STORYLINE

Seeing the Cosmos

Modern Gravity

Listening to the Cosmos with gravity
The COSMOS
1609: Galileo used a **telescope**

What he saw transformed the Cosmos... in a way, he **made** the Cosmos.
Telescopes
Light tells the stories of atoms and the things that happen to them...

The beautiful things we see in the sky are often the Universe obscuring light...
But there are more things in the Cosmos than what we can see with light...

Dim stars
Black Holes
Dark Matter

Everything moves and changes under the influence of gravity.
Albert Einstein: 1905 (the Miracle Year)

Special Relativity:
Nothing can travel faster than the speed of light.

Gravity cannot travel faster than light!
When there is no gravity, particles travel in straight lines.
When there is gravity, particles travel on curved lines.
Matter tells spacetime how to curve.
Spacetime tells matter how to move.
LIGO – Hanford, WA

LIGO – Livingston, LA
LISA

5 million kilometer arms!
LISA
LISA Pathfinder
This is all nice…

…but what can we “see”?

Any dynamical motion of mass will generate gravitational waves.
GW150914

29 solar mass black hole + a 36 solar mass black hole
1.3 billion lightyears away (400 Mpc)
GW150914

Images: LIGO
GW150914

LIGO is all about people

Images: LIGO
Last thoughts...

Technology is providing us with new ways to see the Cosmos.

Gravity will reveal secrets about the most awesome and enigmatic things astronomers know about.

We can see things with gravity that cannot be seen with light!

This is just the beginning...
A FEW OTHER THINGS TO READ

BLACK HOLES & TIME WARPS
(Kip S. Thorne)

Einstein’s Unfinished Symphony
(Marcia Bartusiak)

My Blog & Videos
writescience.wordpress.com
tinyurl.com/grCentennial
tinyurl.com/grVideos
tinyurl.com/ligoVideos

THANKS!
Different Waves for Different Things
Different Waves for Different Things

10 Msun Black Hole + 10,000 Msun Black Hole

circular orbits

10 Msun Black Hole + 10,000 Msun Black Hole

eccentric orbits

Sounds courtesy S. Hughes (MIT)
USS CYGNUS (Disney’s “The Black Hole”)