

Hall A Compton Upgrade

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Jefferson Laboratory

Parity Experiment Meeting
February 19, 2010



Thomas Jefferson National Accelerator Facility

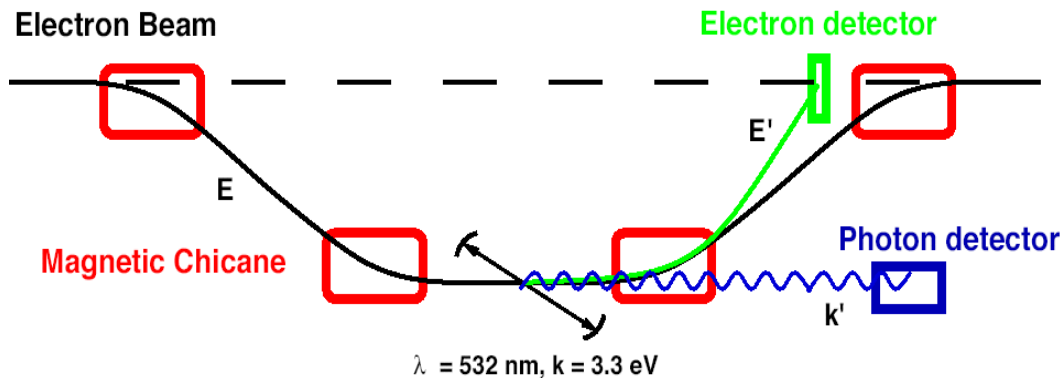
The Hall A Compton Polarimeter Upgrade

Goal:

Provide 1% beam polarimetry up to 11 GeV.

High precision Parity violating experiments are feasible with this upgrade

Scope:



New Electron Detector

- High resolution silicon microstrips
- Movable in dispersive plane for high energy coverage
- requires green cavity for low energy operation

New Photon Detector

- Full shower GSO calorimeter
- Can count, can integrate
- Good low energy detector with any wavelength cavity

High Power Green Fabry-Perot Cavity

Twice the Analyzing power of present IR cavity

➔ Increased Figure-of-Merit at any energy!

Participating Institutions: Jlab, Syracuse, Clermont-Ferrand, CMU, UVA, Duke, ODU

Electron Detector

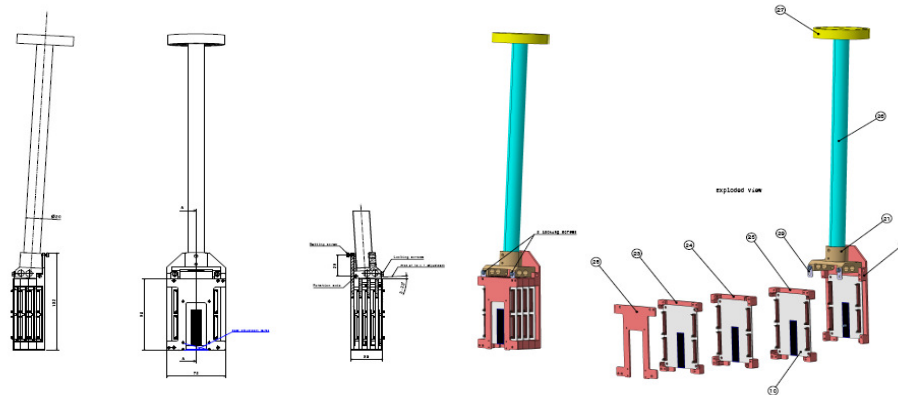
LPC Clermont-Ferrand

- **Goal**

- Stand-alone Asymmetry measurement with improved tracking resolution
- Provide absolute energy calibration for photon detector

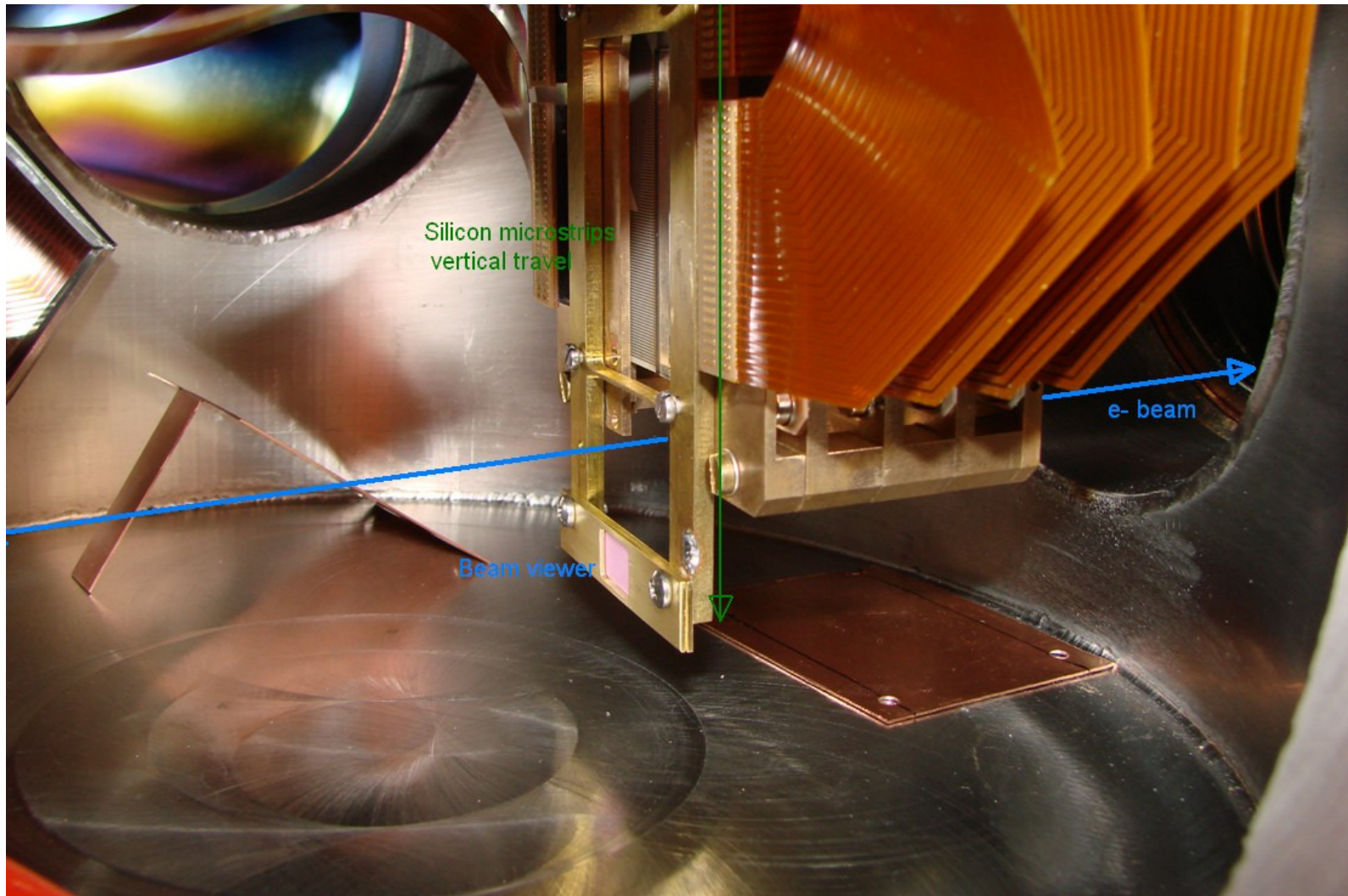
- **Scope**

- 768 ch 240 μm pitch silicon μstrips
- 4 Planes, 192 strips/plane, 1 cm spacing between planes
- 120 mm Vertical motion to allow coverage of Compton edge from 0.8-11 GeV
- New electronics, DAQ, and Analysis Software



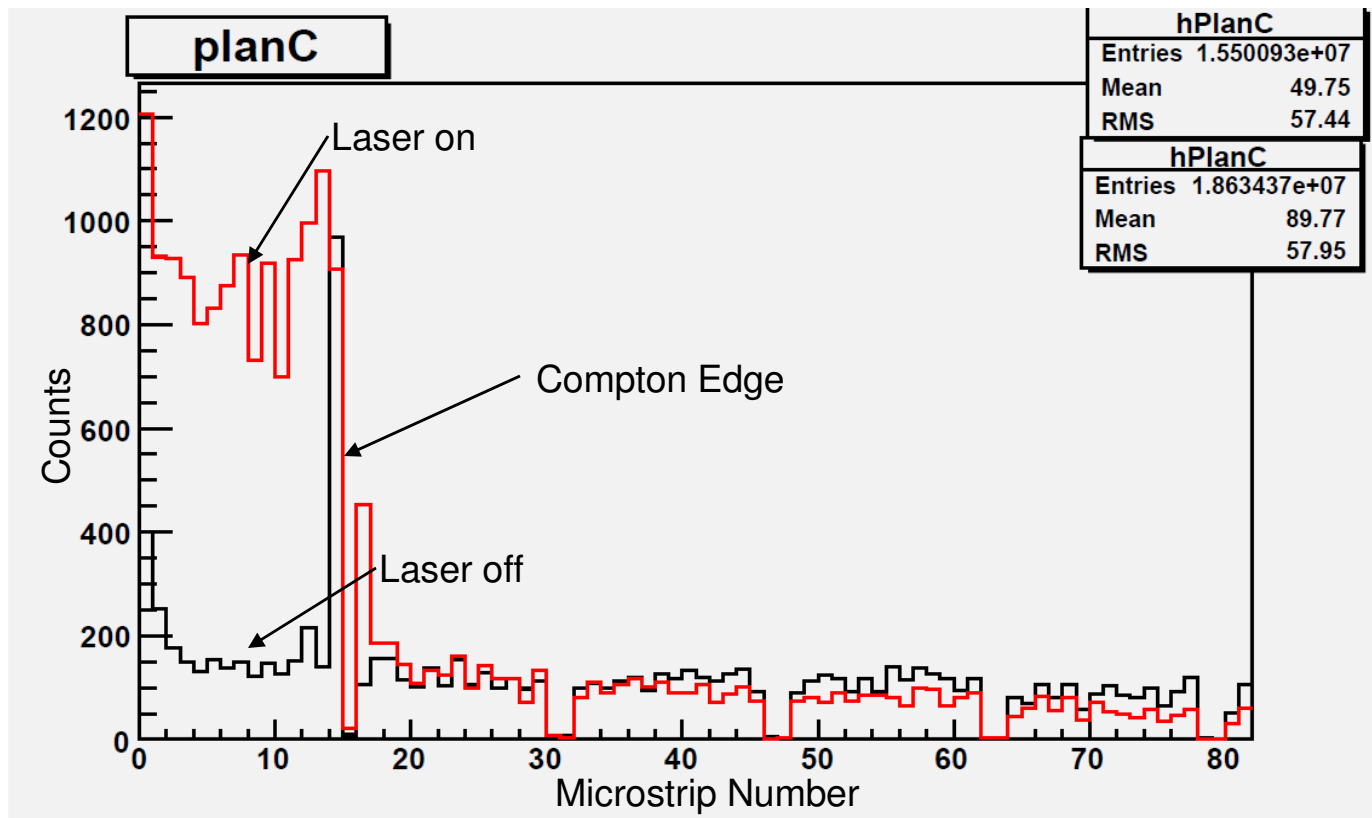
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E-detector Installed



Compton Electron Spectrum

- **First Compton Scattered electron spectrum obtained in the new silicon microstrip e-detector in April 2009**
 - Singles spectrum with 3GeV electron beam
 - Detector plagued with low efficiency. Commissioning efforts continues to improve performance, stay tuned for Alex Camsonne's talk

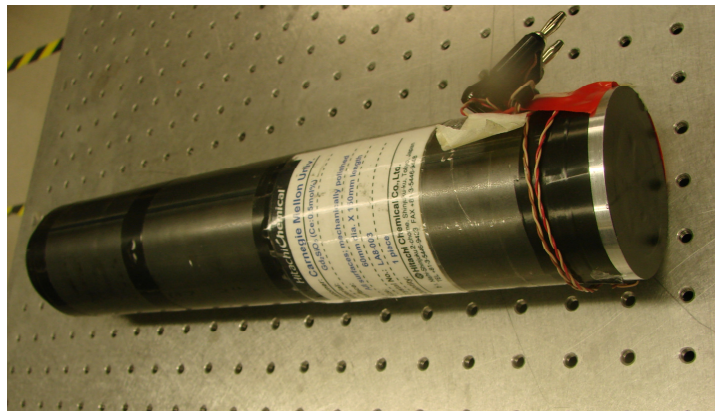


Photon Detector

Carnegie-Mellon University

- Calorimeter

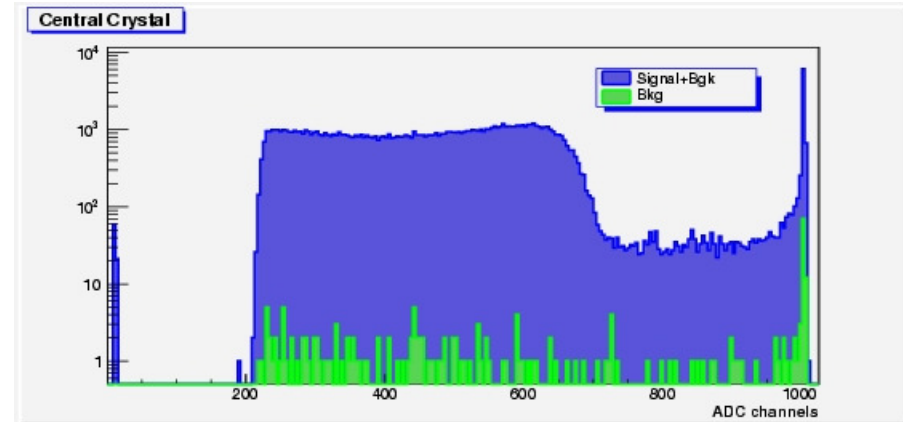
- Single crystal GSO, 6 ϕ x15 cm cylinder supplied by Hitachi Chemicals
 - High light output, fast decay time (less than 60 ns)
 - Triggered counting as well as continuous integration.
 - Assembled and tested and installed by the CMU team
- Performance of the GSO calorimeter meets our goals!
Acquisition and analysis package - work in progress.



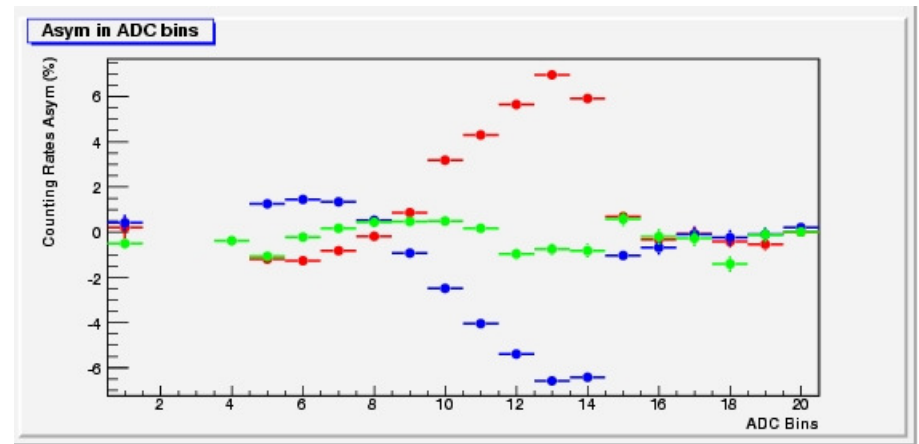
Backup crystal order under consideration

GSO Calorimeter Performance

- First photon Spectrum and Asymmetry with counting DAQ obtained October 2008



- $E_e = 5.9$ GeV
- $E_\gamma = 0.2 - 0.8$ GeV
- $P_{cav} = 450$ W@1064 nm



Green Fabry-Perot Cavity

Jefferson Lab, Syracuse U, and Duke

- **Specification**

- Intra-cavity power 1.5 kW
- Wavelength 532 nm
- Mode CW/ TEM₀₀

- **Solution**

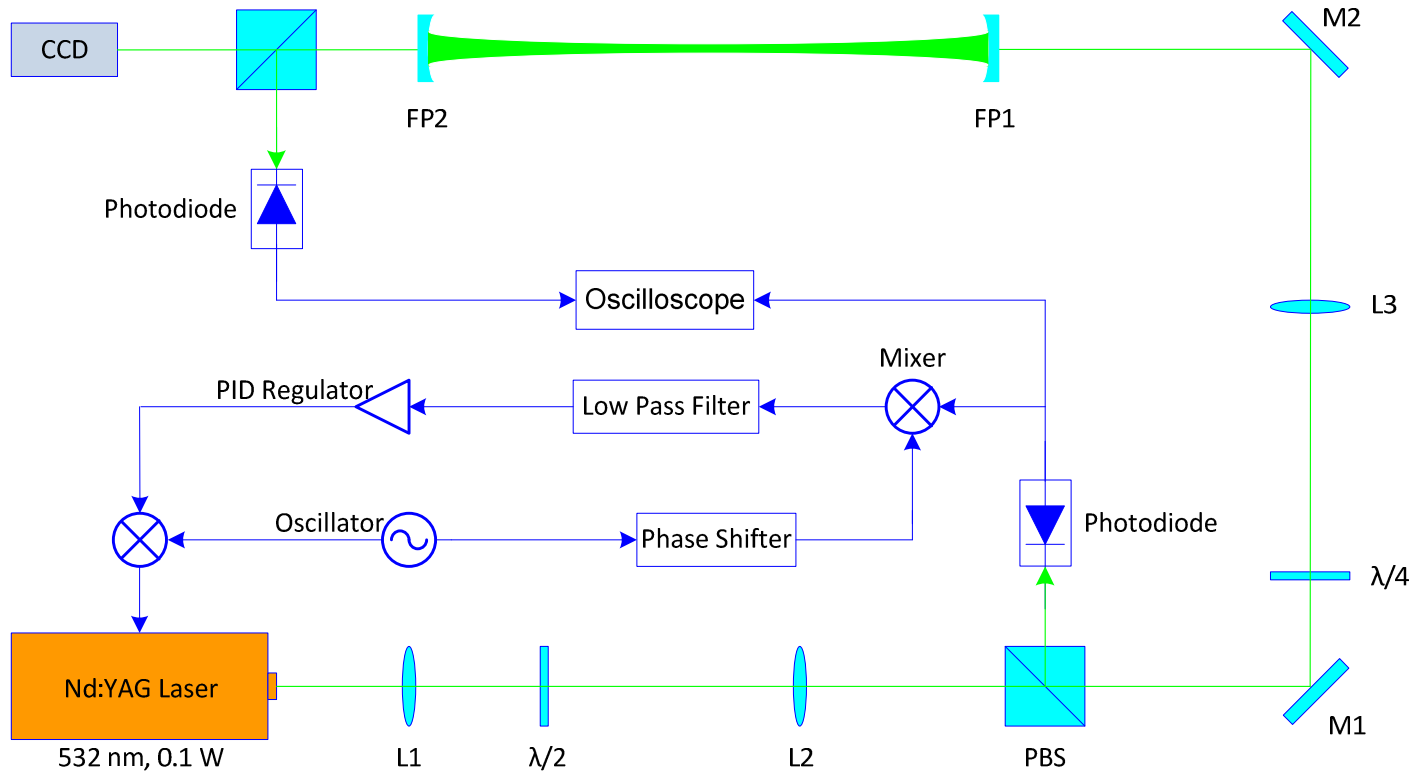
- IR seed laser + Ytterbium Fiber Amplifier + PPLN doubler -> FP Cavity
- Homemade Pound-Drever-Hall cavity locker electronics

- **Achievement**

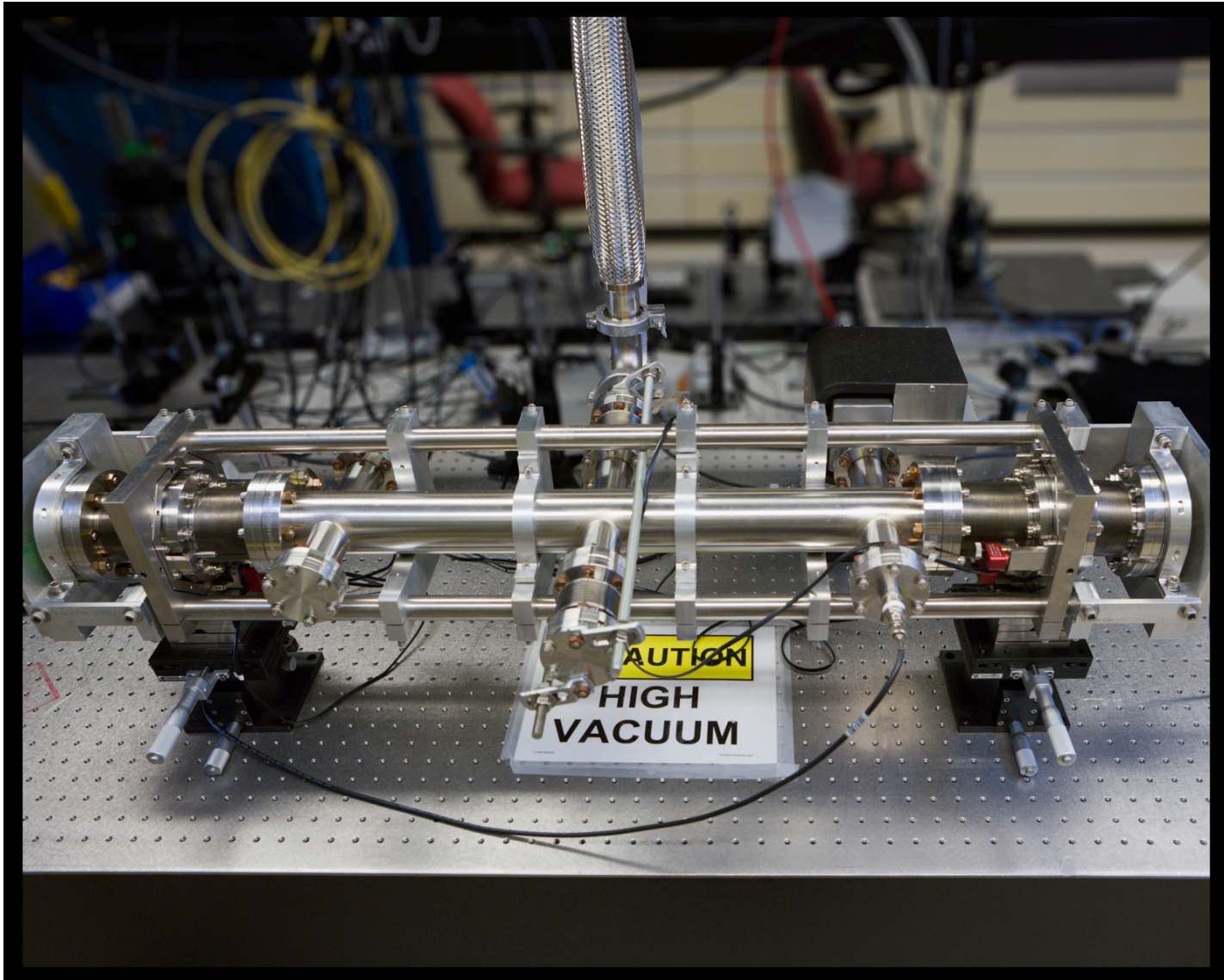
- Successfully acquired lock at ~ 5 kW in test bench Oct-Nov '09



Optical setup



Cavity in the Compton Lab



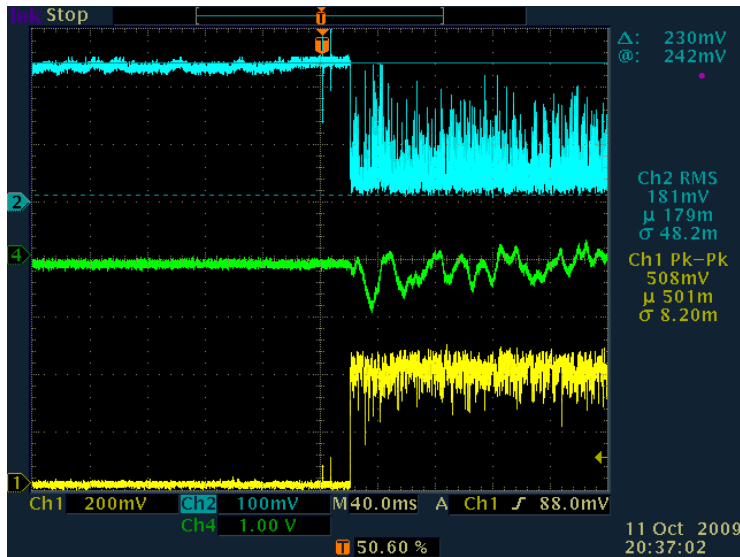
Photograph: Alan Gavalya

Cavity Lock Acquisition

- Our cavity bench test

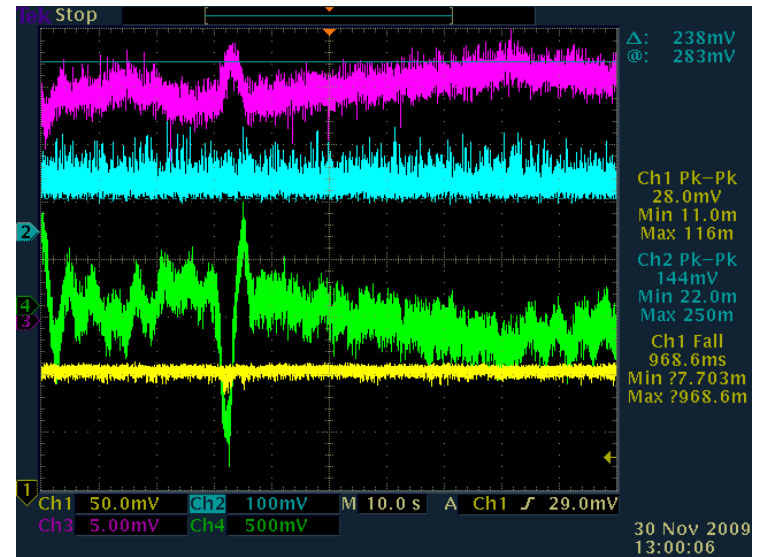


performance record!



- Slow Feedback
- Reflected Power
- Fast Feedback
- Transmitted Power

- First short lock with ATF-80 mirrors (gain ~ 7500) acquired Oct 11, 2009

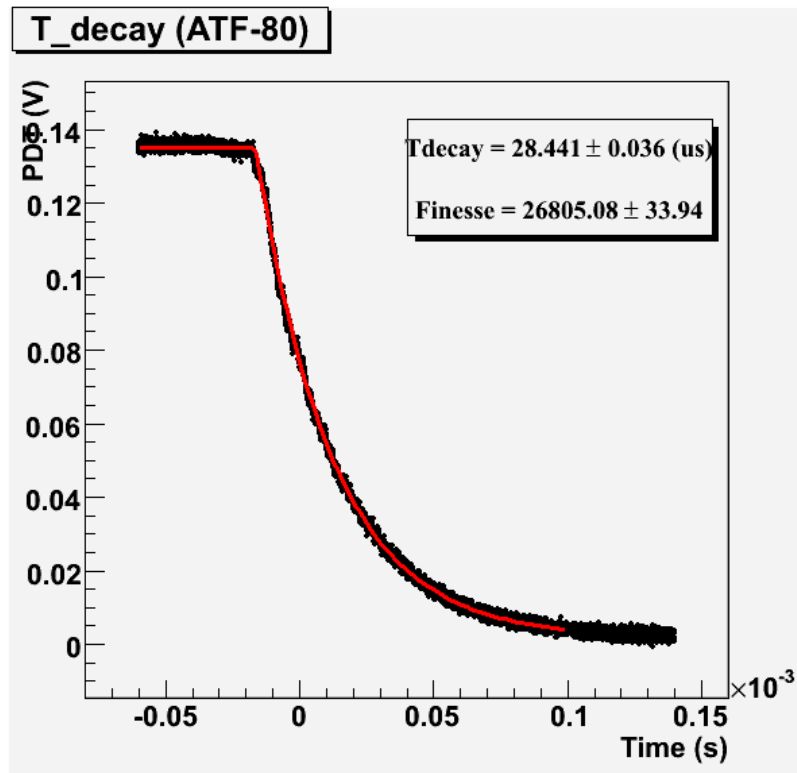


- Longer and more stable lock acquired Nov 30, 2009



Mirror Performance

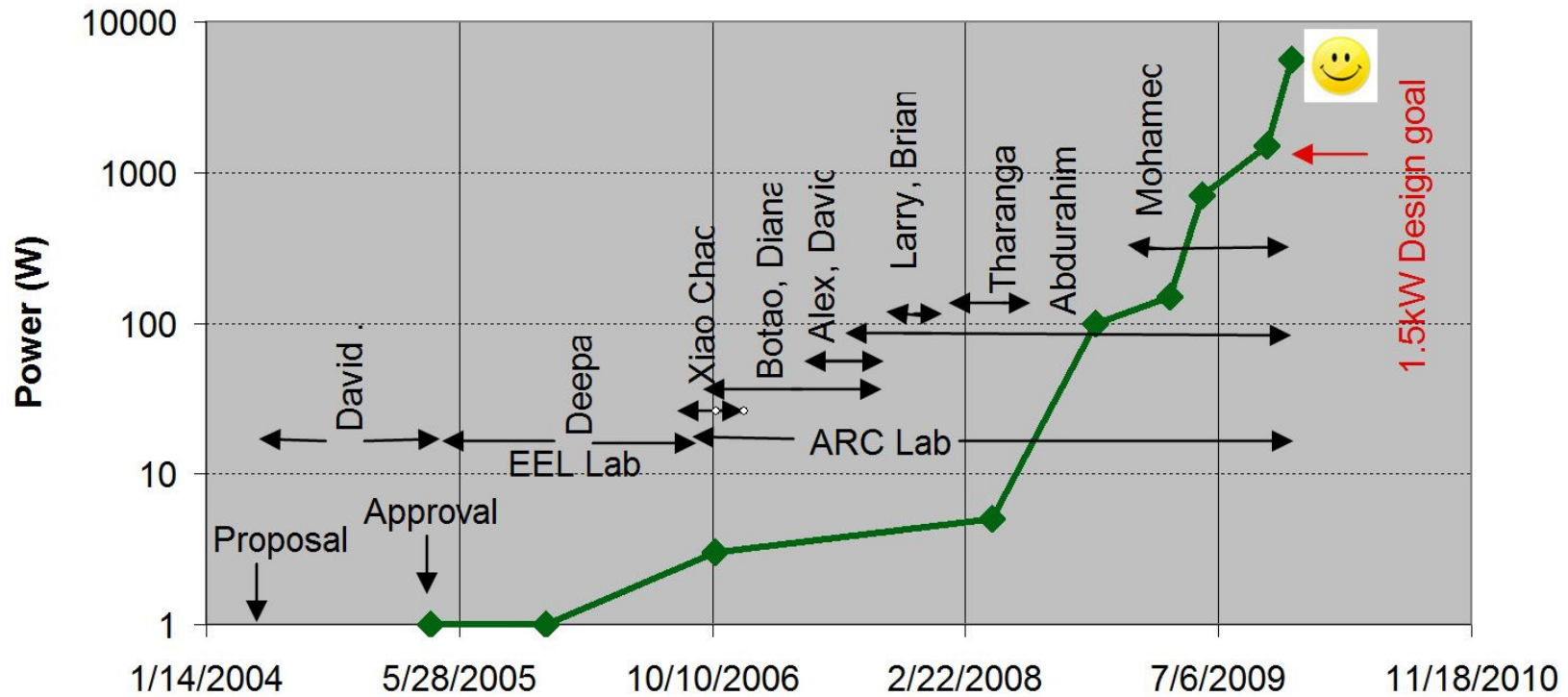
Cavity Decay time



- ATF-80 Mirror (Advanced Thin Films, Boulder, CO)

	Specs	Measurement
Diameter	7.75 mm	
ROC	500 mm	
Thickness	4 mm	
Transmittance	100	87 ppm
Loss	10	13 ppm
Finesse	28560	26800
Gain	8000	7500

The 5kW journey - Hall A Green FP Cavity



Installation Progress



New laser hut!
– no more working in a tin can☺



- Hard-wall laser enclosure installed (J. Miller, N. Wilson)
- Laser Interlock system installed (M. Taylor)
- HEPA filter system installed (E. Smythe)
- Electricity/phone/net installed (R. Sprouse)

• LSOP approved for operation Jan 26, 2010
Thanks to coordination by Mohamed and Vladimir

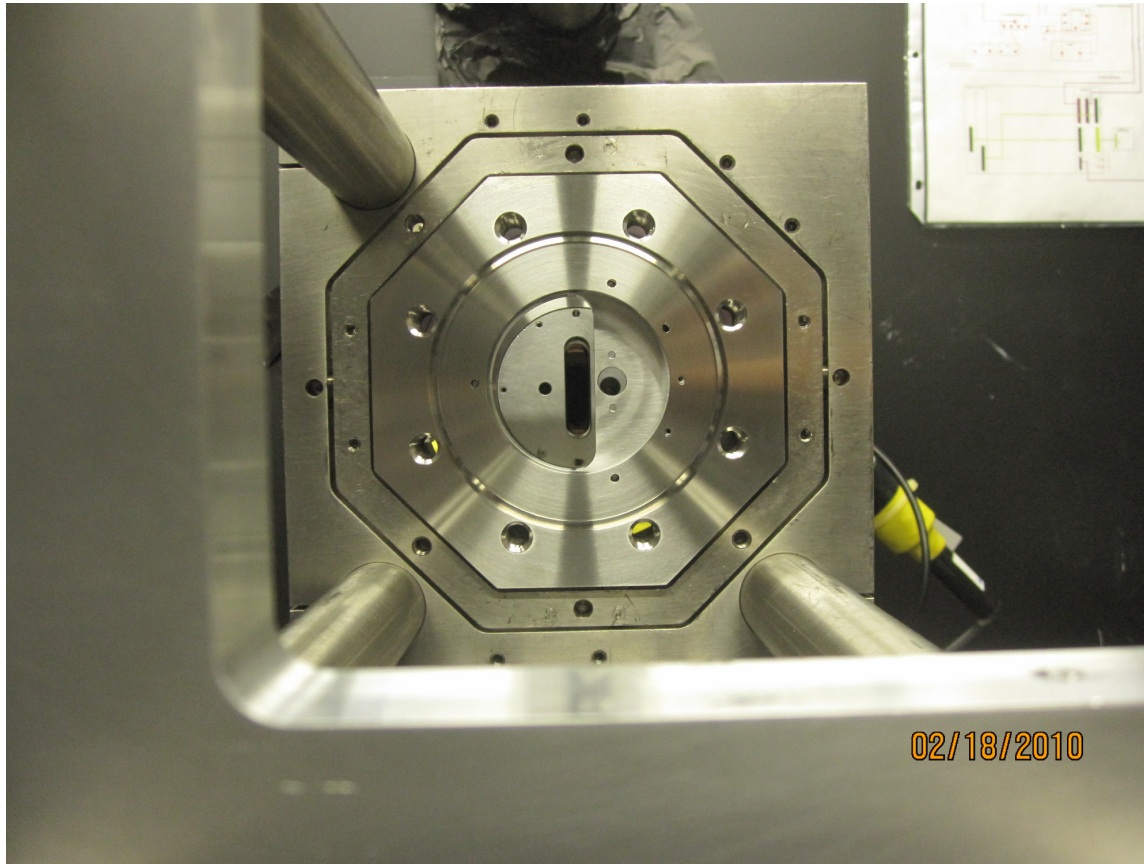
Optics Table



Green cavity installed – *no vacuum chamber yet*
Green optics installed – *not fully aligned yet*

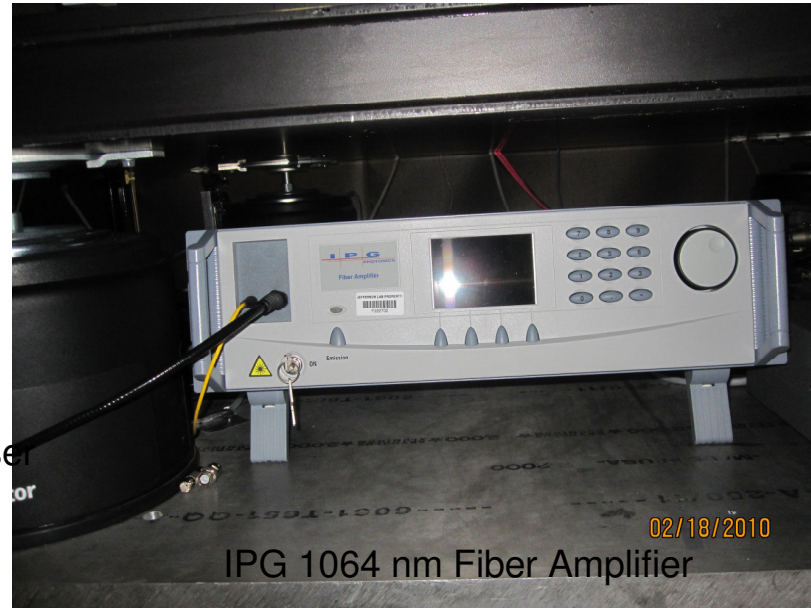
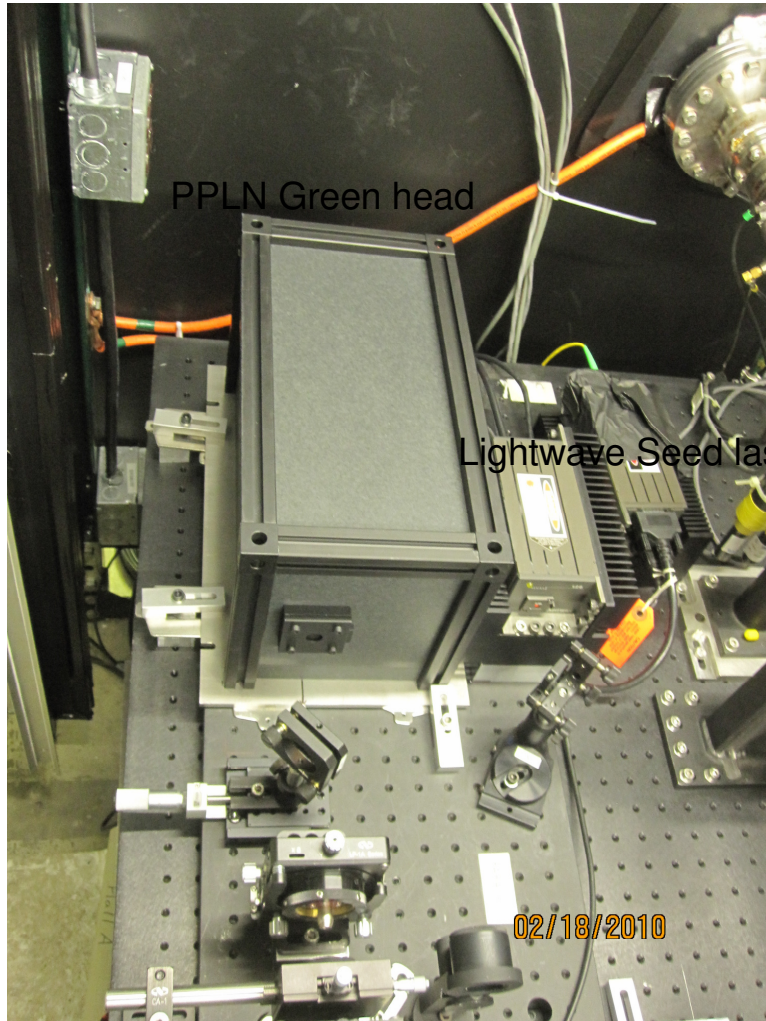
Mirror Gimbals

Cavity mirror gimbals installed. Thanks to Abdurahim!

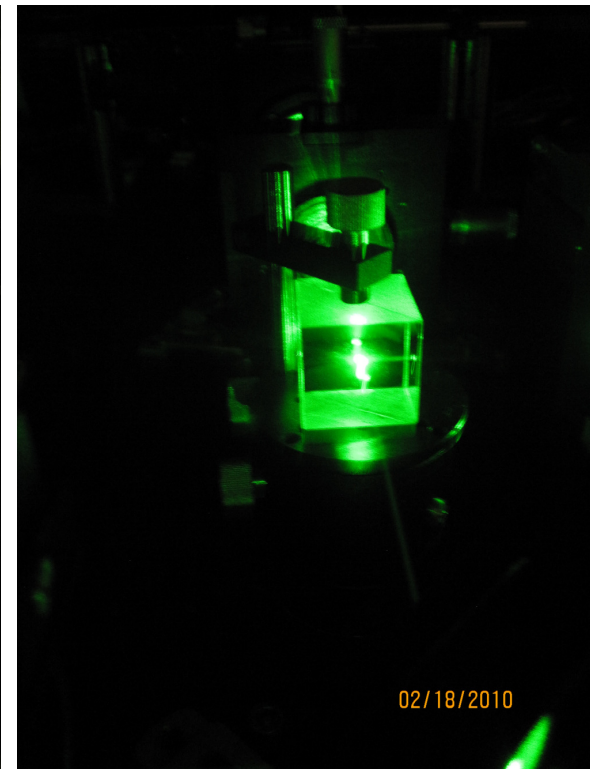
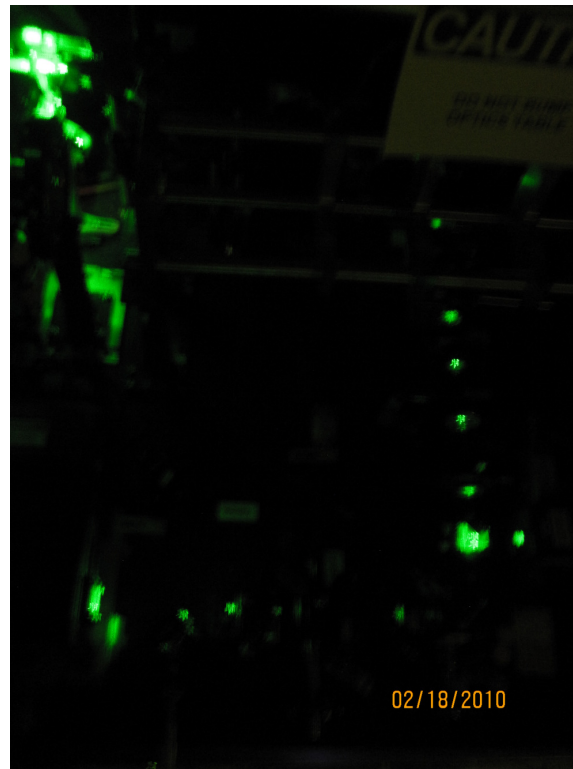
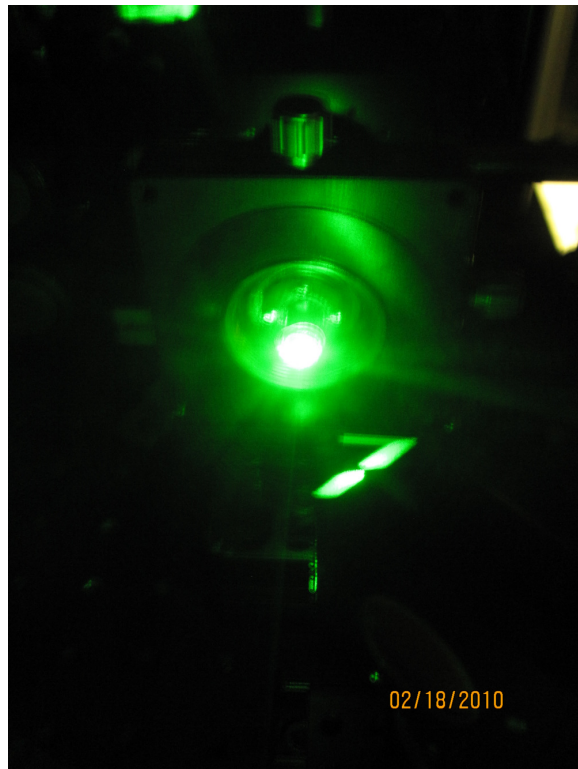


02/18/2010

PPLN Laser installed

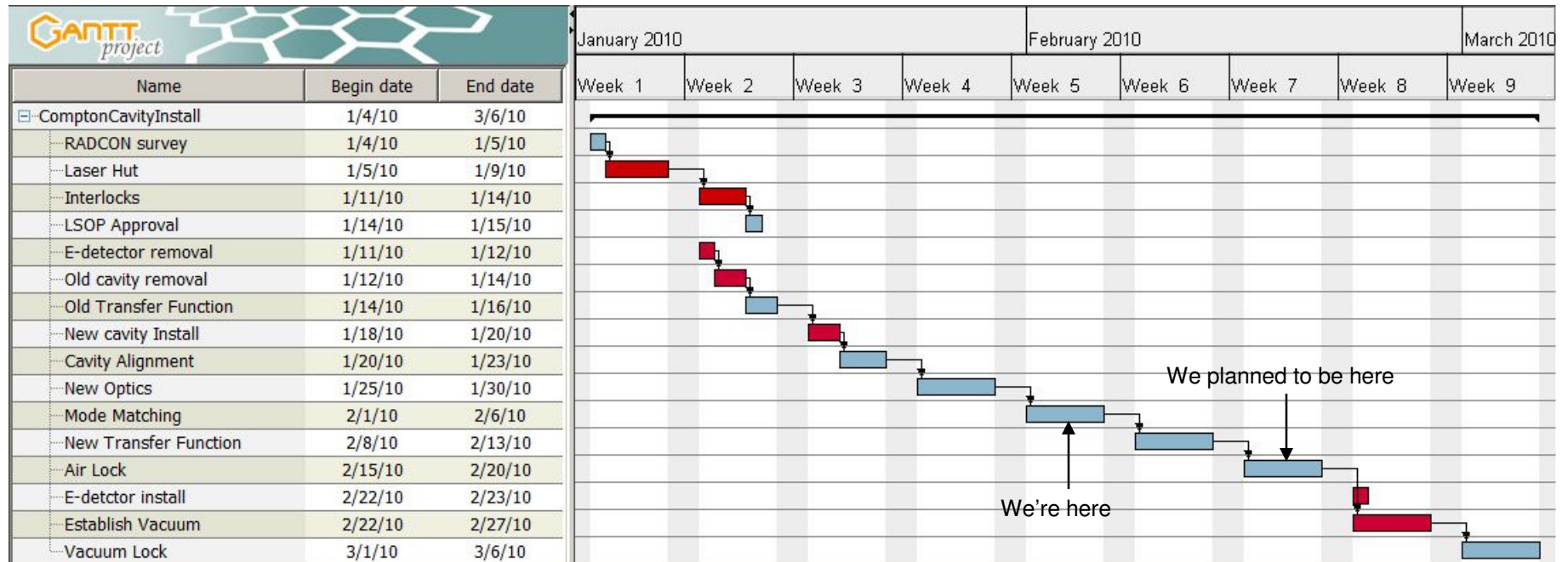


Green laser system commissioned

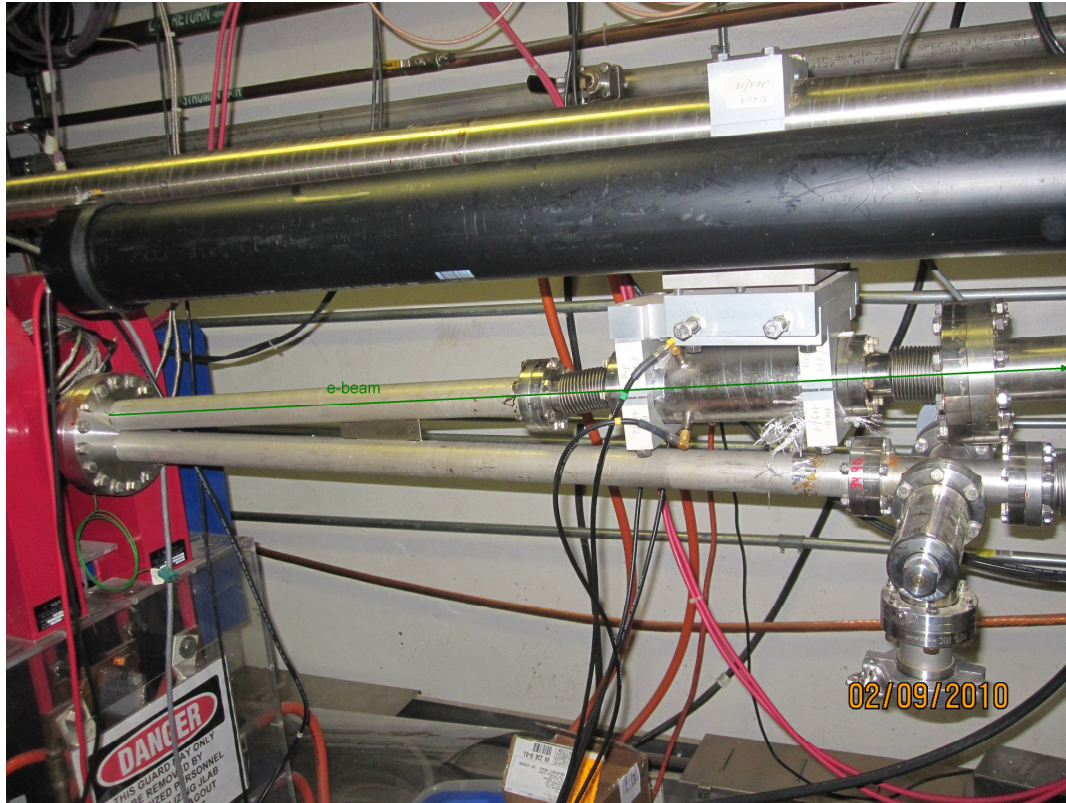


Schedule

- Green Laser and Cavity Installation – *the plan from December '09*



Kinky Beamline



After uncovering thermal shields from the Beamline, we find out that many bellows in the Compton chicane are kinked. It dates back to initial installation of 1997.

Given that we have run the Compton successfully with a kinky line over the years, proceeding judiciously in straightening kinks out

A survey of where things are is next week.