
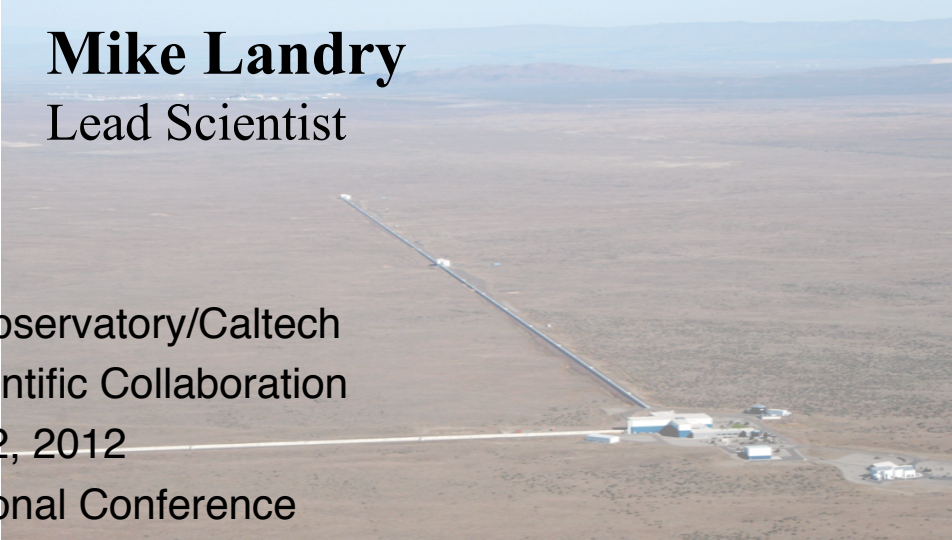




Complexities in Operating Large-scale Gravitational Wave Interferometers



Corey Gray
Lead Operator
Siksika Nation

An aerial photograph of the LIGO Hanford Observatory. The image shows a long, straight, light-colored road or path that runs diagonally across a green, forested area. In the foreground, there are several large, white, rectangular buildings. The background shows a hazy, distant horizon.

Mike Landry
Lead Scientist

An aerial photograph of the LIGO Livingston Observatory. The image shows a long, straight, light-colored road or path that runs diagonally across a dry, brown, hilly landscape. In the foreground, there are several small, white, rectangular buildings. The background shows a hazy, distant horizon.

LIGO Hanford Observatory/Caltech
for the LIGO Scientific Collaboration

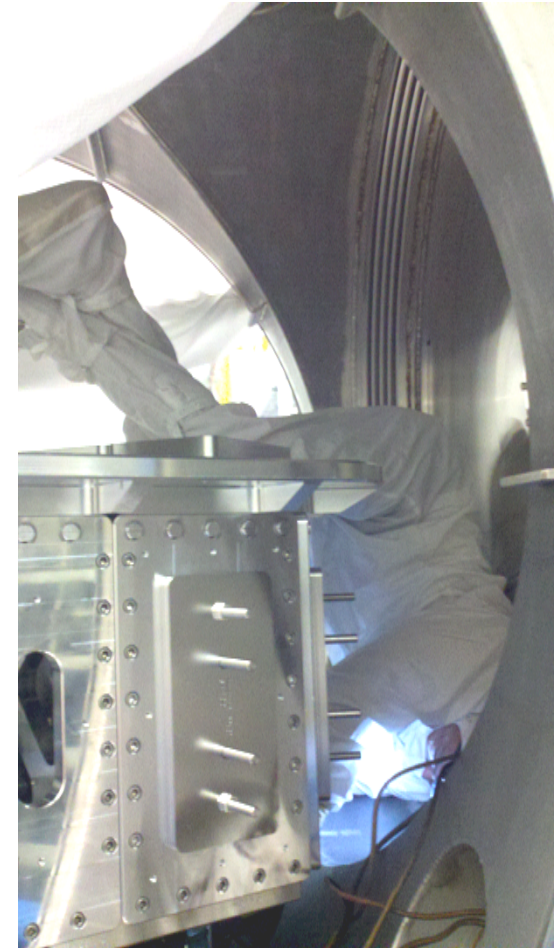
Oct 12, 2012

SACNAS National Conference

G1201071

Outline

- WHO works at LIGO?
- THE WORK at a LIGO observatory
 - » Building
 - » Commissioning
 - » Operating
- Running an Interferometer
 - » What it takes
 - » Investigations/problems
 - » Tweak, perfect, & be quick!
 - » Goal



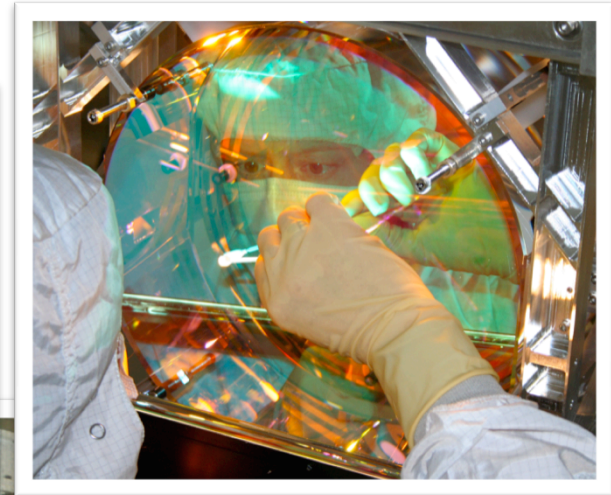
In-Chamber Work



WHO Works At The Observatory



LIGO encompasses a wide array of fields
(Physicists, engineers, technicians, post docs, grad students, interns)



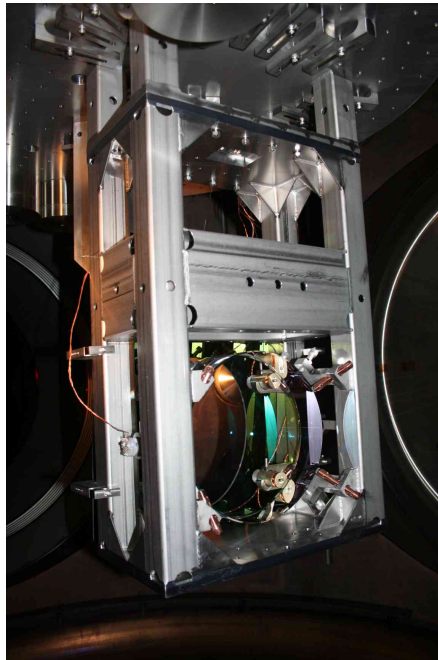
Site Population: 40-90



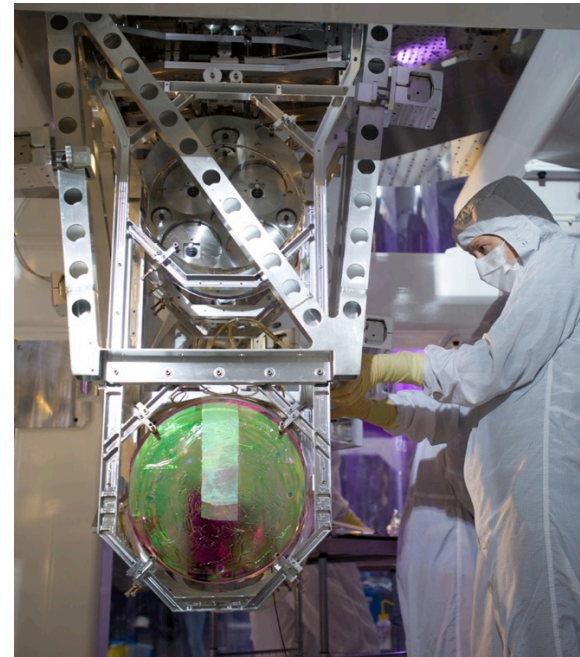
The Work: Assembly

10X more sensitive, >10X harder...

- 14 unique fabricated parts
 - 68 fabricated parts total
 - **165** total including machined parts and hardware
- 188 unique fabricated parts
 - 1569 fabricated parts total
 - **3575** total including machined parts and hardware



Test mass suspension
From **Initial LIGO**



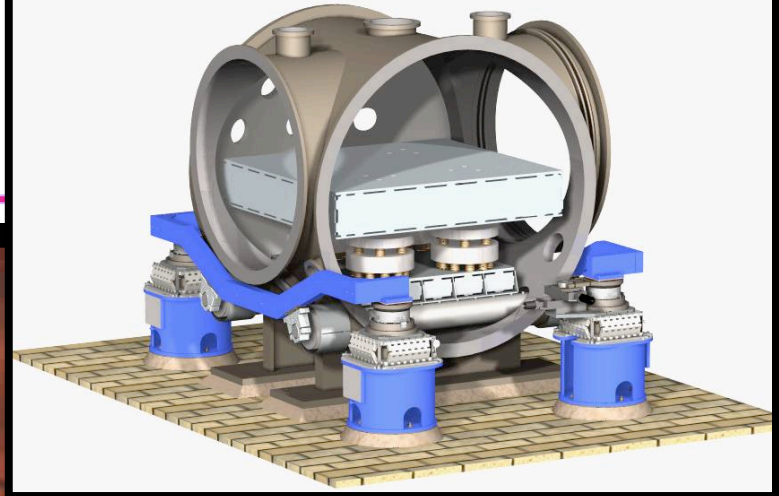
Test mass suspension
From **Advanced LIGO**

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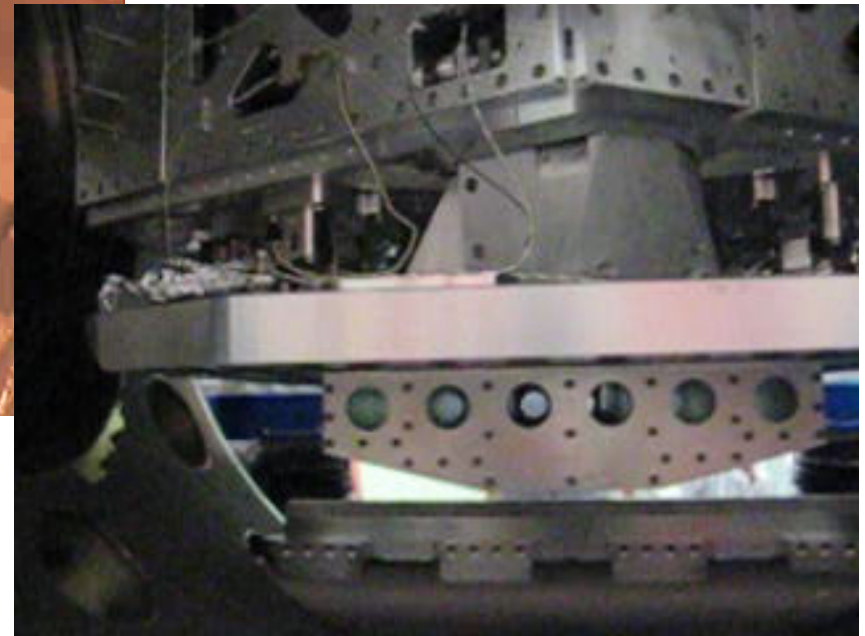


Assembly & The Work: Installation

iLIGO seismic isolation table



Building a Seismic Isolation Table



Installation



The Work: Installation

Building a gravitational wave detector:
One piece at a time.



The Work: Commissioning

Commissioning a gravitational wave interferometer:

- » Putting it all together.
- » Simplify & automate
- » Reduce noise
- » Make ready for detections





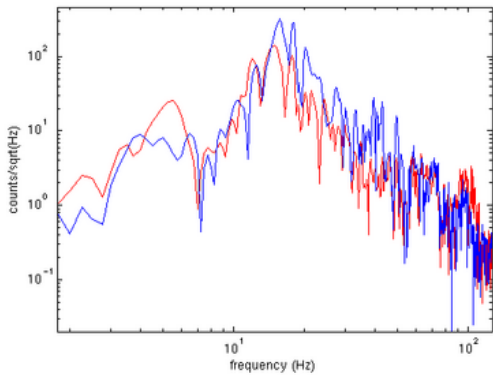
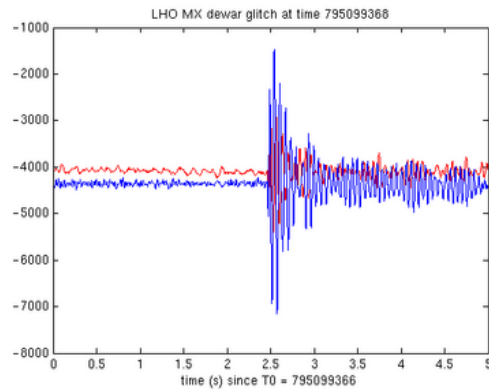
What It Takes

- » 24hrs a day Operation
- » Want a *boring* shift!

Interferometer Arch Enemies:

- » Environmental Issues (earthquakes, wind, ocean storm, etc.)
- » Cultural “Noise” (traffic, dams, logging, etc.)
- » Equipment (computers, laser, liquid nitrogen tanks, ...)

Problem Solving, An Example: *Liquid Nitrogen Tank Jolts*



Original



Thermally insulated



Liquid Nitrogen Tanks

Running An Interferometer



Tweak, Perfect, & Be Quick

- » Real ways to optimize your interferometer:
 - Alignment
 - Optimized damping
 - Monitoring/minimizing site activities
- » Consistency
- » Long & quiet stretches are always what you want

A Quiet Night In LIGO Control Room



Dec 27, 2009 Evening shift
G1201071



Ultimate Goal: Gravitational Wave Detections!

- Keep an eye out for LIGO when we bring our new detector online
- Visit one of our observatories in Washington or Louisiana (or India)
- And drop by our booth today and tomorrow!!



Important Plots

