

# Compton Green Laser & Cavity Status

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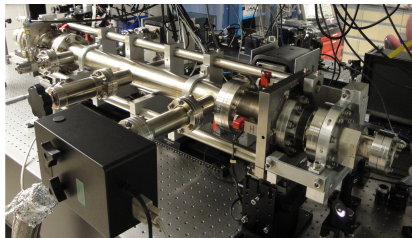
## Goals:

- Achieve  $\sim 1\%$  beam polarimetry for PREx
- Cover a broad operating range for 1  $\sim$  11.0 GeV electron beam
- Cut short the polarization measurement time by continuous and non-invasive monitoring of the electron beam, achieve precision polarimetry

## Implementation:

- Laser power is amplified by a Fabry-Perot resonant cavity to provide high photon flux
- Laser light has to be highly circularly polarized to give Left/Right backscattered photons and recoil electrons detectable
- Power amplification is achieved by detecting the phase of the resonance from reflected light off the cavity and feeding it to a tunable element to stay "locked" to resonance

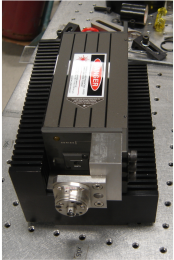
Intra-cavity power	1.5 kW
Q-factor	$5 \times 10^{12}$
Optical gain	$\sim 4,700$
Wavelength (CW)	532 nm, $TEM_{00}$
Bandwidth	11 kHz
Length	85 cm
Mirrors	0.5m ROC, 7.75mm Dia.
CIP spot size ( $\sigma$ )	87 $\mu\text{m}$



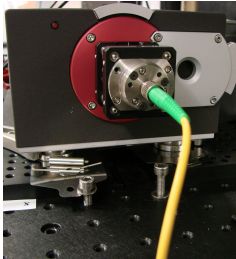
## Solution:

- 1 IR seed laser + IPG Fiber Amplifier + single pass PPLN doubler  $\rightarrow$  FP Cavity  $\rightarrow$  Feedback to seed laser PZT to lock
- 2 High Finesse cavity mirrors from Advanced Thin Films (ATF).
- 3 Depend on the seed use either French or CavLock electronics

- We have three seed lasers with two different types are on hand.



Lightwave



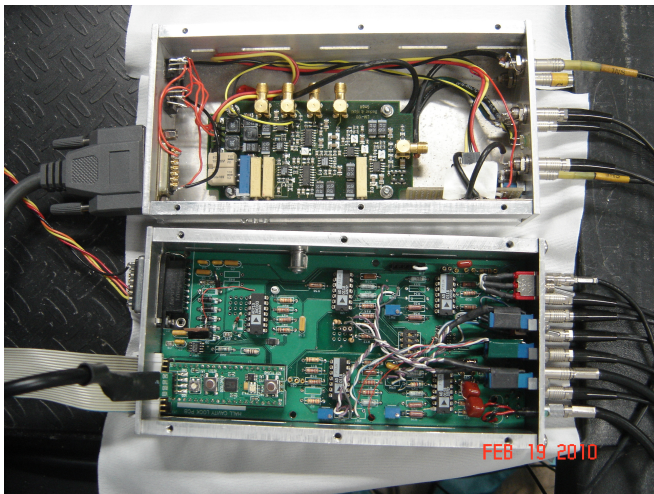
Prometheus



Mephisto

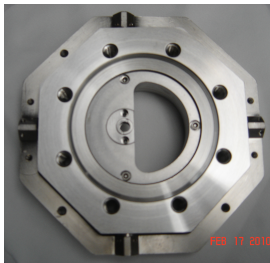
- French servo system can be tried first with Lightwave.
- CavLock has been working reasonably well with Prometheus, might work with Mephisto as well.

- CavLock servo box reasonably demonstrates compatibility for locking our cavity in the lab

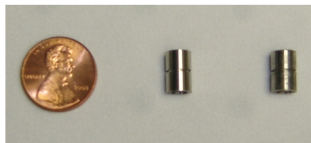


new on cavity:

- 1 Worked hard on improving cavity stability
- 2 Designed a new mirror adaptor ring and mirror holder



New Gimbal with mirror mount

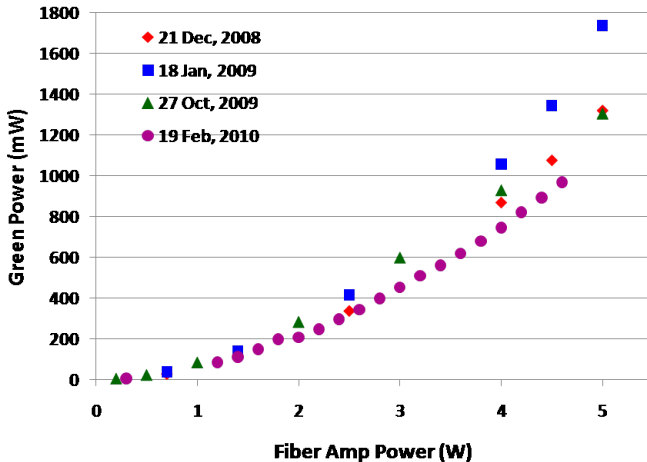


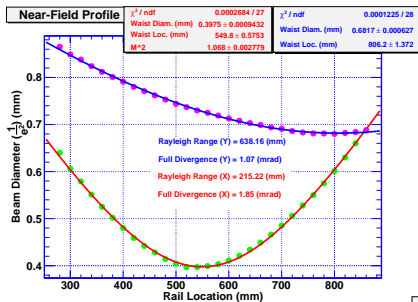
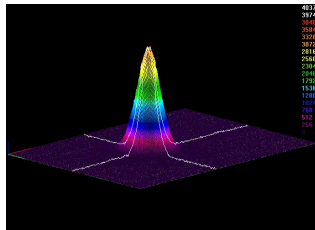
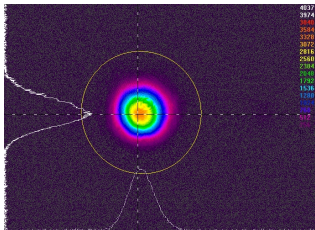
C-Flex Bearings



Cavity Plunger

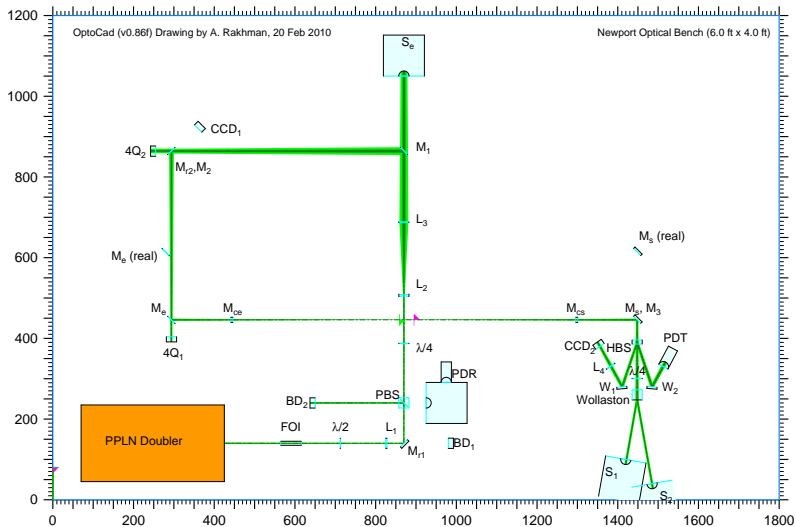
- PPLN crystal has been in use since 2006, most extensively since 2008
- Getting a good conversion efficiency without worrying about beam quality







## Green Cavity Optical Setup

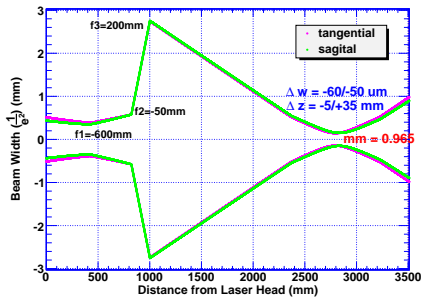


(PPLN Profile at 100 mW)

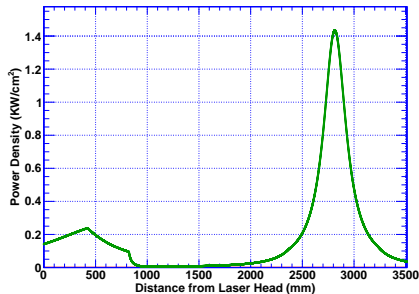
2010-02-20

Power Density @ 1 W

2010-02-20



Beam Profile



Power Density

- ① Established a good locking scheme and servo feedback mechanism
- ② Polarization transfer studies are next priority
- ③ Schedule is tight, but hopefully will be ready for PREx !

