Status of Hall C Compton Polarimeter Project

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Acknowledgements

Jefferson Lab
Dave Gaskell

Mississippi State
Dipangka Dutta, Amrendra Narayan

UVa
MD, Don Jones, Kent Paschke

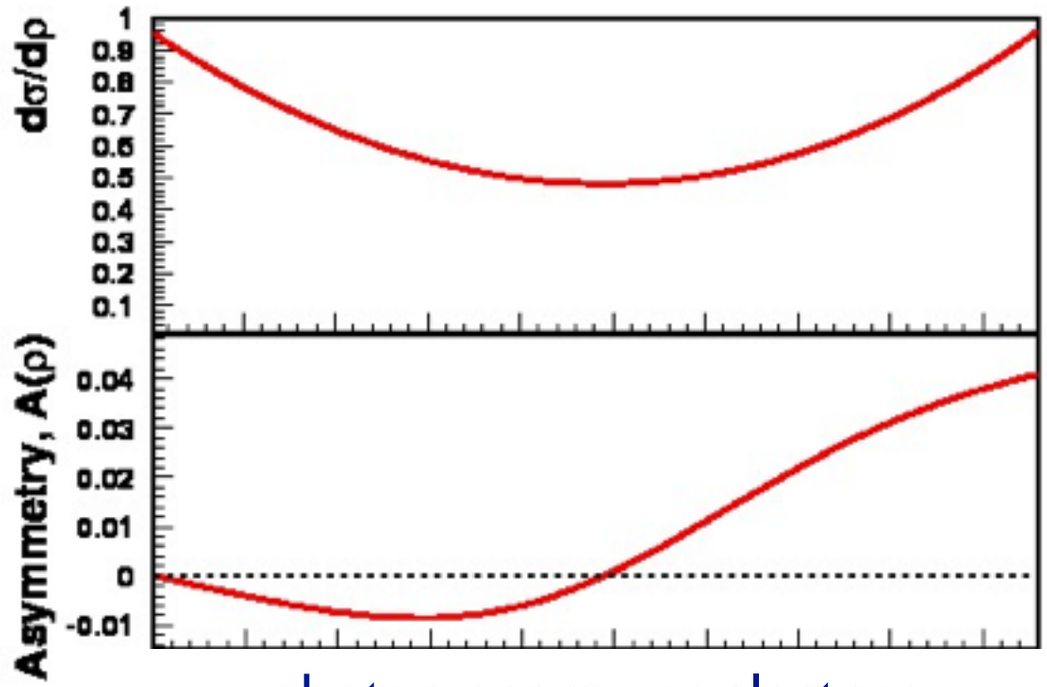
William & Mary
Juan Carlos Cornejo, Wouter Deconinck

Winnipeg
Jeff Martin, Vladas Tvaskis

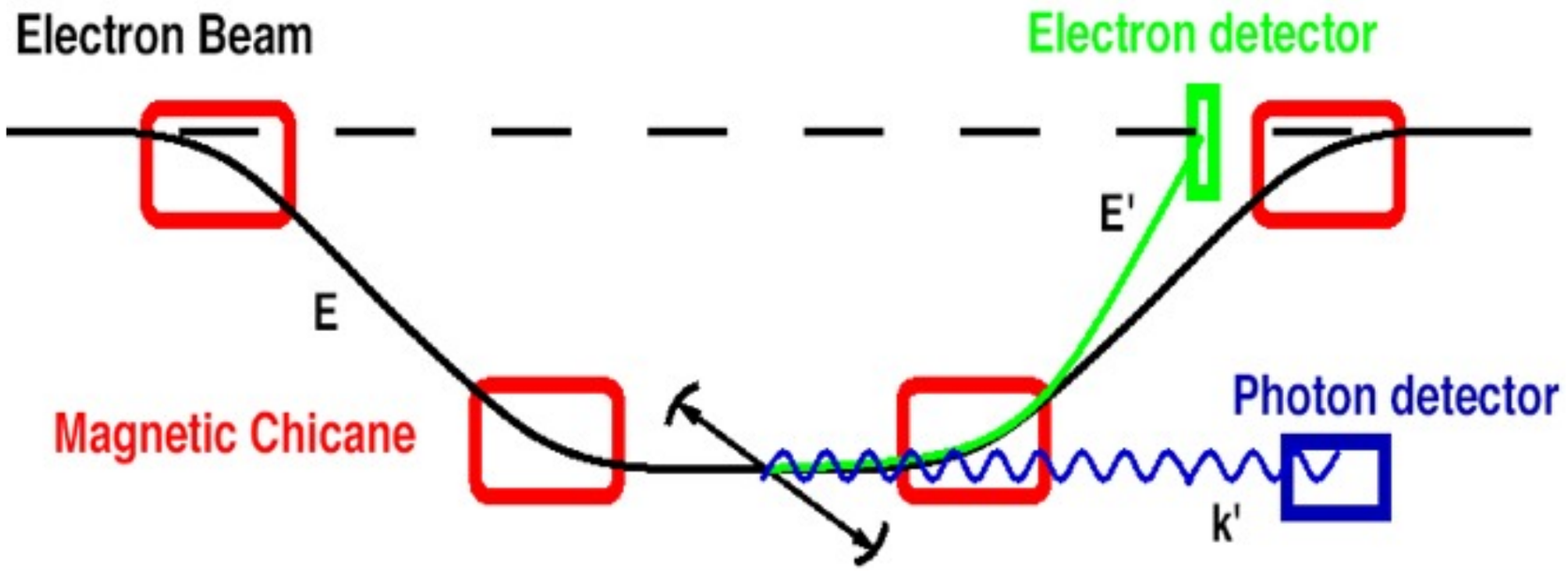
Yerevan
Arshak Asaturyan

Overview

Aim: to produce a Compton polarimeter for Hall C, initially for the QWeak experiment



photon energy or electron dispersion distance



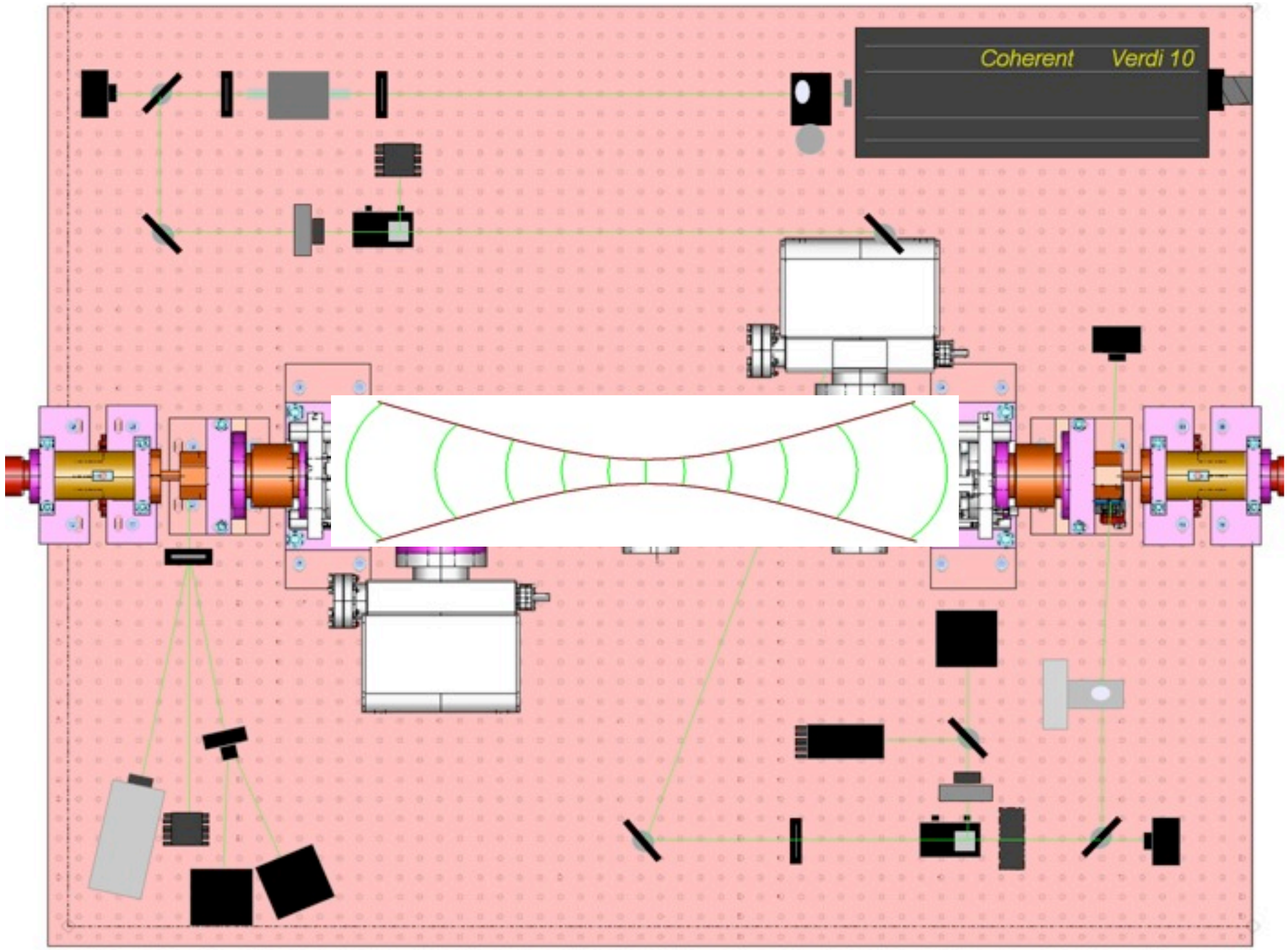
Resonant cavity "photon target", up to 1 kW intensity

Laser System

High power laser (10 Watts)

low gain cavity (~100)

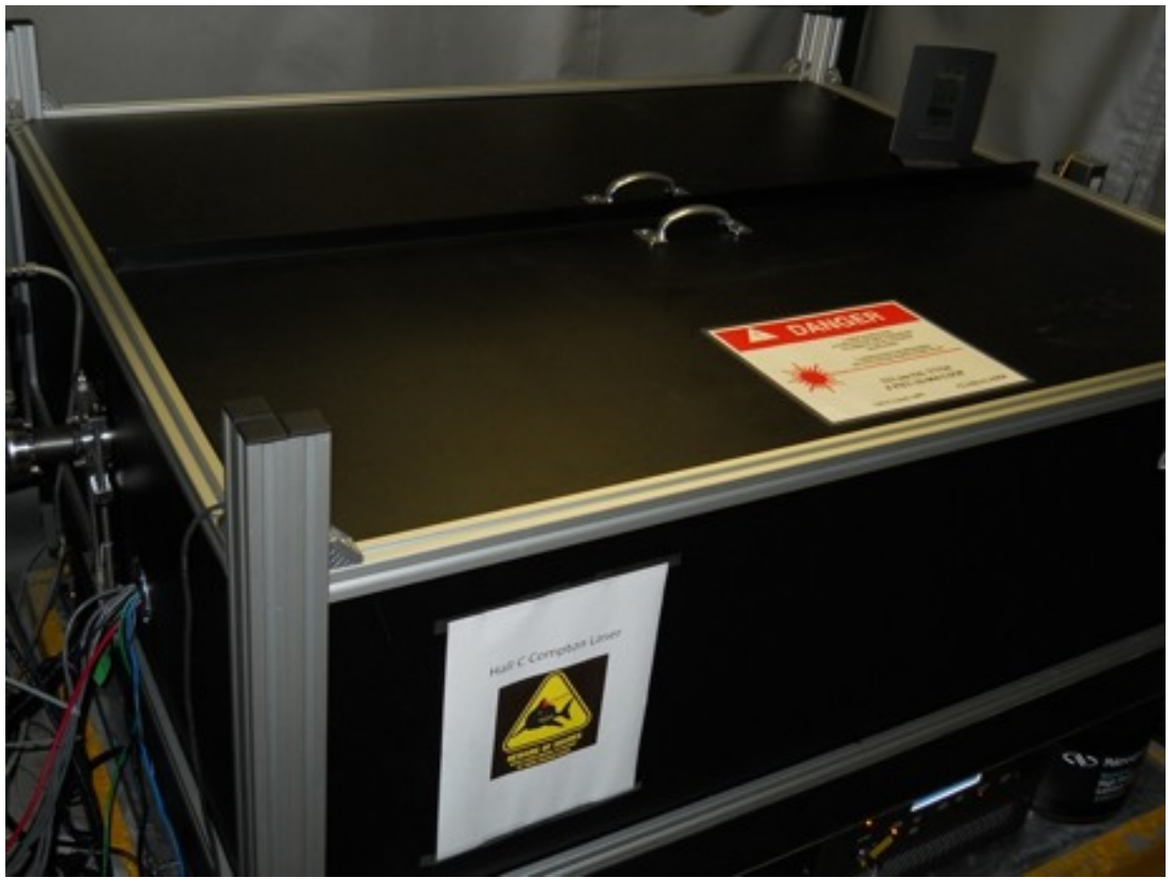
Routinely obtain >700 Watts in interaction region

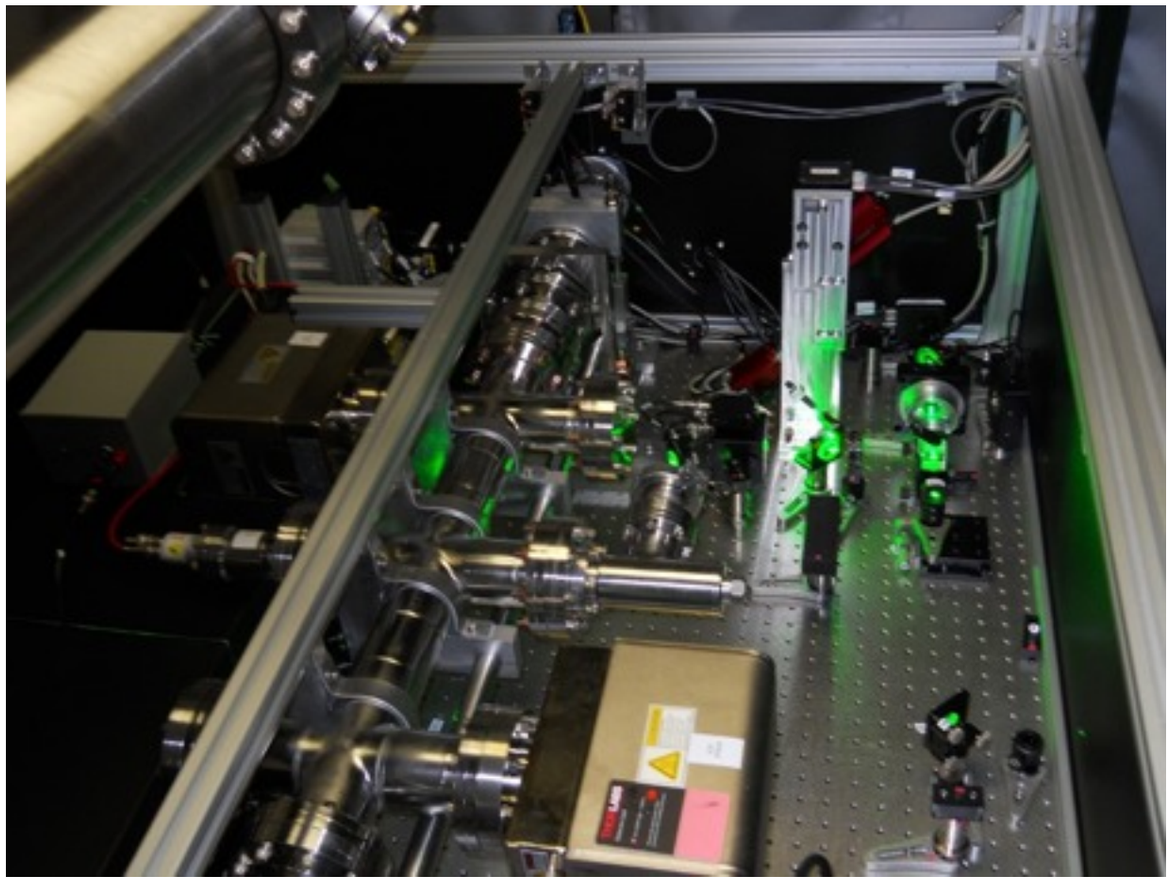


Laser System Installation

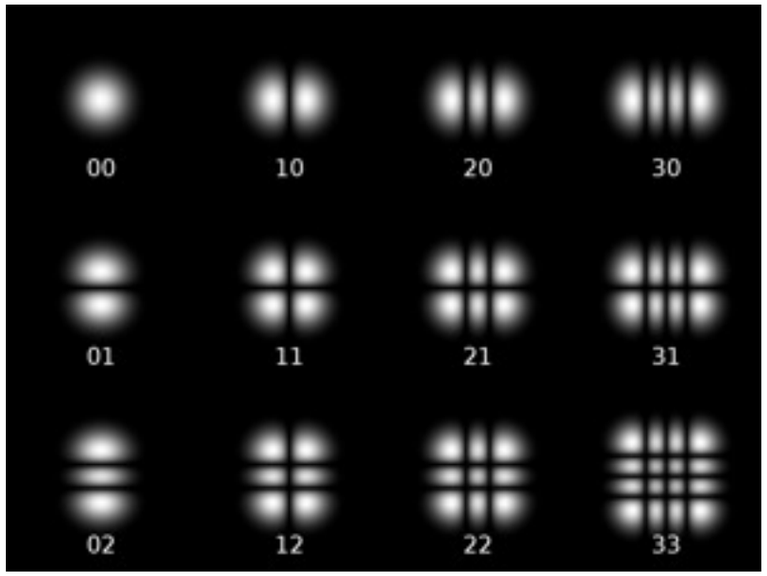
Very quick installation

2009 March: Final decision on project parameters
2009 July: Laser arrives and set up at UVa
2010 July: Install laser system in Hall C

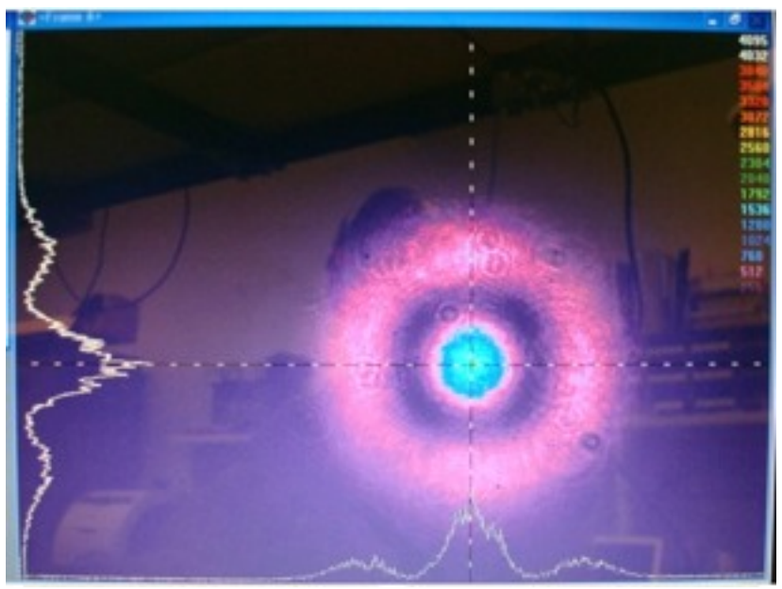




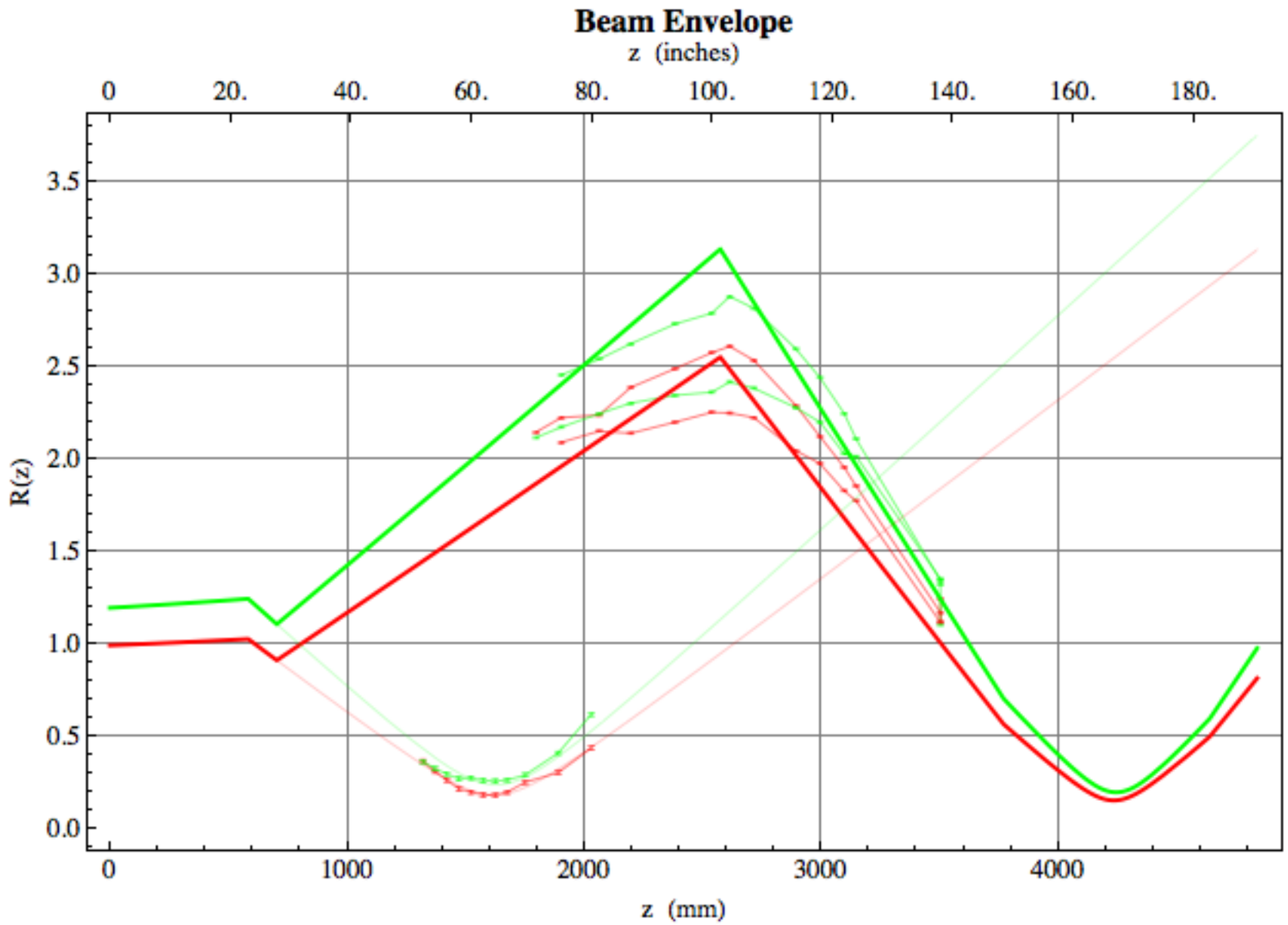
Mode Matching



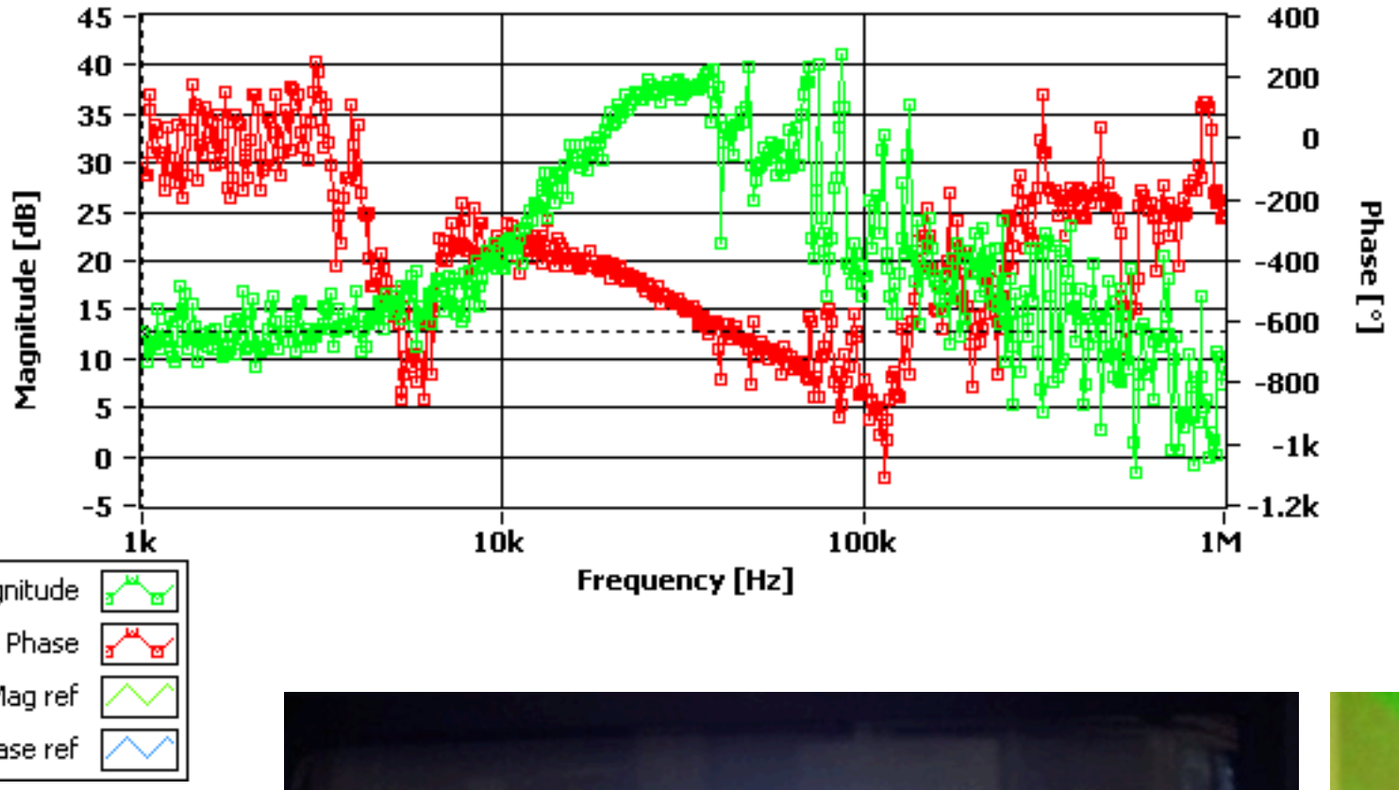
Thermal lensing effects



Final profile, design and measurement



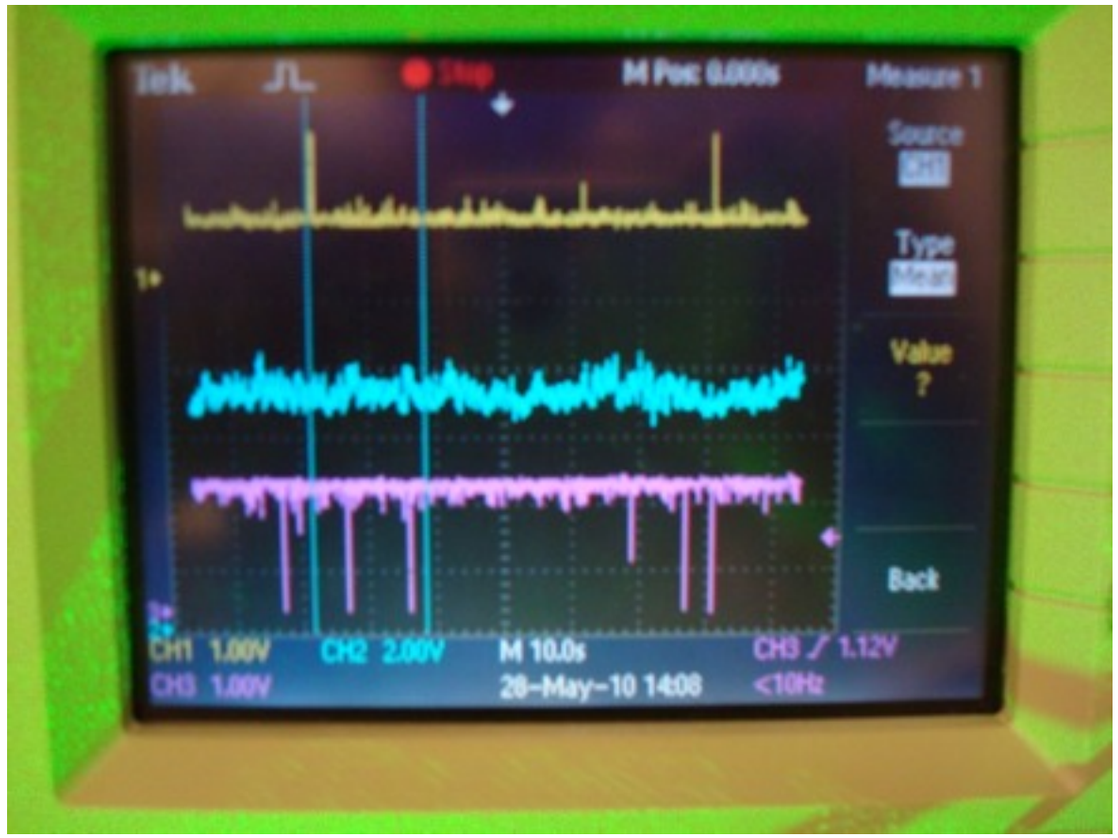
Laser System Feedback



Frequency response of feedback system

Visual indication of laser in cavity

Lock quality indicator

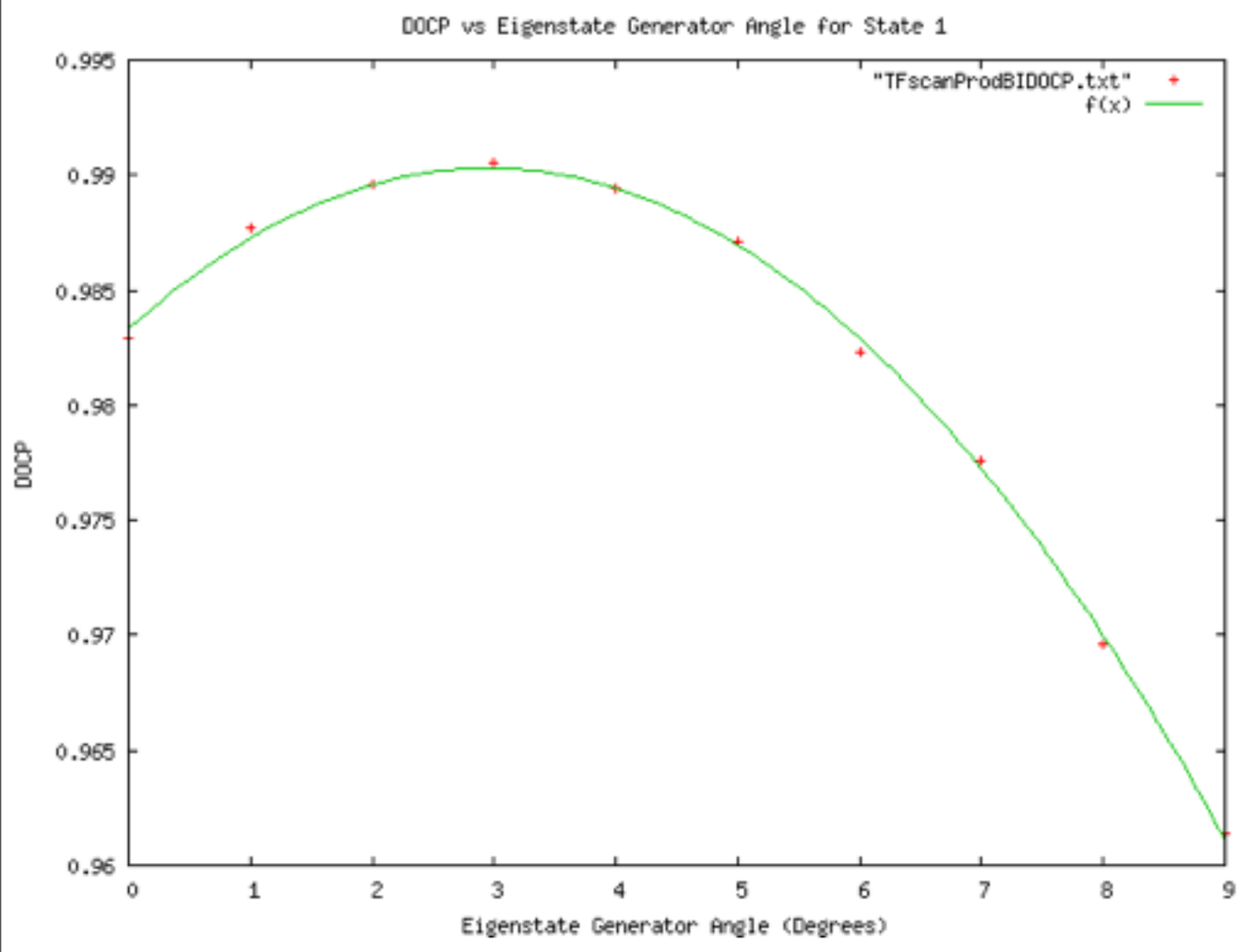


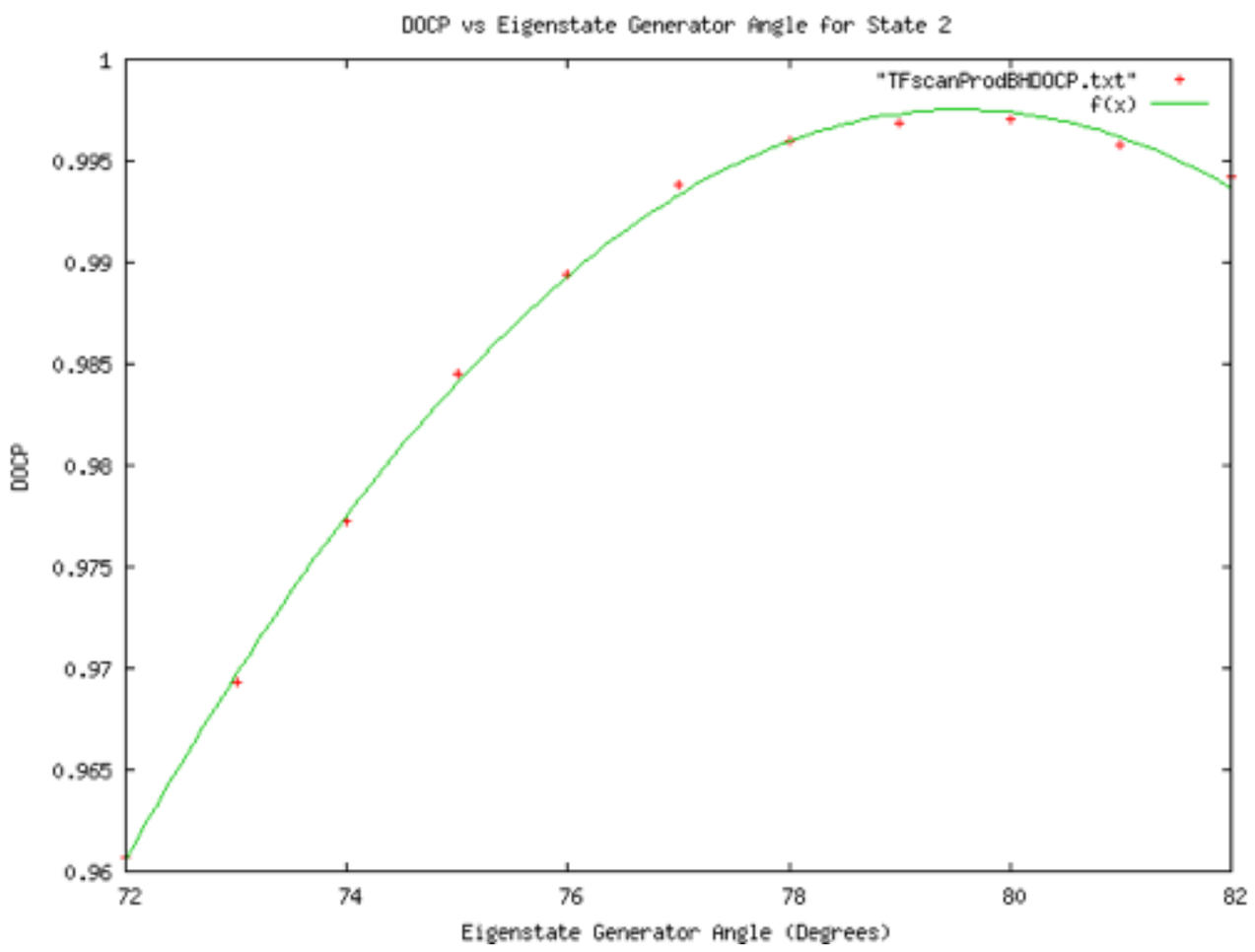
Laser System Polarisation

one state ~99.8 %

other state ~ -99.0 %

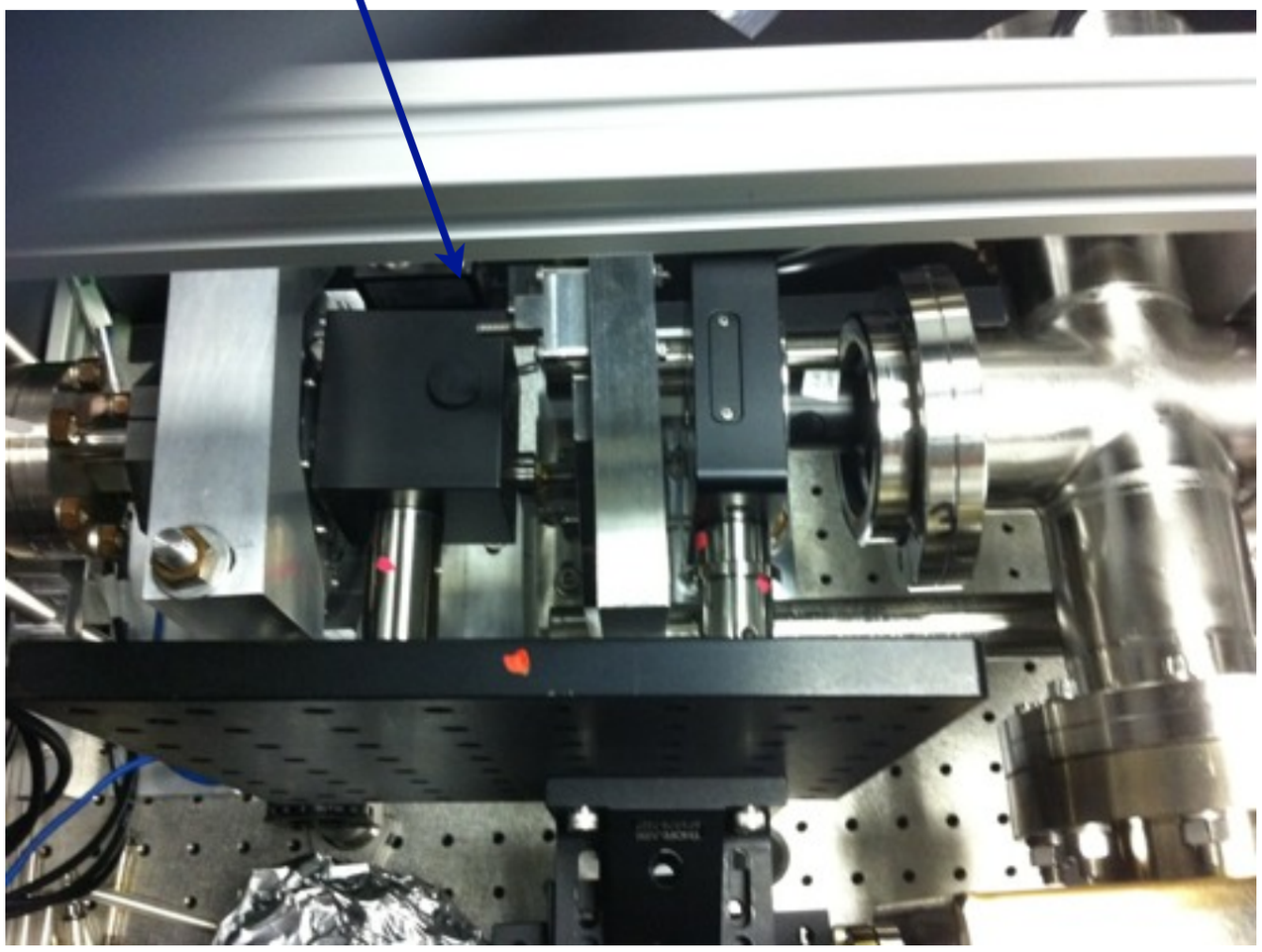
Difference due to birefringence from strain in mirror substrate.





Transfer Function

Measurement of polarisation in cavity region

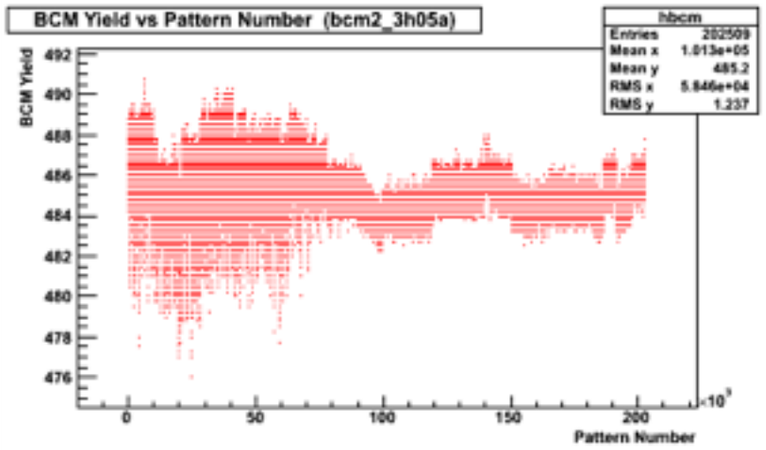


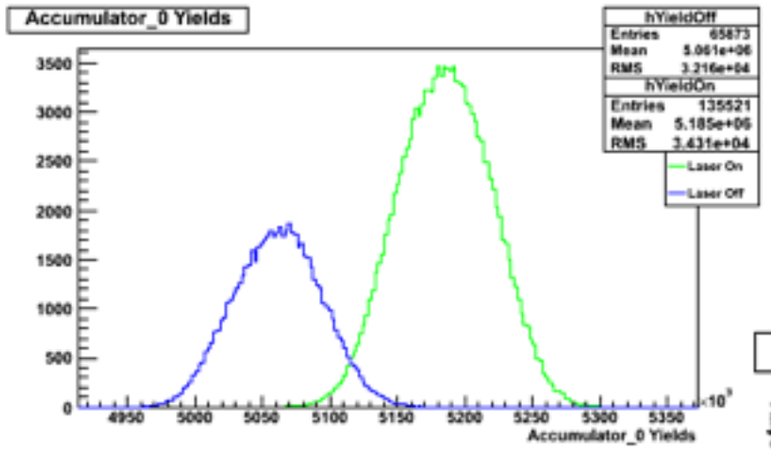
Produce well defined polarisation for measuring transfer function

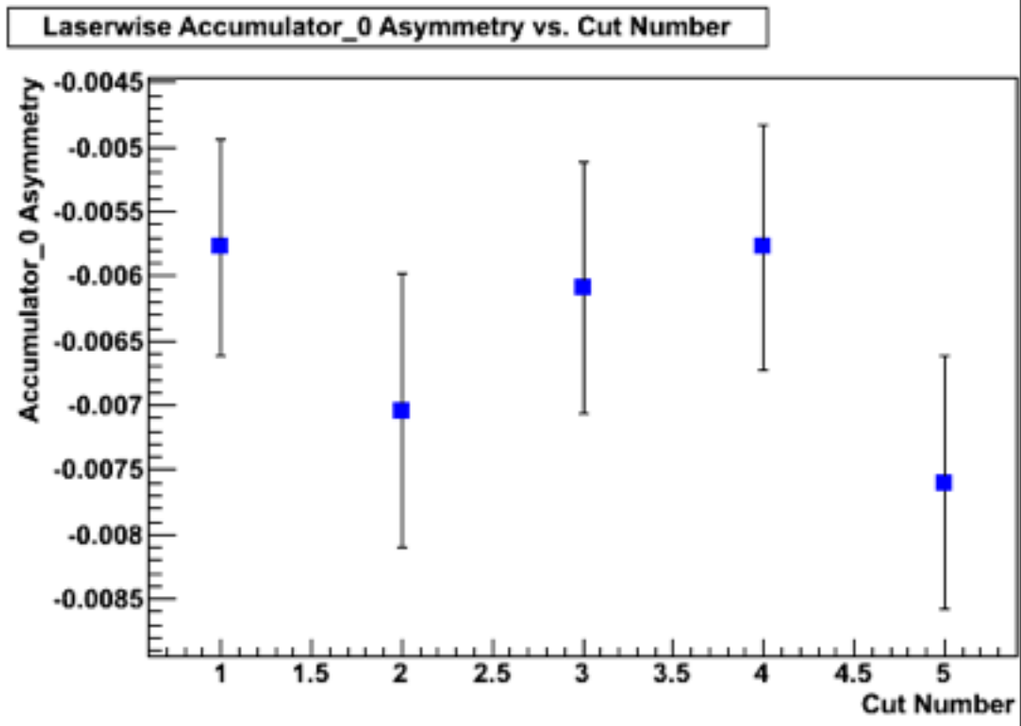
Photon Detector

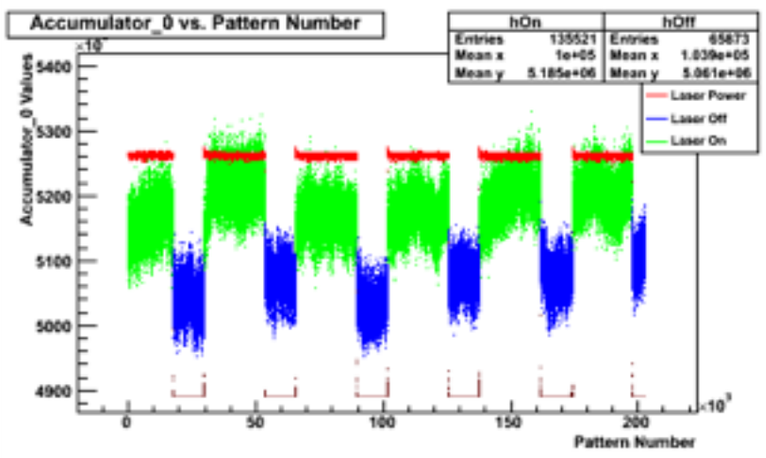
30 x 10 x 10 cm CsI crystal
Hamamatsu R4885 3" PMT
Flash ADC integrating DAQ

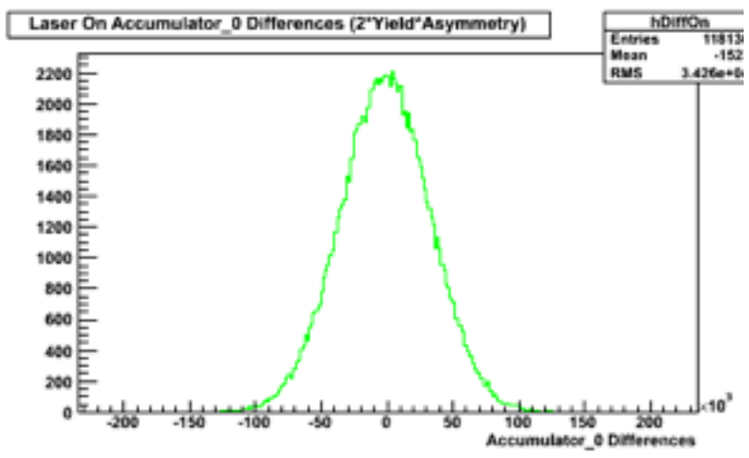
Photon Detector Data

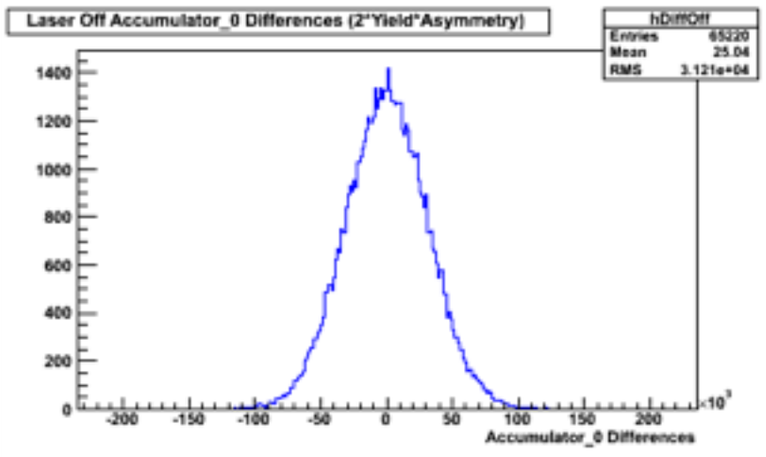


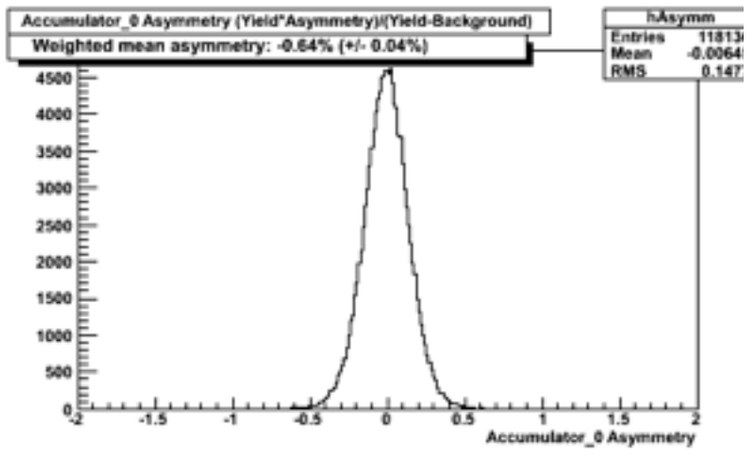




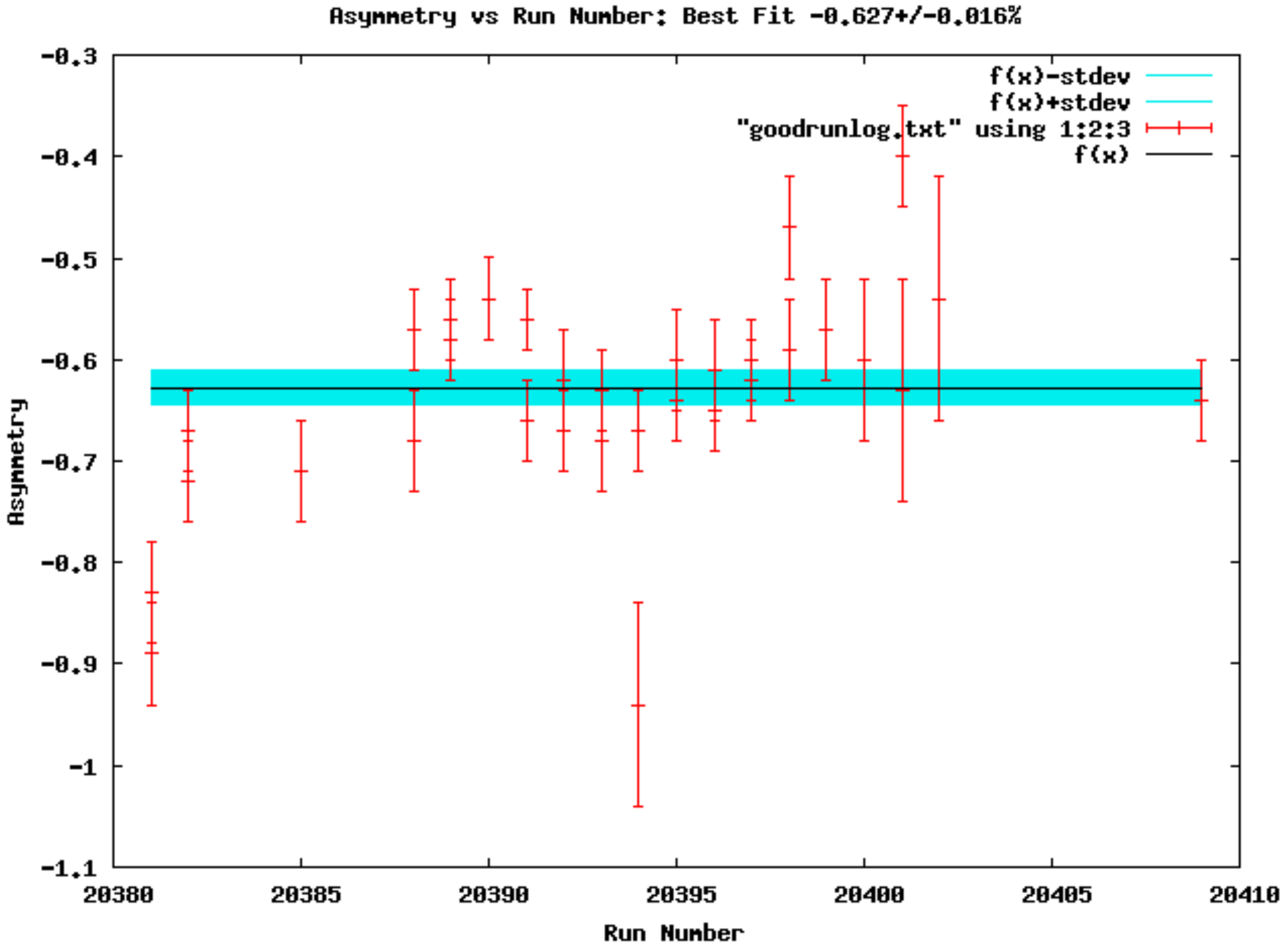








Photon Detector Cumulative

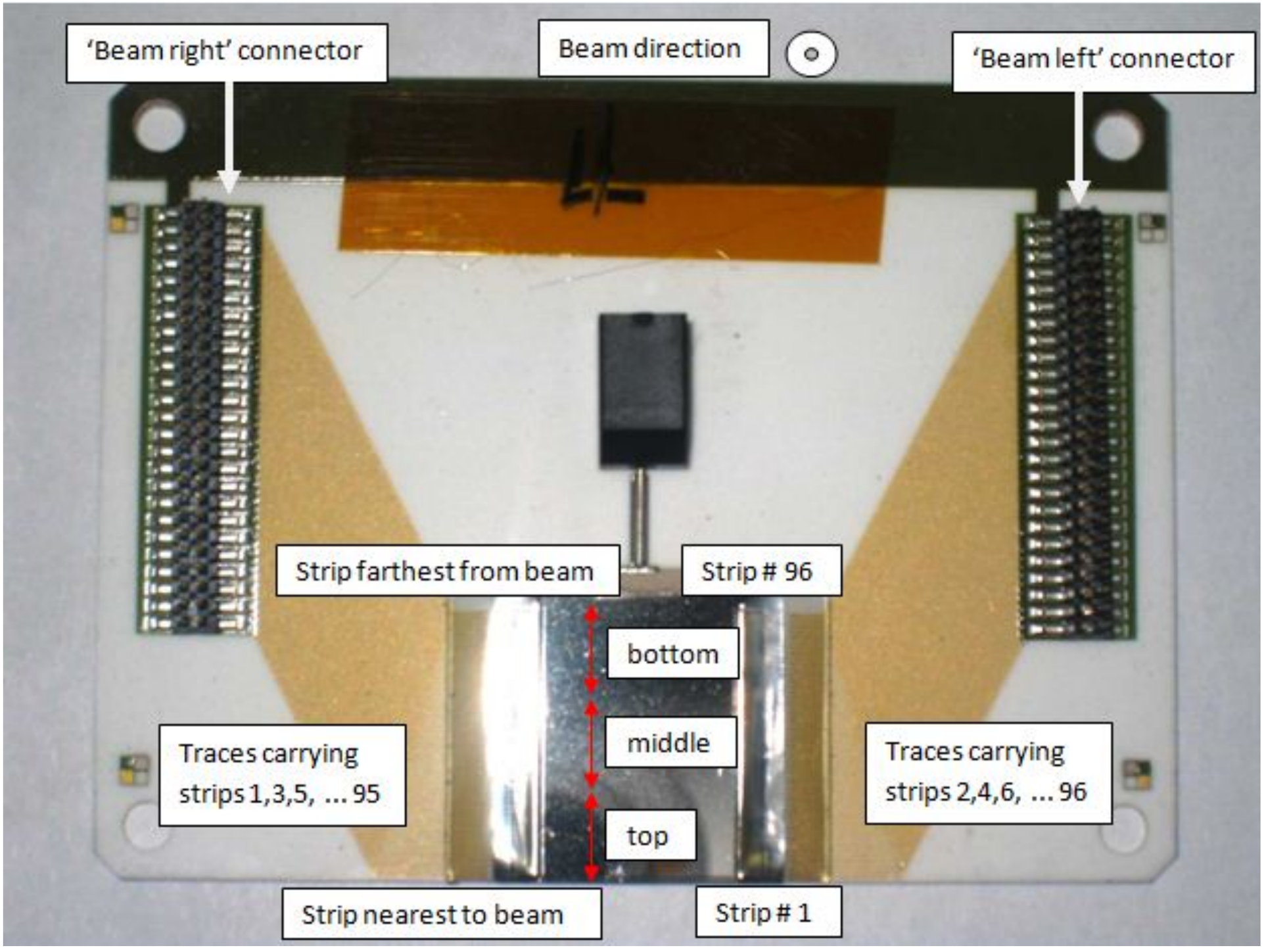


Electron Detector

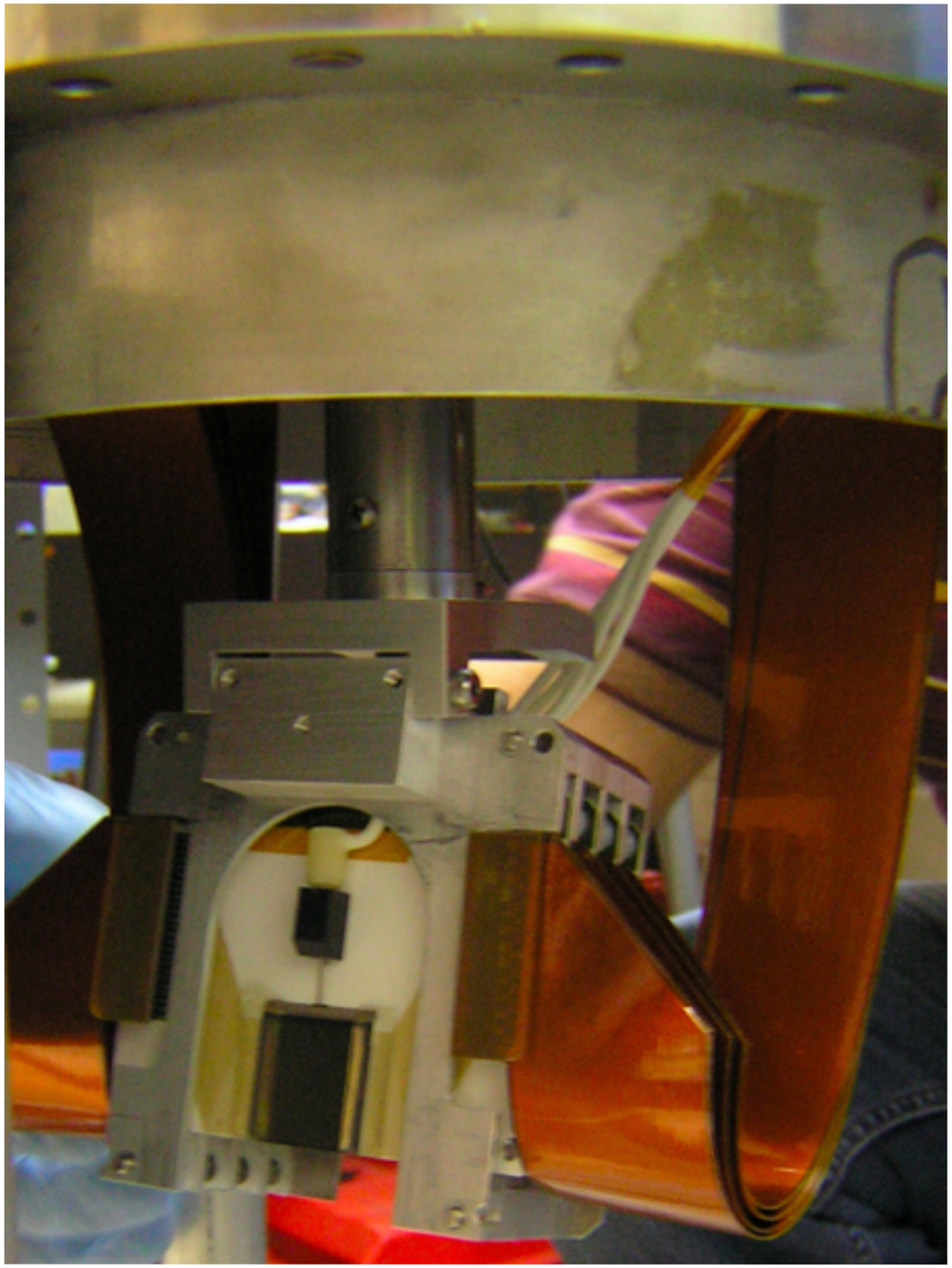
Diamond strip detector

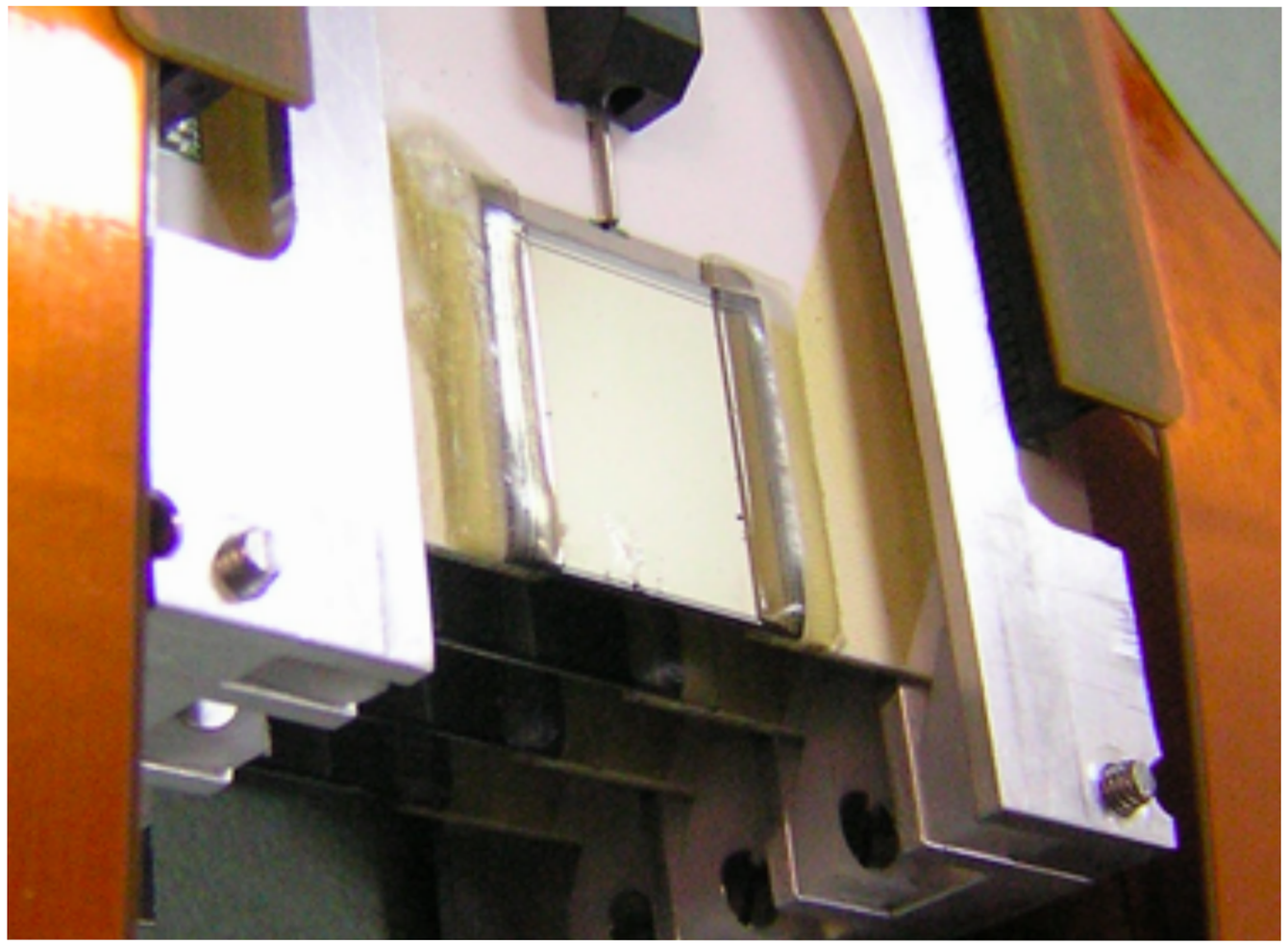
4 planes

96 strips per plane



Electron Detector



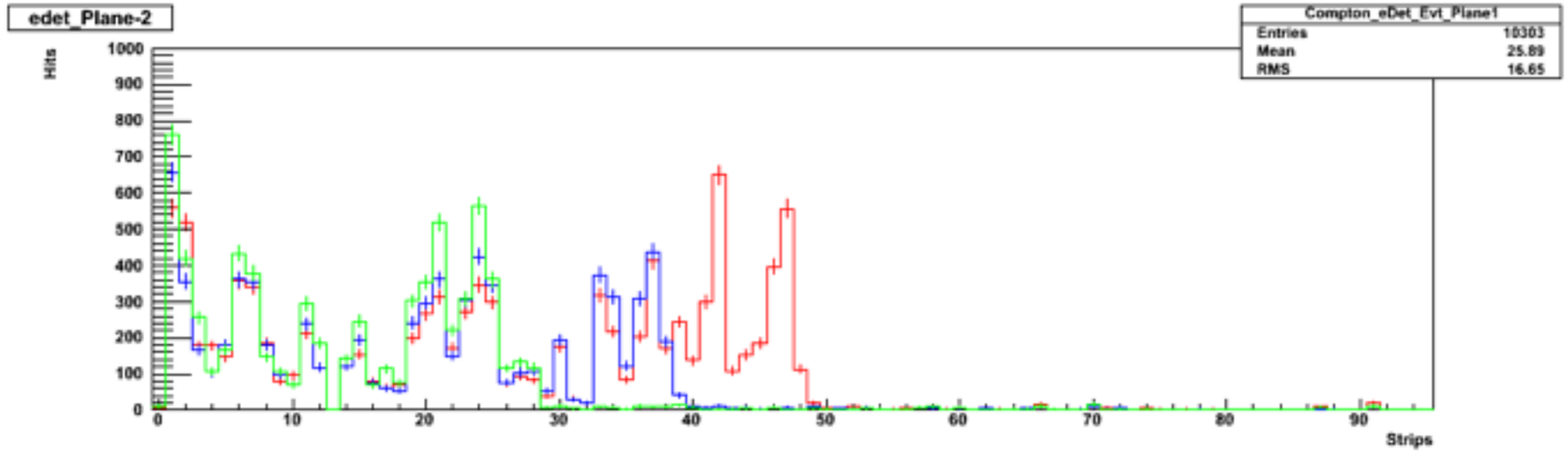


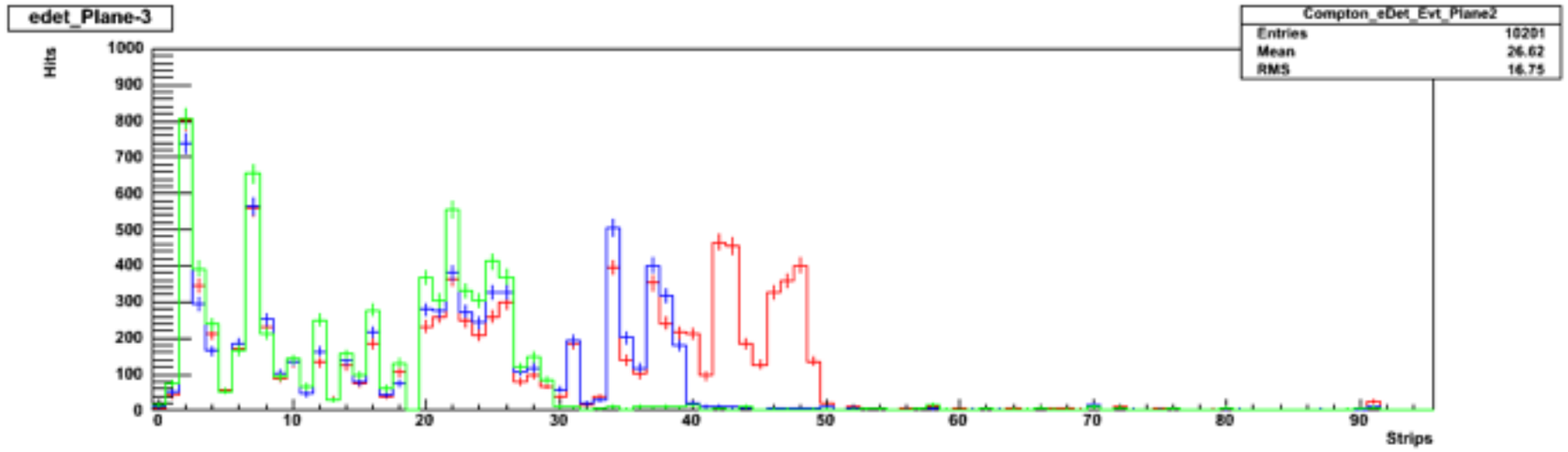
Electron Detector Data

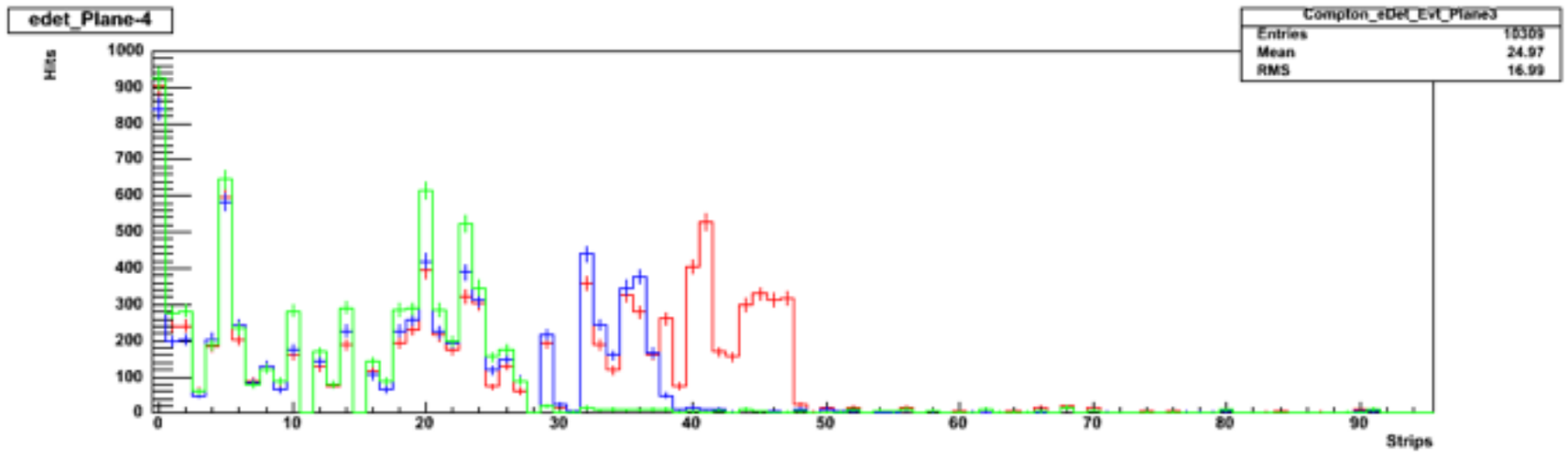
1.7 cm from beam

1.5 cm from beam

1.3 cm from beam







Future Developments

- Increase signal size ⇒ cavity laser power ⇒ replace mirrors (higher reflectivity)
- Unlock other polarisation state ⇒ upgrade mirror mounts
- Increase mechanical stability and ease of working ⇒Upgrade gimbal mounts⇒
- Convert to absolute device ⇒ Measure response function ⇒ combine DAQs OR big simulation effort
- Electron detector: add 4th plane, replace vacuum signal cables, amplifier discriminator cards

Summary

The Compton polarimeter is a working relative device.

Significant development is still required but the roadmap is clear.