Compton Laser Status

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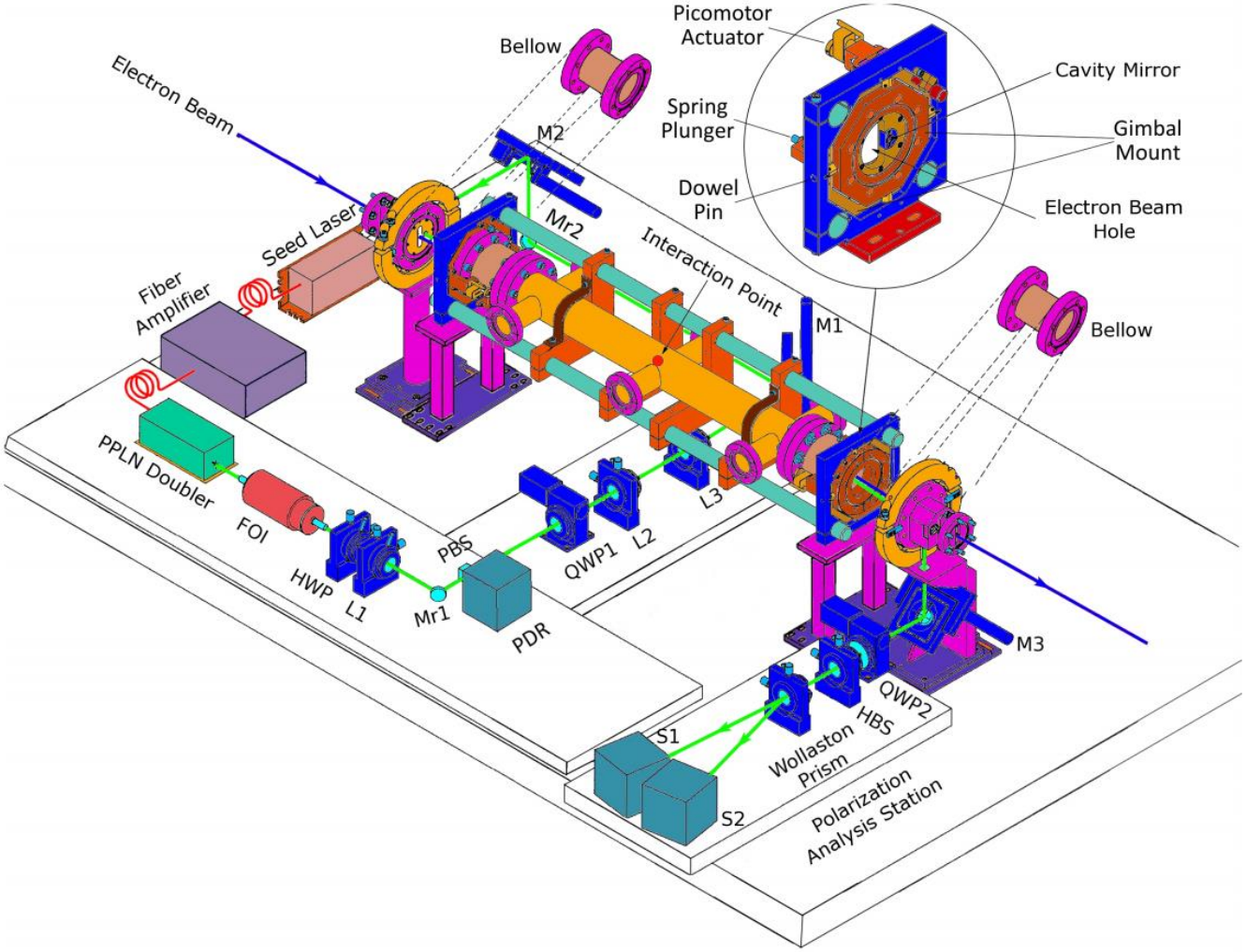
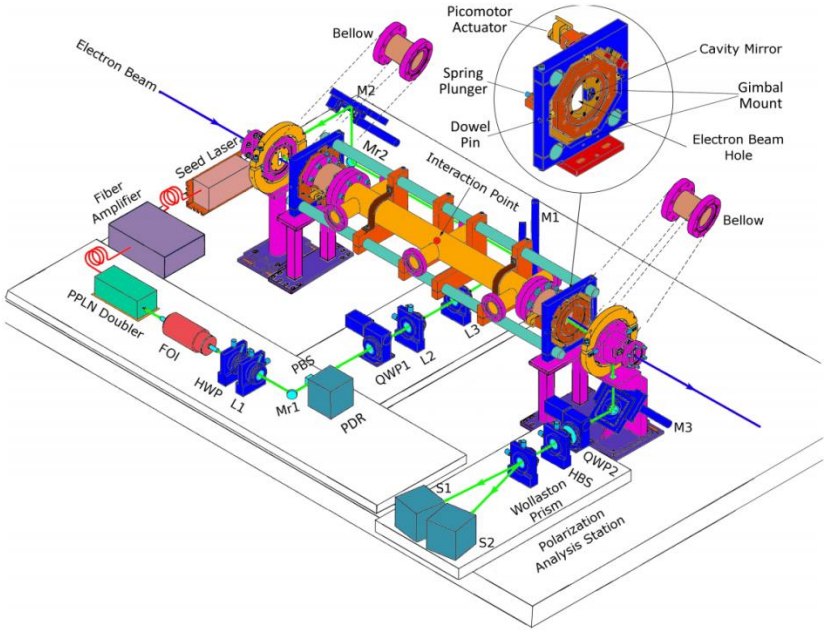
Compton Laser Setup



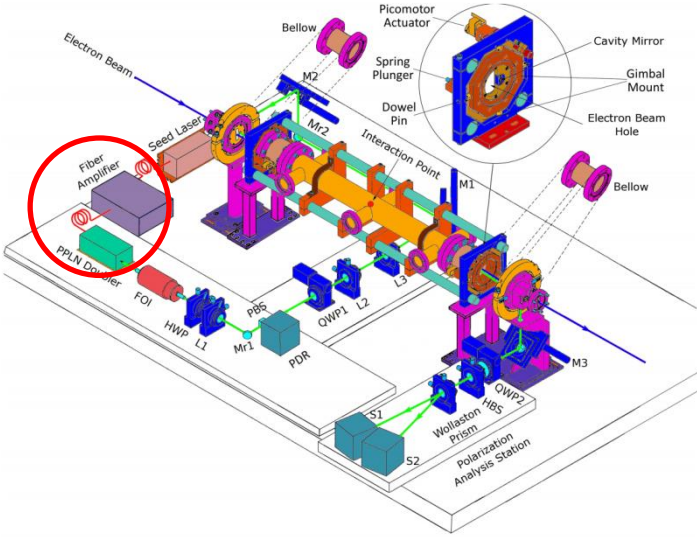
Compton Laser Wishlist

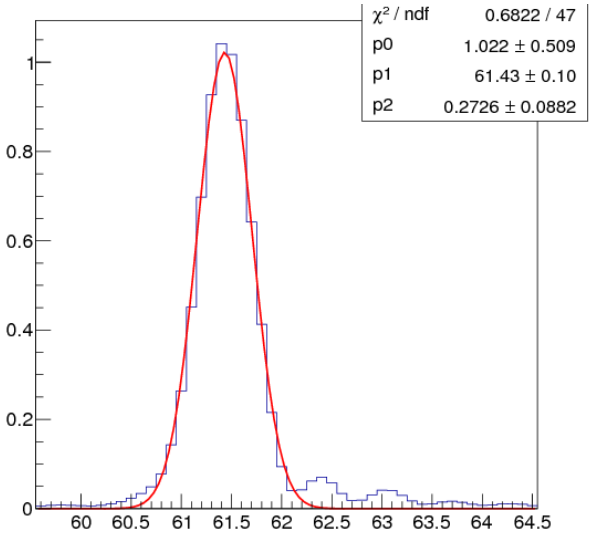
- High power in the FP cavity (8 kW)
  - Use of high reflectivity mirrors
- Minimized losses on the table
- Automated calibration
- Maximize the circular polarization in the cavity



Things that are working now

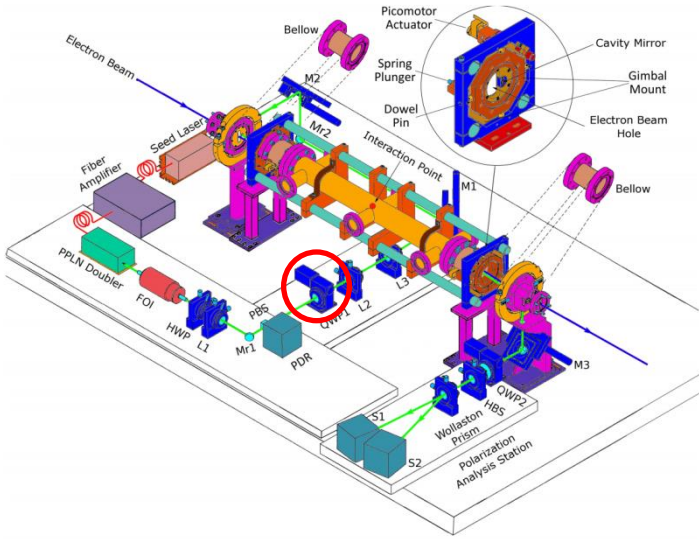
- Full remote control of the seed laser
  - Amplifier has had some issues
- PPLN doubling crystal works at about 20% efficiency
- We measured the power output as a function of the oven temperature and seed laser temperature

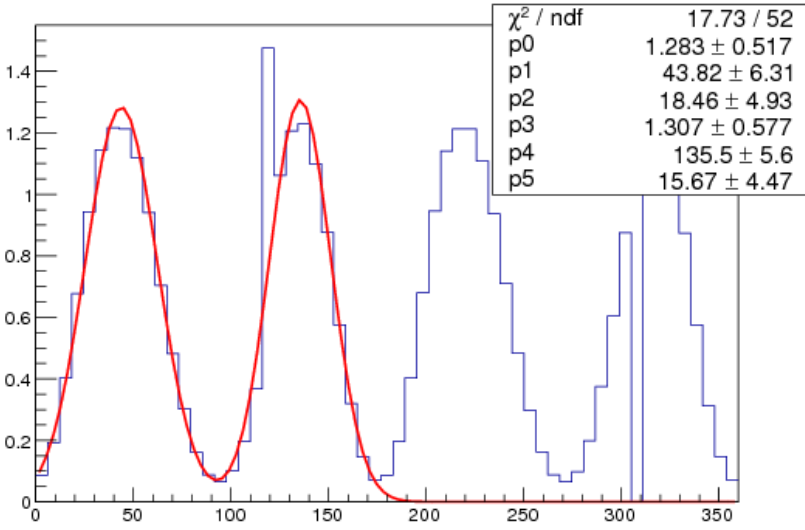




Things that are working now

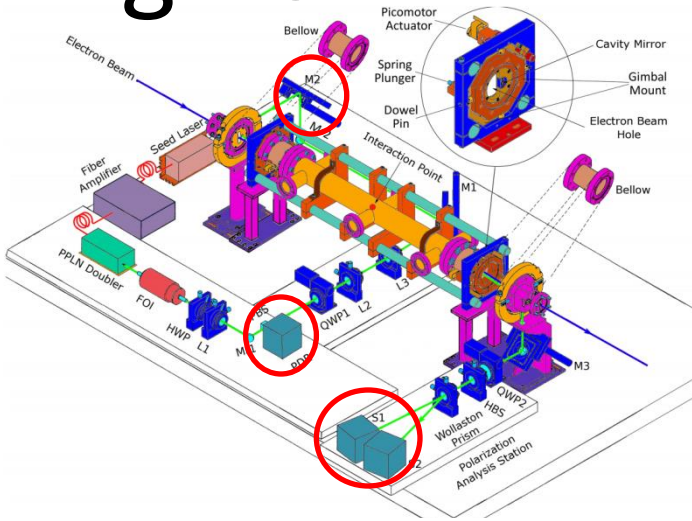
- Full remote control of wave plates, mirrors
- We calibrated the QWP and have a set of scripts to automate the calibration procedure

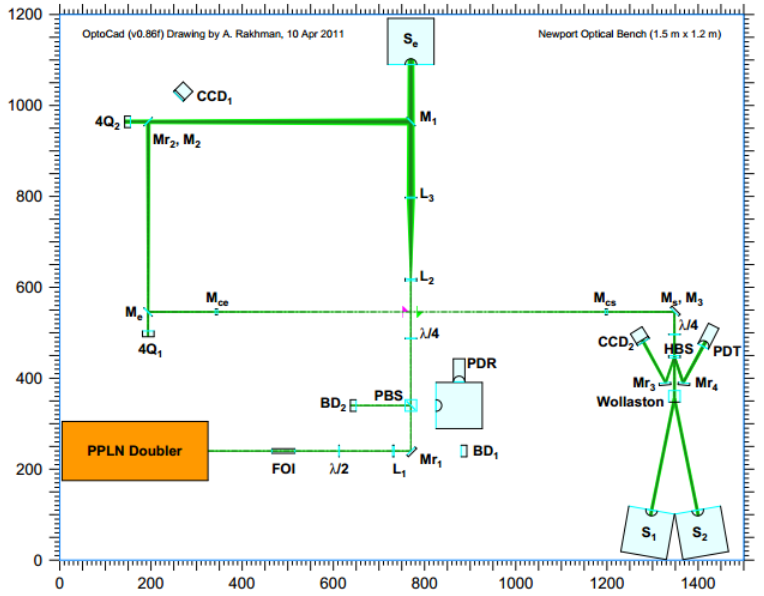




Things that are working now

- Full remote control of wave plates, mirrors
- We calibrated the QWP and have a set of scripts to automate the calibration procedure
- Preliminary optimization of the beam transverse profile to the input cavity mirror
- Verified that the photodiodes are properly calibrated





Things that are working now

- Installation of FP mirrors and their orientation manipulation can be done only without vacuum
  - The picomotors cannot be used with vacuum
- We ran into serious difficulties locking the cavity with high reflectivity mirrors
  - Decided to use low reflectivity (99.8%) before we needed to pull vacuum
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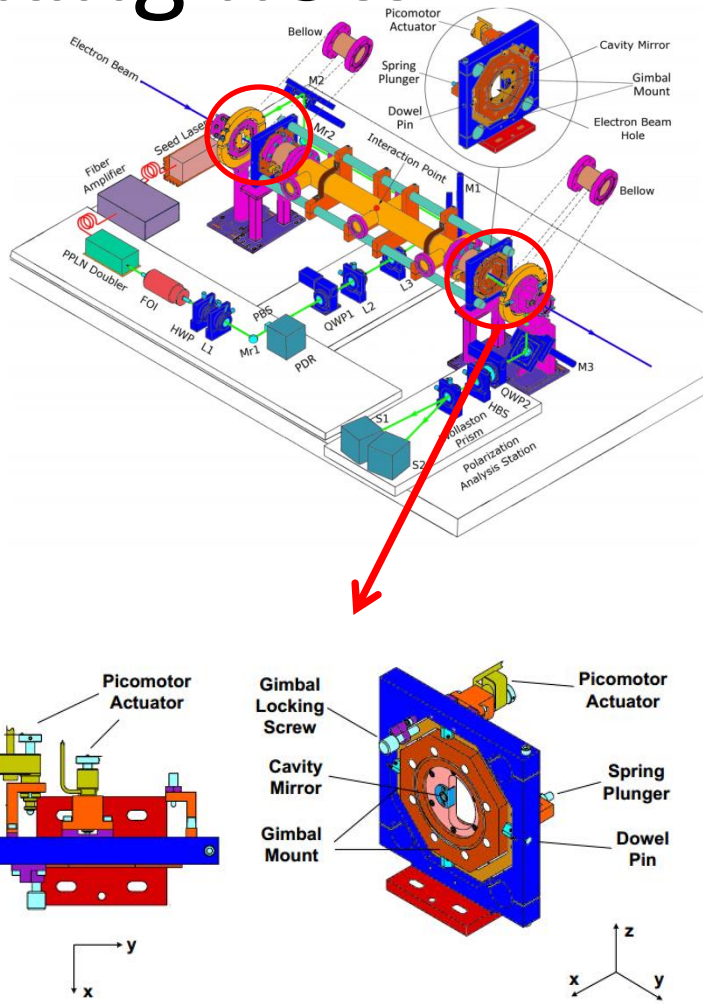
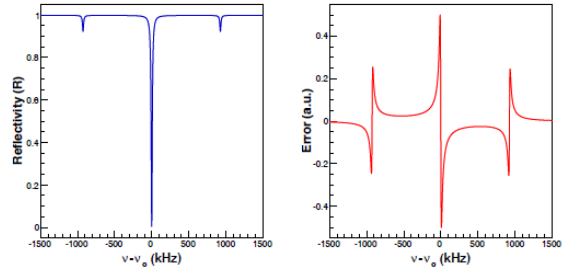
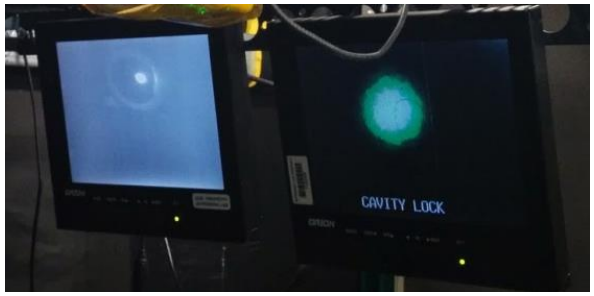


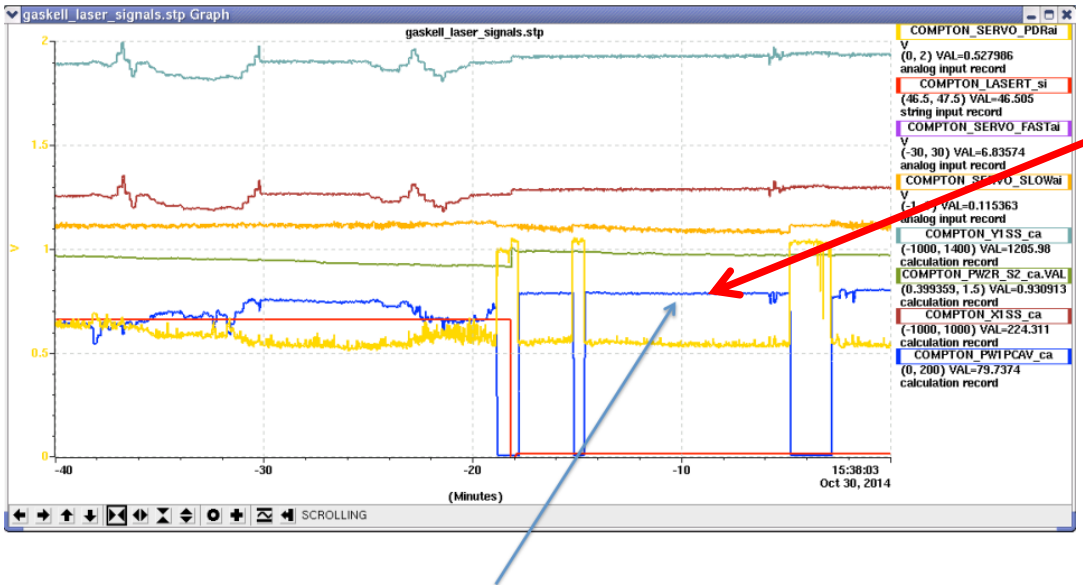
Things that are working now

- Locking electronics proved to be quite a headache because of the lack of documentation
- Even with reasonable looking reflected and error signals feeding into the electronics it was impossible to lock the cavity with the scripts and setup we had





Things that are working now



Locked cavity

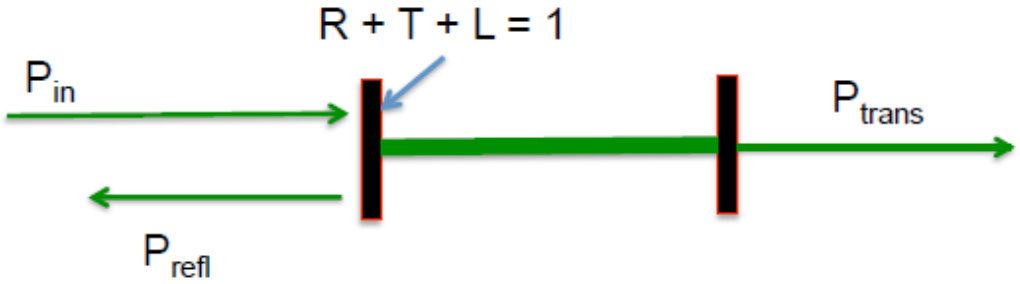
- After much fiddling with the locking electronics we have succeeded in locking the cavity

Things that are NOT working now

- Even though it's locking:
  - We have very little power in the cavity ~100W (we expected about 500W from the current setup)

Inputs:
P_{in} = 851 mW
P_{refl} = 539 mW
P_{trans} = 120 mW
Mirror T = 0.163%

Cavity properties:
Finesse = 1274
Gain = 102
c0 (mode match) = 46%
Total loss = 0.22%



Things that are NOT working now

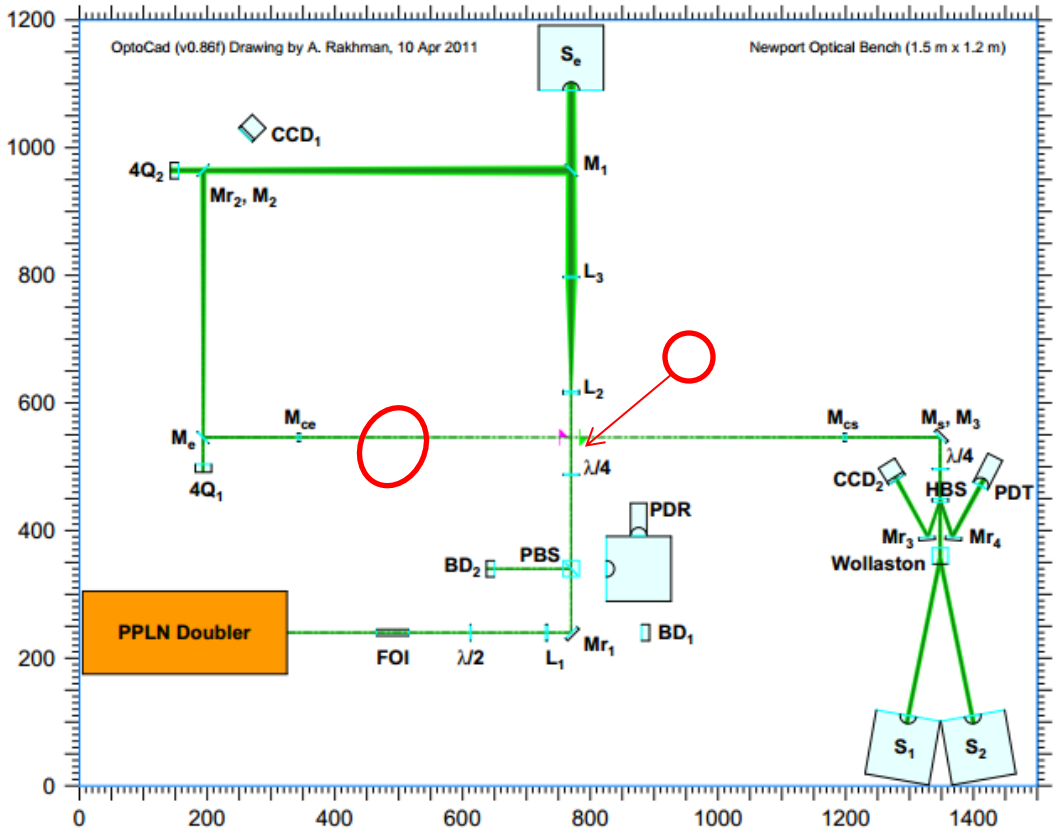
- Even though it's locking:
  - We have very little power in the cavity ~100W (we expected about 500W from the current setup)
  - There seem to be significant losses (~22%)
    - Dirty optical elements?
    - This needs to be addressed when we open up in January

To do list – Jan down

- Pin down and remove the source of the losses
- Install high reflectivity mirrors
  - we have higher confidence that we will manage to lock the cavity
- Optimize the optical elements and get an improved mode match with a locked cavity
- Setup procedures and scripts to automate calibration and monitoring

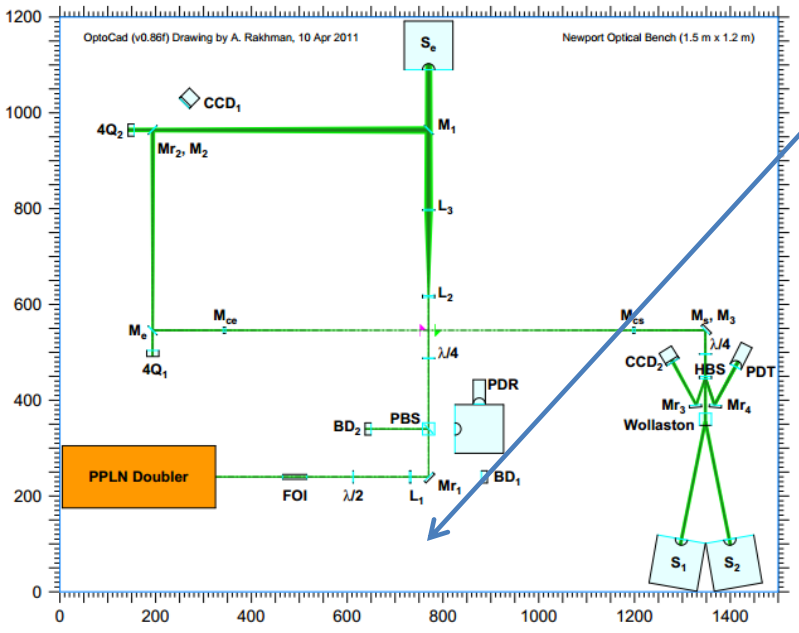
To do list – longer term (summer?)

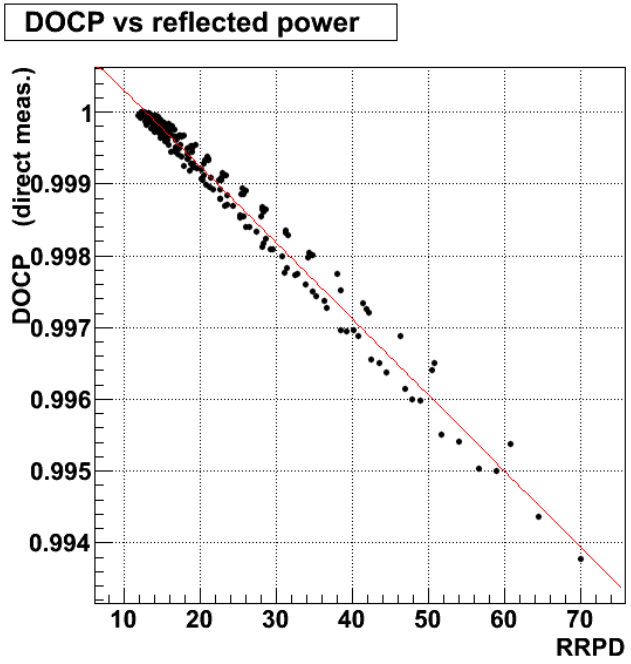
- Replicate the Hall C cavity circular polarization maximizer to obtain a small laser polarization systematic
- Circularly polarized light after λ/4 plate
- Due to optics imperfections it could lead to an elliptical shape in the cavity



Maximize cavity circular polarization

- By monitoring the reflected light after the λ/4 plate it was shown that one can measure the degree of circular polarization in the cavity





Maximize cavity circular polarization

- Instead of perfecting the optical path we can provide a polarization state after the λ/4 plate that will cancel the effect
- This has been done in Hall C with the addition of a λ/2 plate after the polarizing cube and before the λ/4 plate
- Through remote calibration of the orientation of the plates we can minimize the reflected light and thus maximize the circular polarization in the cavity