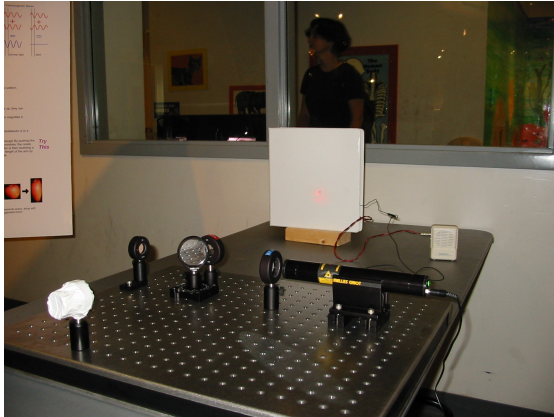


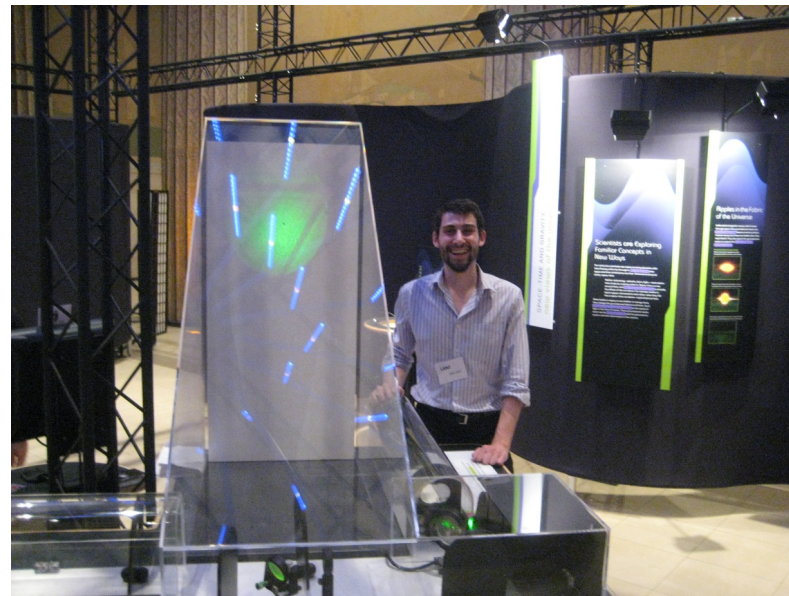
Building Interferometer Exhibits



Keith Riles
University of Michigan



LSC-Virgo Meeting, Arcadia March 14-17, 2011



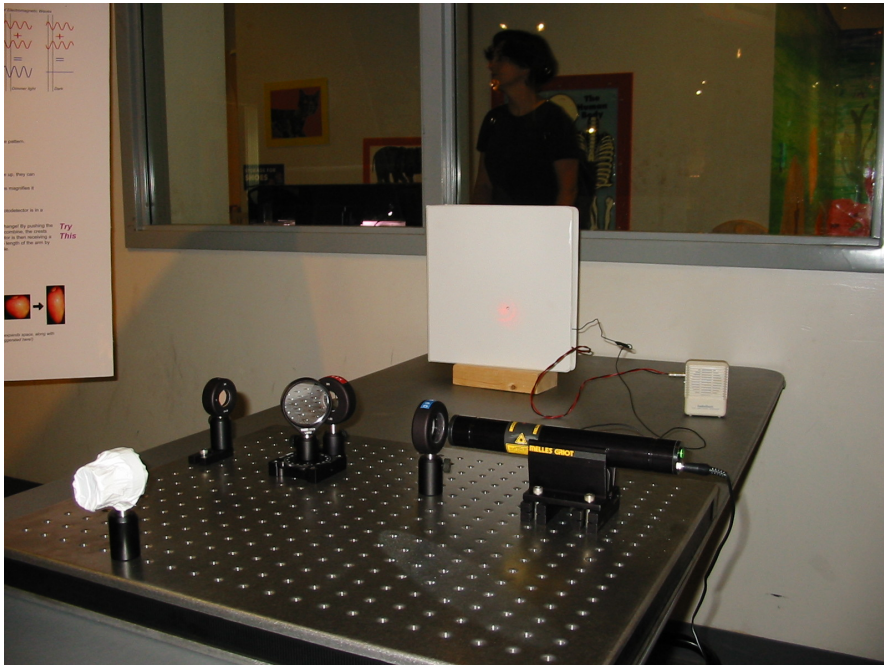
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History of Michigan group's exhibit building

[more details at <http://gallatin.physics.lsa.umich.edu/~keithr/outreach>]

Built 1st prototype Michelson interferometer in spring 2006

- 1 mW red HeNe
- Off-the shelf lenses, beamsplitter
- Optical breadboard
- Retroreflectors for end mirrors (robust against misalignment)
- Photodiode, homemade pre-amplifier and Radio Shack post-amplifier



Built by undergraduate Ramon Armen with electronics assistance from graduate student Evan Goetz

Showed prototype several times over the next year at Ann Arbor Hands On Museum – put together two posters on interferometers and gravitational waves

Ramon and/or I attended exhibit to answer questions and ensure safety

Lessons learned:

- Posters not effective for children
- Need plexiglass enclosure for laser and optics
- A child will do whatever is necessary to destroy alignment



Museum director (Mel Drumm) and staff very enthusiastic about building an exhibit around the prototype

Settled upon a “kiosk” cabinet housing with addition of an interactive “electronic label” using a small computer running a flash program

All optics & laser fully enclosed, but external operated level allows beam blocking to make fringes come & go

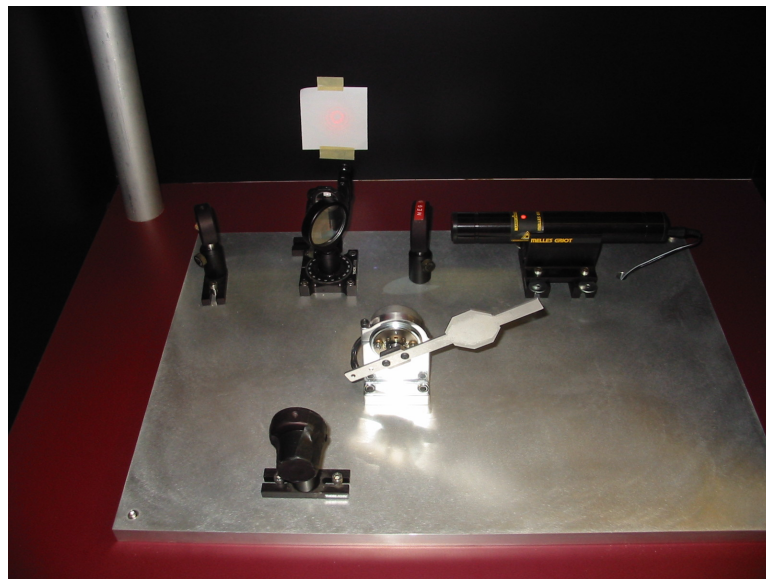
Exhibits staff (John Bowditch, Charlie Stout, Dave Stapp) built the cabinet in about ~1 year (in parallel with other exhibits and work)

Cabinet costs footed by the Museum

Installed in museum’s Light & Optics Gallery in December 2008



Near end of construction...



Back
access
panel

Joined LSC Education and Public Outreach Committee in 2008

Hi Dave,

I am interested in participating (to a limited degree) in this working group. I have some experience in working with a science museum here in Ann Arbor and have some ideas to share, but I'm afraid I would not be able to spend a lot of time on the effort.

cheers,
Keith

One thing led to another...

World Science Festival – June 2009

Subcontract to Museum to build a copy of the kiosk exhibit for the traveling LIGO exhibit

Michigan provided laser, optics, photodiode, preamplifier

Museum staff added small refinements to 1st copy:

- New motif to match rest of LIGO exhibit
- Improved housing for photodiode



John, Charlie and Dave with final exhibit in museum's fabrication shop

Off to New York!



At fabrication
facility in
New Jersey

World Science Festival – June 2010

Subcontract to Museum to build another copy of the kiosk exhibit for the traveling LIGO exhibit

Again, Michigan provided laser, optics, photodiode, preamplifier

Museum staff added more refinements to 2nd copy:

- Improved plexiglass enclosure
- Improved beam stopper control
- Improved window for photodiode (adjustable translucent filters)



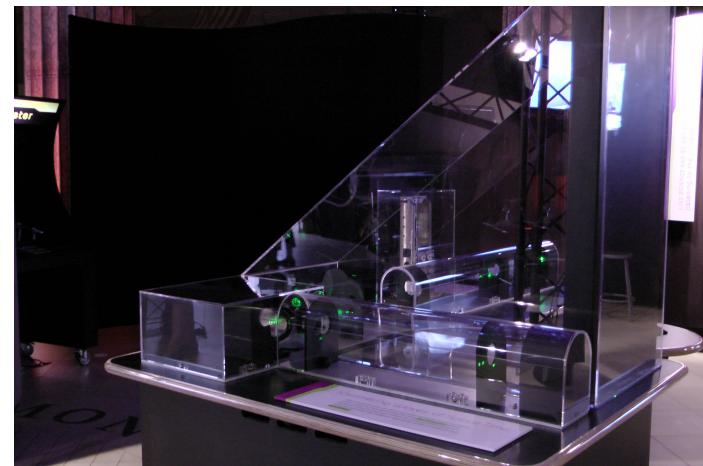
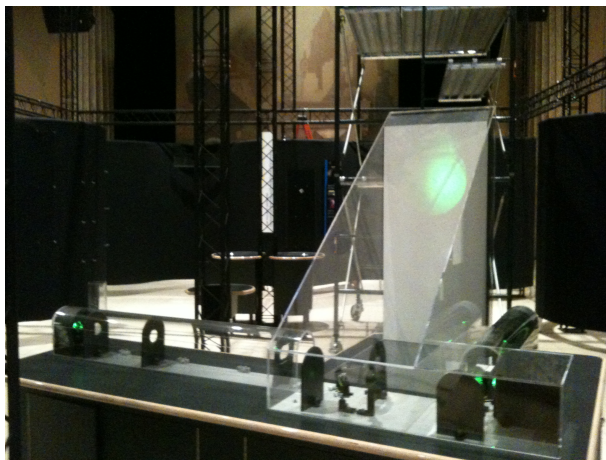
World Science Festival – June 2010

Volunteered to build a tabletop interferometer for large WSF 2010 Exhibit

- 60 mW green Nd-Yag (Laser Lab Components) – 50-m coherence length
- Asymmetric arms to give bullseye fringe pattern
- Customized plexiglass enclosure
- Baffles to block stray light
- Photodiode with audio amplification
- Designed and built by graduate student Grant Meadors
- Supporting table built by contractor

More details at

http://gallatin.physics.lsa.umich.edu/~keithr/outreach/index_ifo4.html



World Science Festival – June 2010

Some issues:

- Laser more powerful than needed → Attenuated output for safety
- Practical issues in fringe formation:

Retroreflectors do provide robustness against misalignment, but centering beam leads to unaesthetic artifacts in fringe pattern:

Displacing beam to side of retroreflector moves artifact away from bright center of fringes, but increases horizontal width of baffle apertures

→ Harder to suppress stray beams

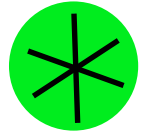
Eyecatching fringes need to be large and at eye level

→ Projection at a distance (via a short-focal-length lens)

→ Large plexiglass enclosure

Beam clipping was a nuisance – required iterative alignment

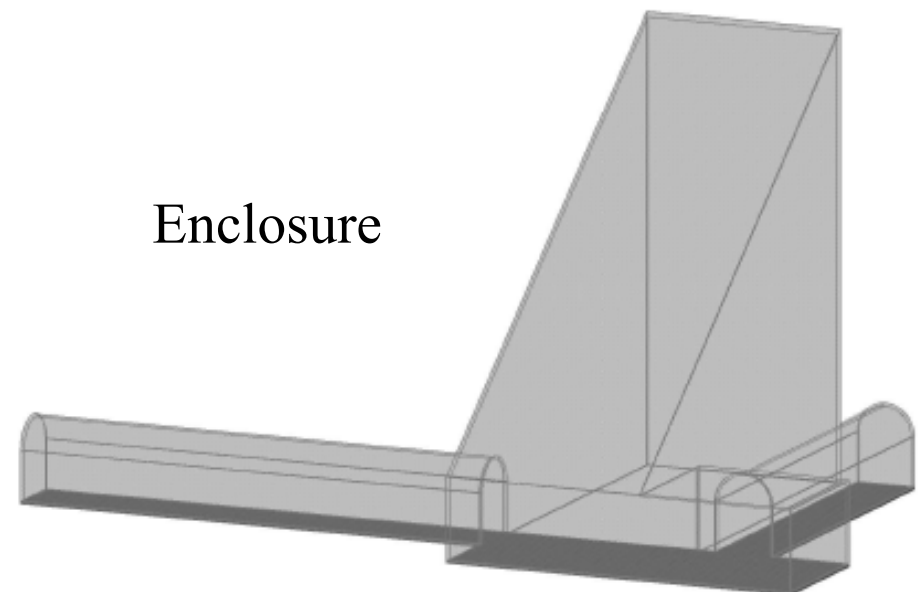
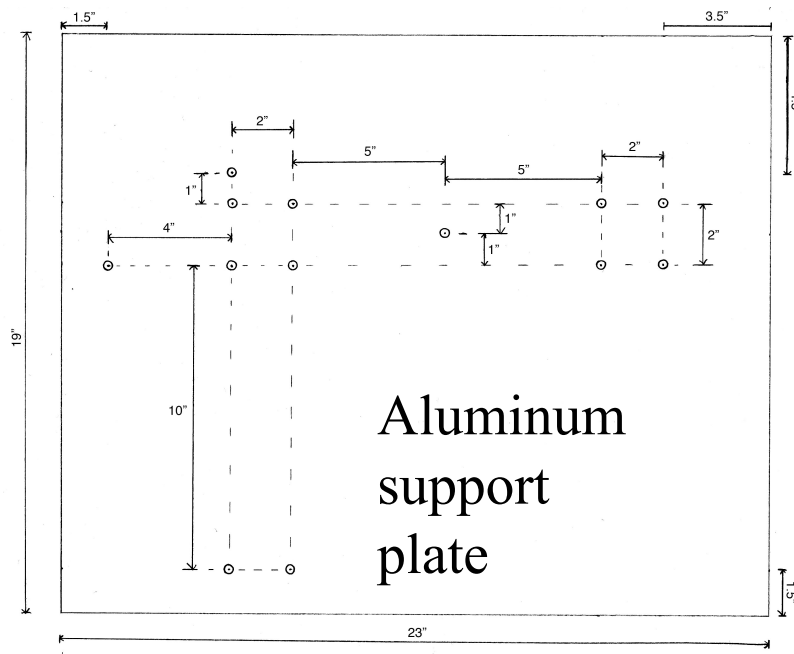
→ “Next time” – use larger optics



World Science Festival – June 2010

Some issues:

- Working with plexiglass fabricator (local Michigan firm) required many iterations → Final result was satisfactory
 - But enclosure was heavy!
 - With delicate glue joints where arms join the corner station
 - Required ≥ 3 persons to move
 - Real pain during prep work in Michigan lab



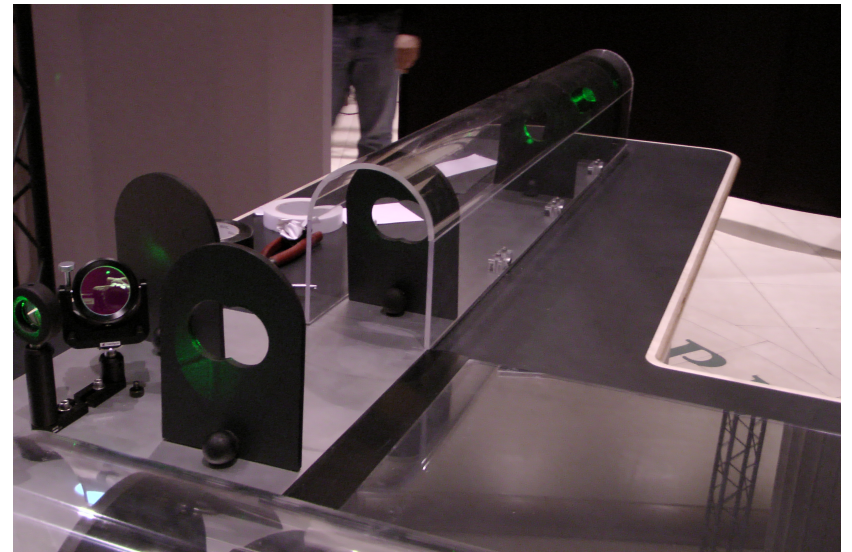
World Science Festival – June 2010

Fortunately, during transport into the U-Haul truck, the joints broke, making final prep work in New Jersey and Manhattan much easier!

Turned out we didn't need them glued in the first place



Prepping in Manhattan

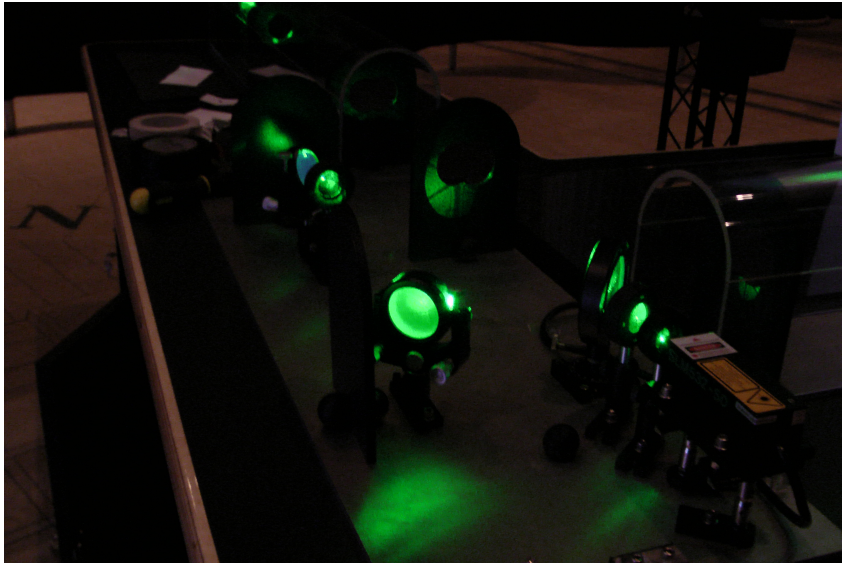


World Science Festival – June 2010

Some issues:

- Working with local contractor on screen / photodiode box and baffles was frustrating
 - Screenbox quotes kept changing, despite Grant's having provided a full-scale mockup at the outset
 - Delivered screenbox had a backing we didn't want
 - We sawed a slot in it to get an easily detachable cable to photodiode

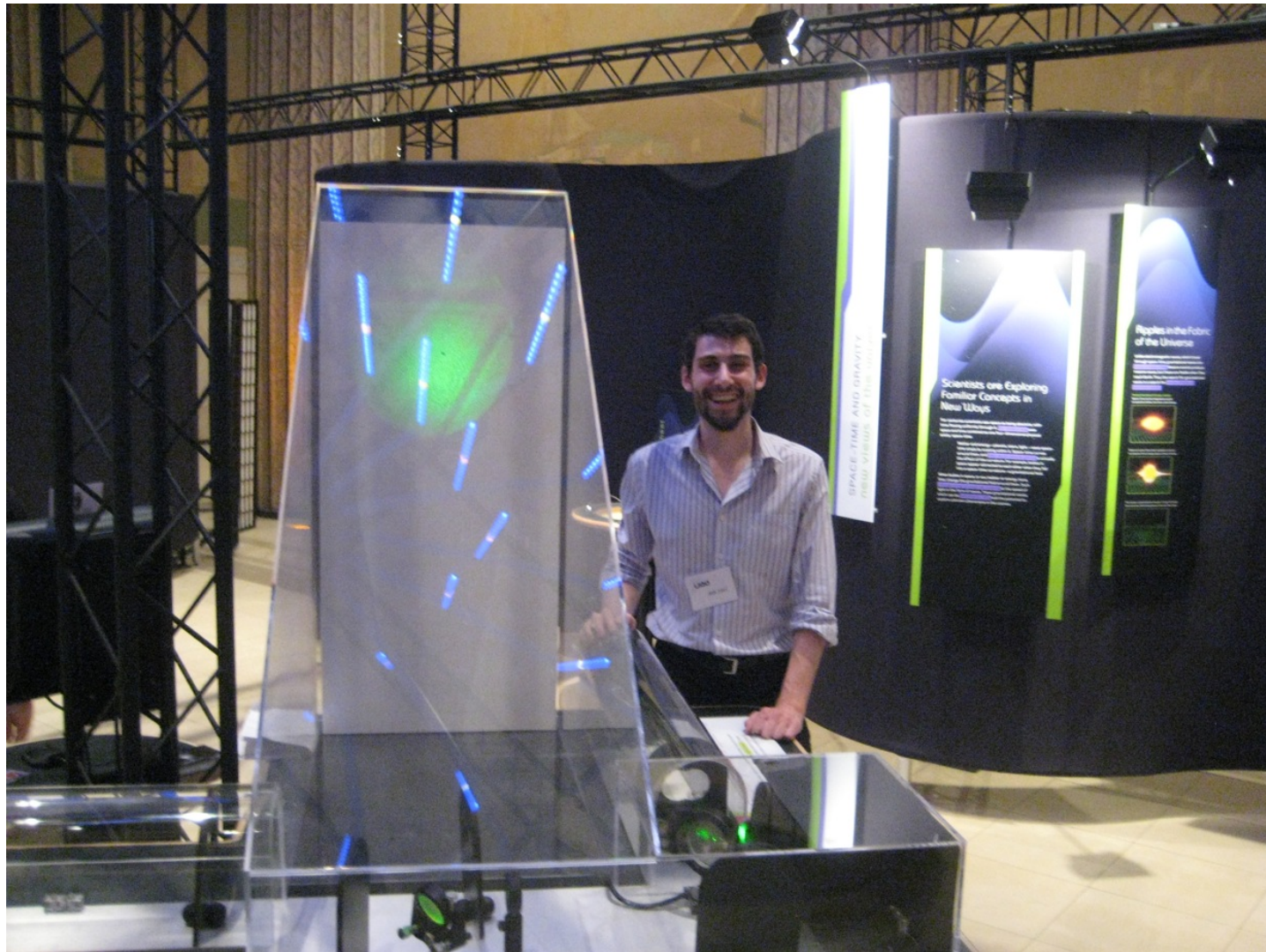
World Science Festival – June 2010



More close-up images



The Big Picture



Building robust interferometer exhibits is a lot of work, but fun too!