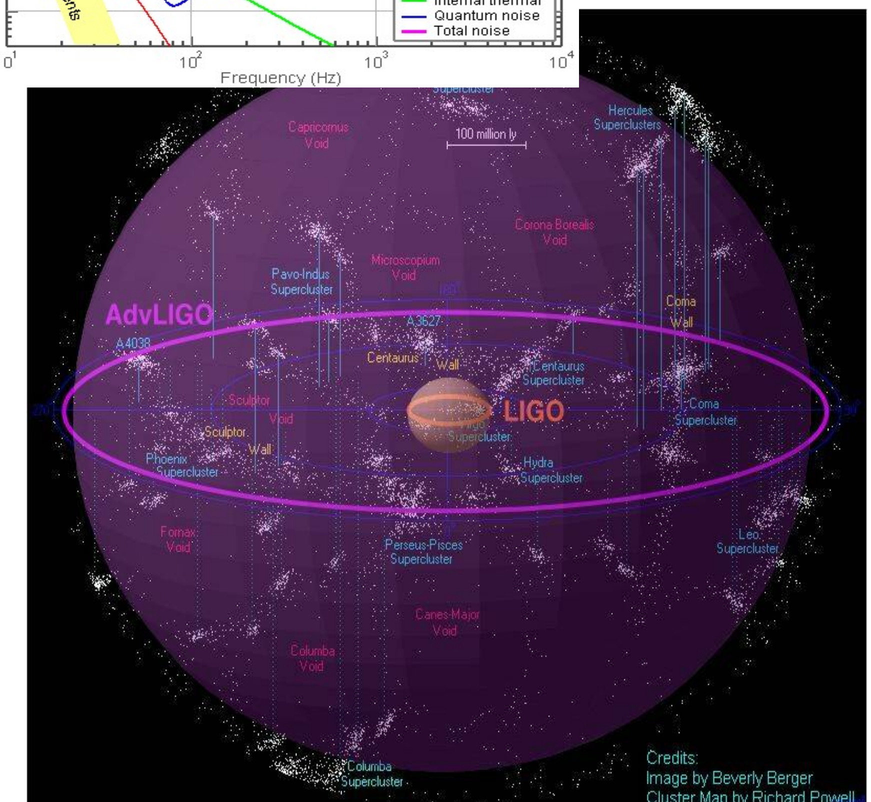
"Realistic rate" ~ 40/year (but can be 0.4 or 400)

Other binary systems:

NS-BH: 0.004/yr → 10/yr

BH-BH: 0.007/yr→ 20/yr

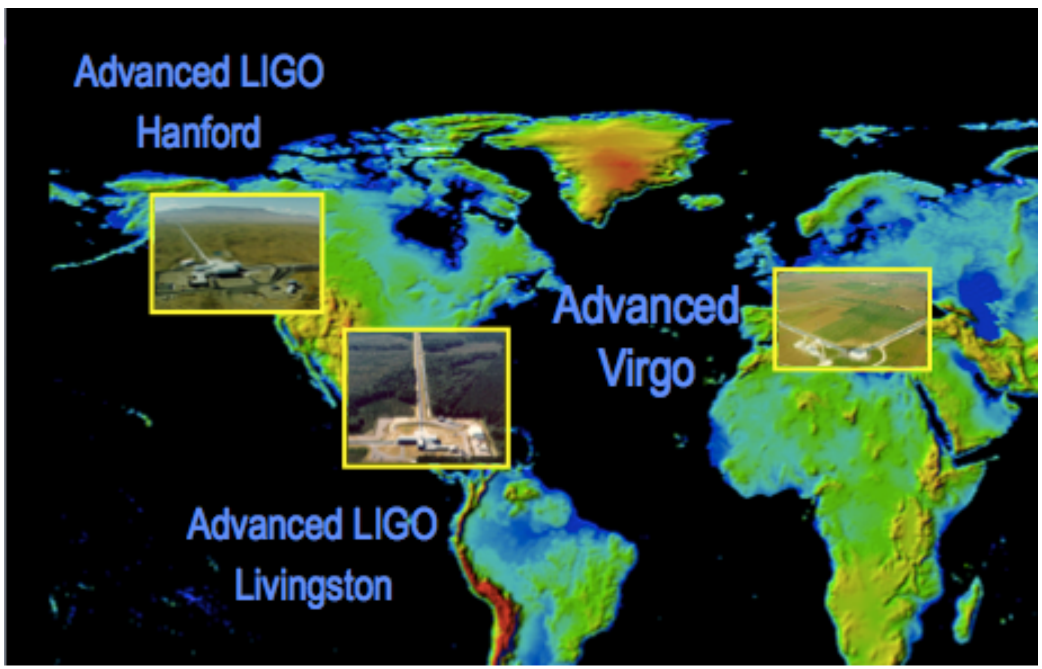
Class. Quant. Grav. **27**, 173001 (2010)



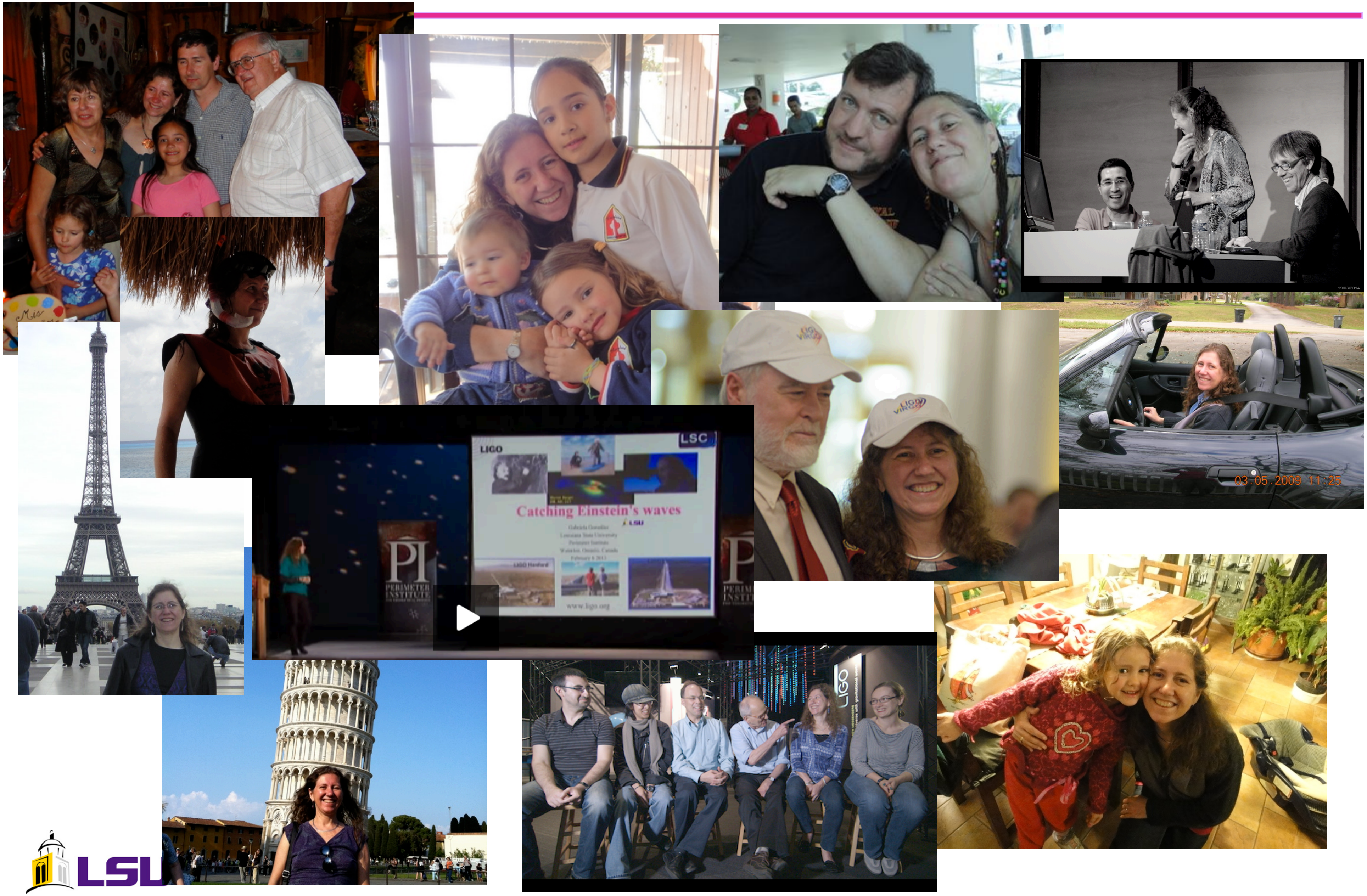
Are we there yet?
Soon!!!

Epoch	Estimated Run Duration	$E_{GW} = 10^{-2} M_\odot c^2$ Burst Range (Mpc) LIGO	Virgo	BNS Range (Mpc) LIGO	Virgo	Number of BNS Detections
2015	3 months	40 – 60	–	40 – 80	–	0.0004 – 3
2016–17	6 months	60 – 75	20 – 40	80 – 120	20 – 60	0.006 – 20
2017–18	9 months	75 – 90	40 – 50	120 – 170	60 – 85	0.04 – 100
2019+	(per year)	105	40 – 80	200	65 – 130	0.2 – 200
2022+ (India)	(per year)	105	80	200	130	0.4 – 400

arXiv:1304.0670



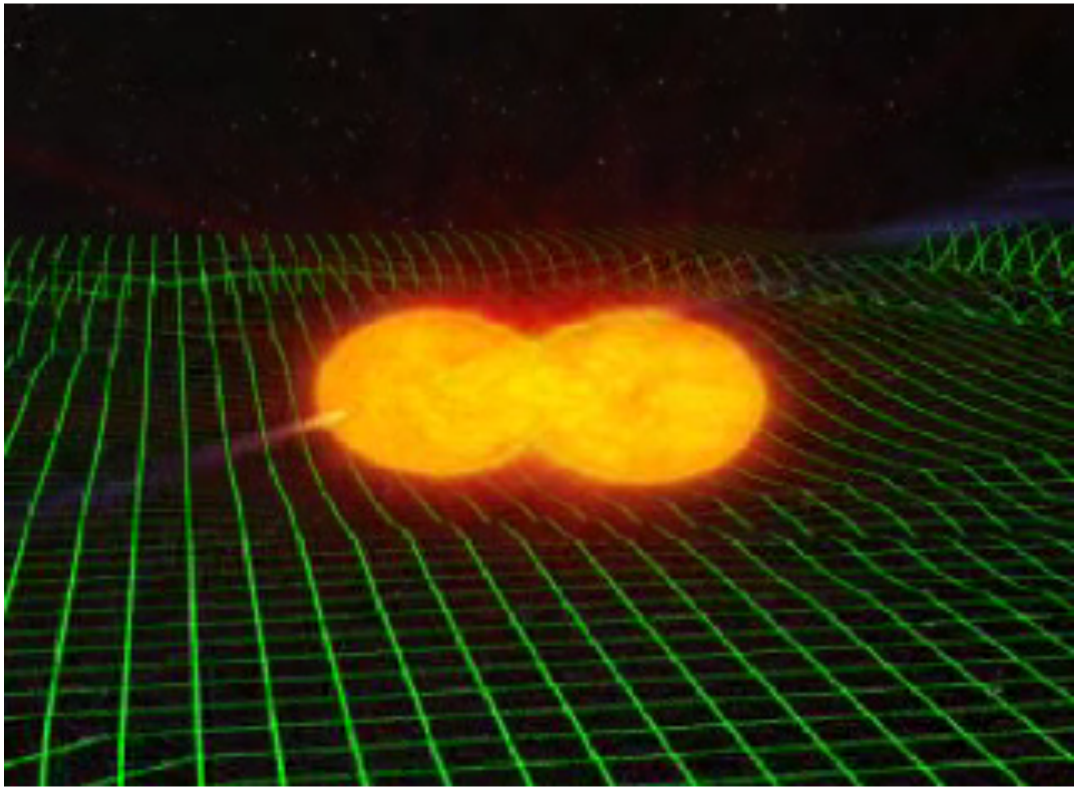
Family, science, fun!



LSU

Life in Physics is Fun

And there's a lot of gravitational waves excitement coming to a theater near you!



To learn more about LIGO : www.ligo.org

To ask me (any!) question: gonzalez@lsu.edu

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