

Compton Polarimetry Preparations for MOLLER

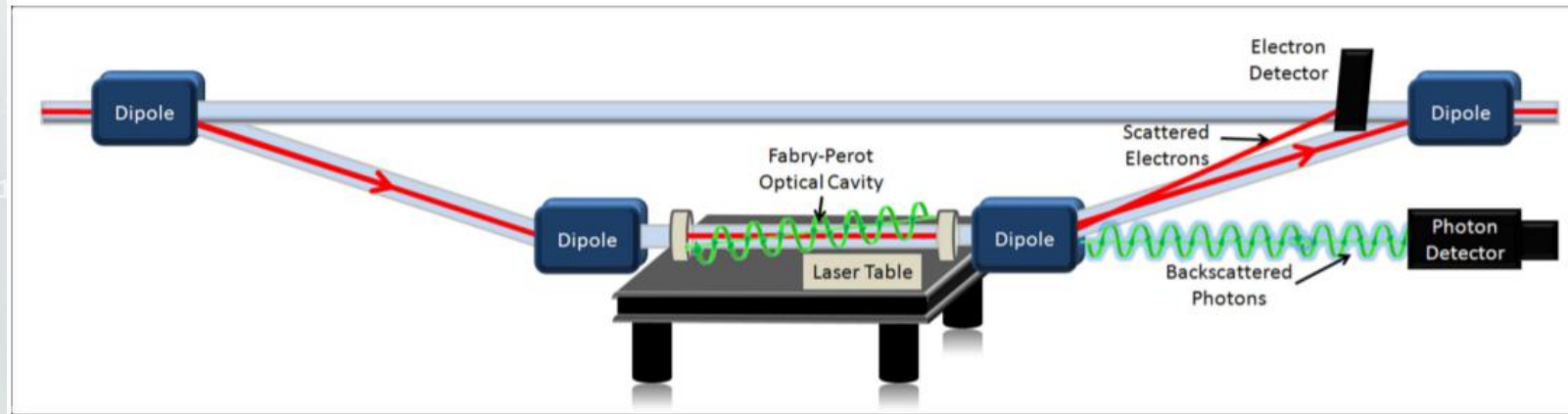
Allie Zec
she/her/hers

2026-01-21

Hall A Winter Meeting



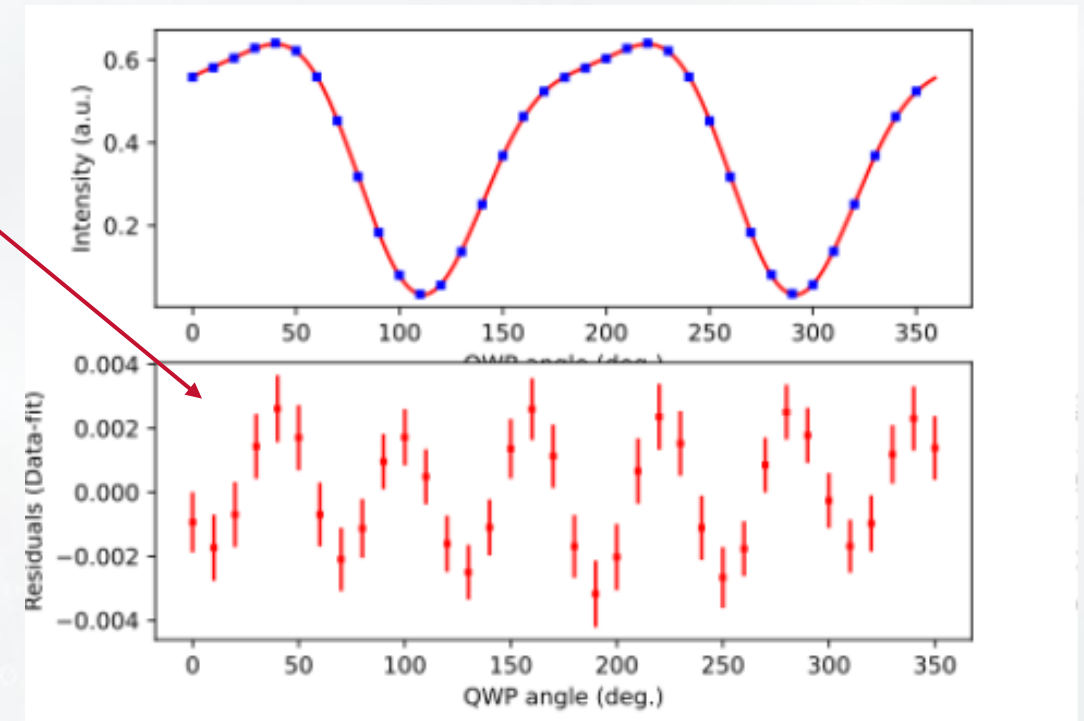
Compton Goals for MOLLER



- **0.4% beam polarimetry measurement**
- Functional photon and electron detector polarimetry measurement
- CREX had a 0.4% Compton measurement from photon det alone... problem solved?
 - Not solved! Old CMU Compton DAQ can't handle MOLLER event rates
- Subsystems to revive:
 - Laser
 - Photon Detector & DAQ
 - Electron Detector & DAQ
 - New analyzers for both DAQs
 - 1 Online & offline polarization analysis for both DAQs

Laser Work

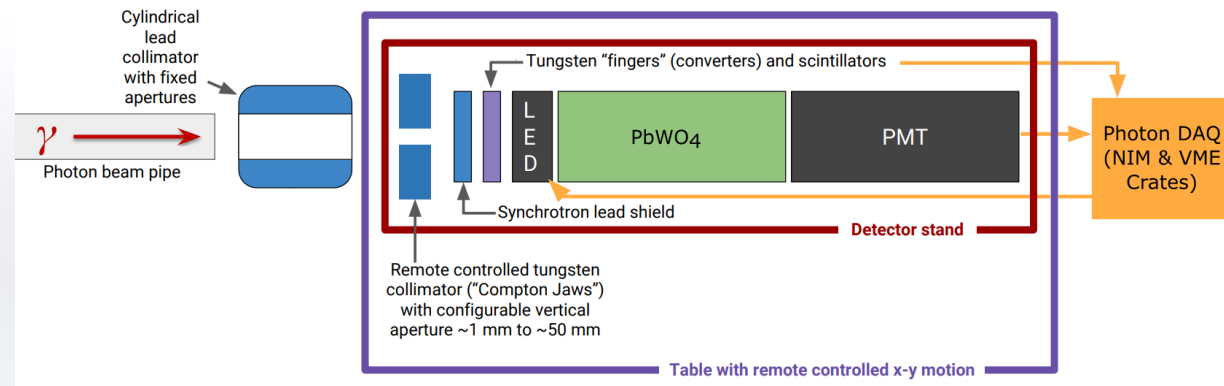
- Polarization measured on table using quarter and half waveplate optics
- Characterizing optical components such as waveplates and beam splitters
- Stokes parameters characterization and fit
 - Periodic “wobble” in the fit residuals has since been fixed by X. Zhang
- Fiber amplifier:
 - Needs to be replaced
 - Looking into possibility of moving amplifier out of hall into labyrinth



Figures courtesy D. Gaskell

Photon Detector

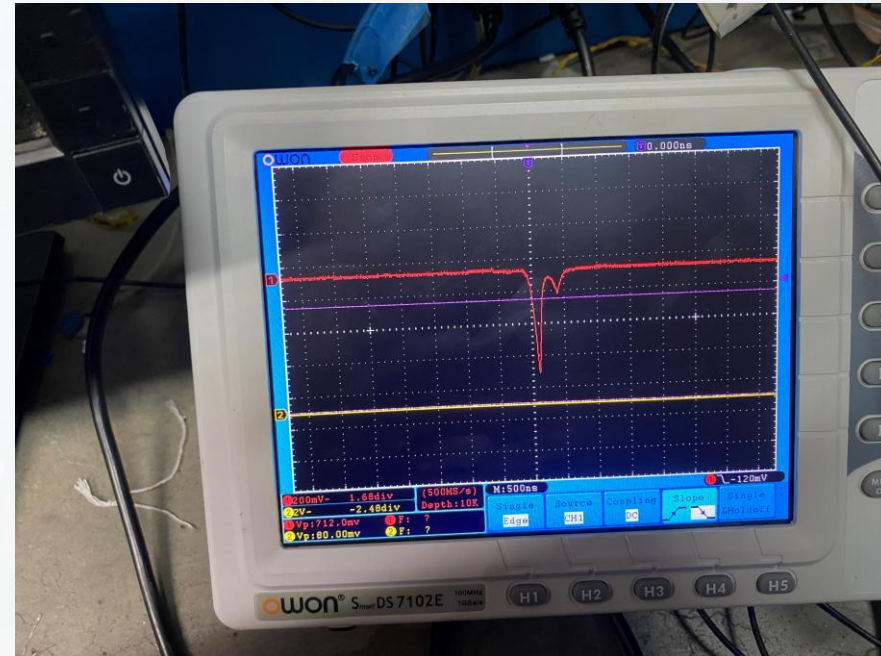
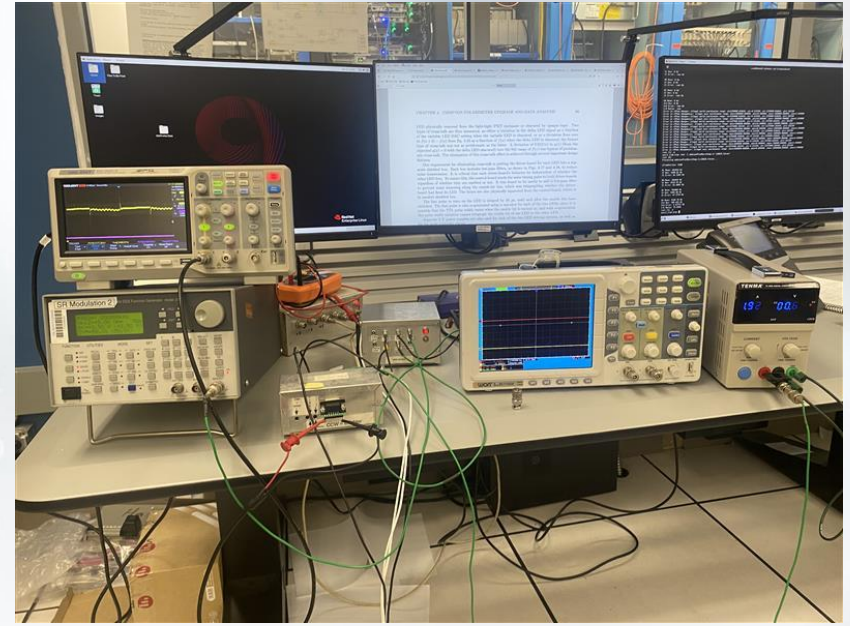
- PbWO_4 scintillator
- Cylindrical + jaws collimators, synchrotron shielding, high linearity* PMT + base
 - *linearity hasn't been measured for awhile
- Detector used for hall A DVCS measurements in 2016
- Beam tests with this detector were planned for GeP running
 - Laser wasn't working when tests were scheduled, didn't happen
- Cable integrity between detector & DAQ isn't great
 - May need to pull some, full testing yet to be done



Bottom figure courtesy of D. Gaskell

LED Pulser Recovery

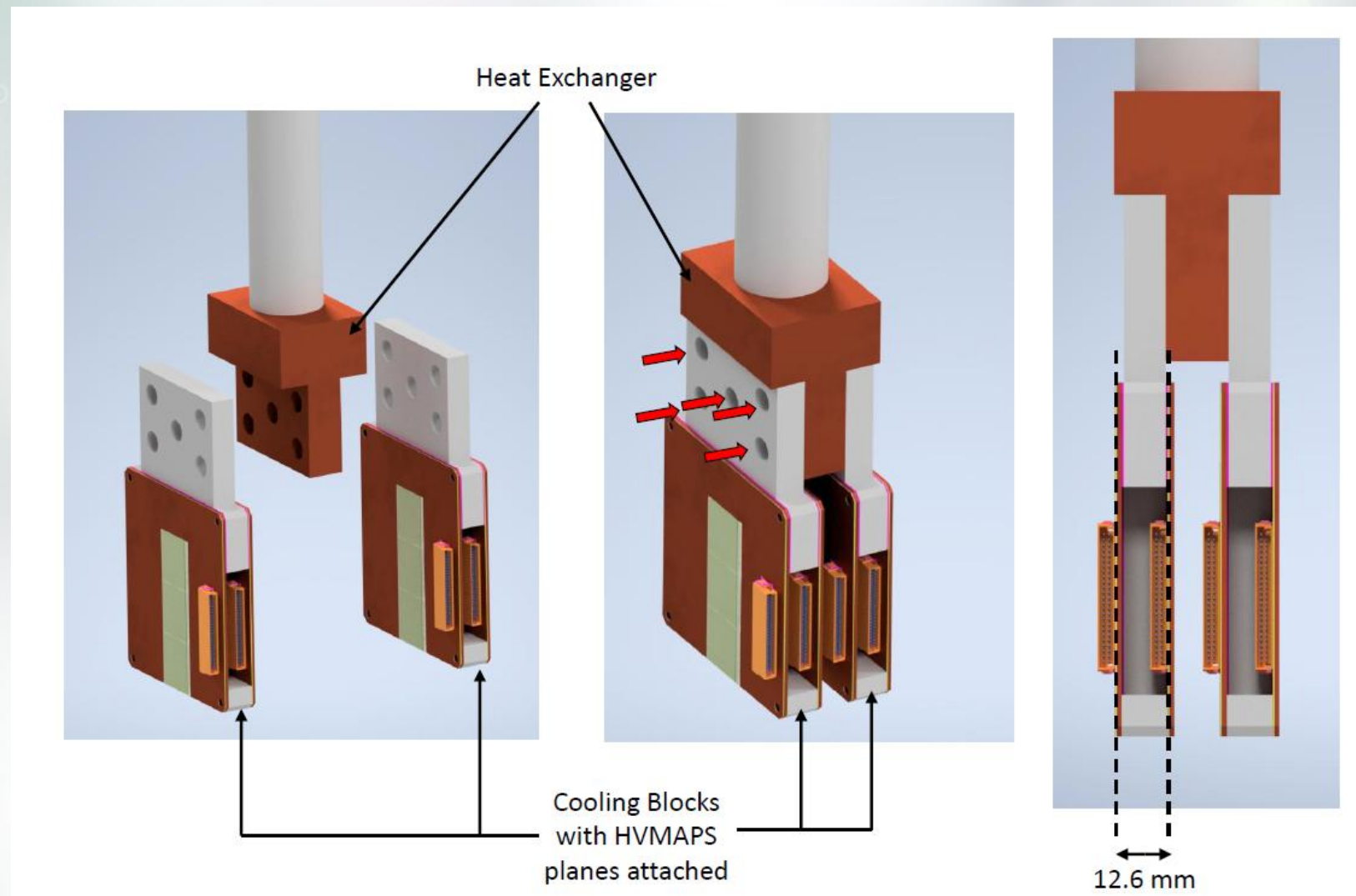
- LED pulser uses two flashing LEDs to measure PMT + base linearity
 - One constant brightness (“delta”), one variable brightness (“variable”)
 - Variable hasn’t worked since October 2020
- Benchtop tests revealed variable LED control board was faulty
- After reinstallation in hall, variable started working again
- LED brightness can be manually (but not automatically) controlled from HAPPEX TB DAC’s
 - 16-bit and 12-bit
- Not fully working yet! Still need to:
 - Fix DACs on HAPPEX TB
 - Reassemble pulser trigger in CMU DAQ



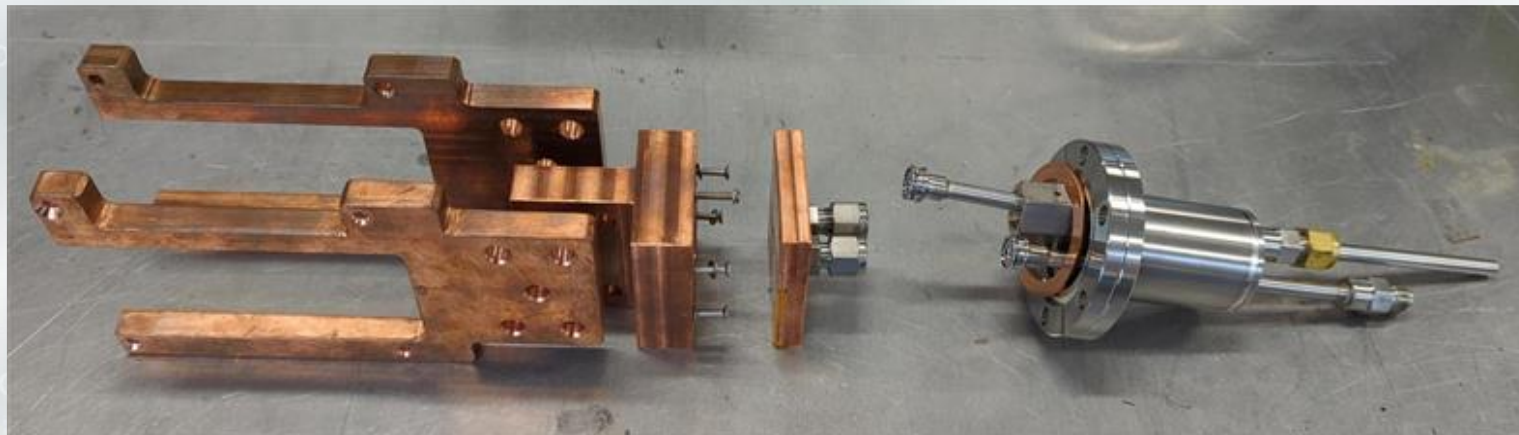
Electron Detector Design

Figures courtesy of N. Niloy

- Two planes diamond strip, two planes HVMAPS
- Complication: detector cooling
 - CFD simulations suggest 12 W heat deposition
- Cooling element comes from copper blocks and baffles
 - Metal-core PCBs for additional cooling
- CFD simulation with baffles and cooling: 25 C max temp
- Sealed in specialized vacuum chamber

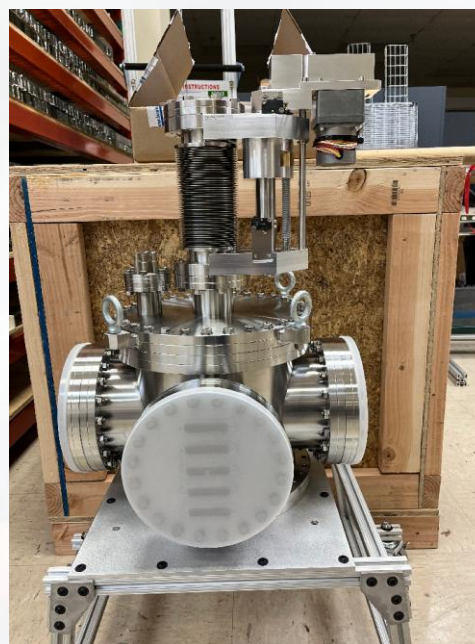
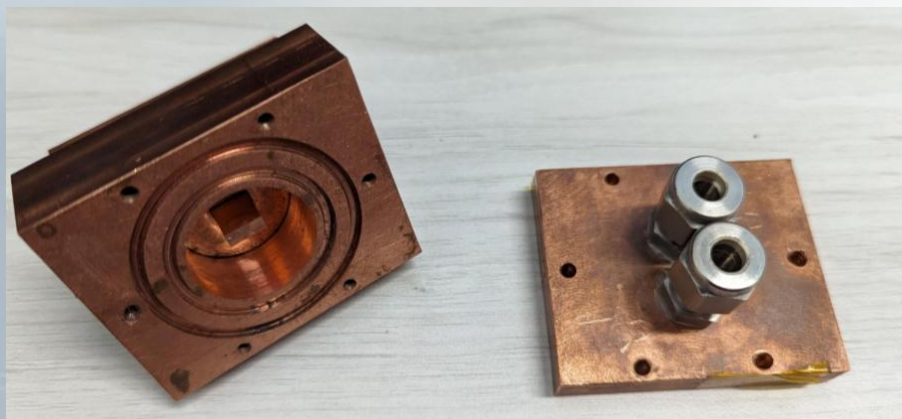


Electron Detector Parts

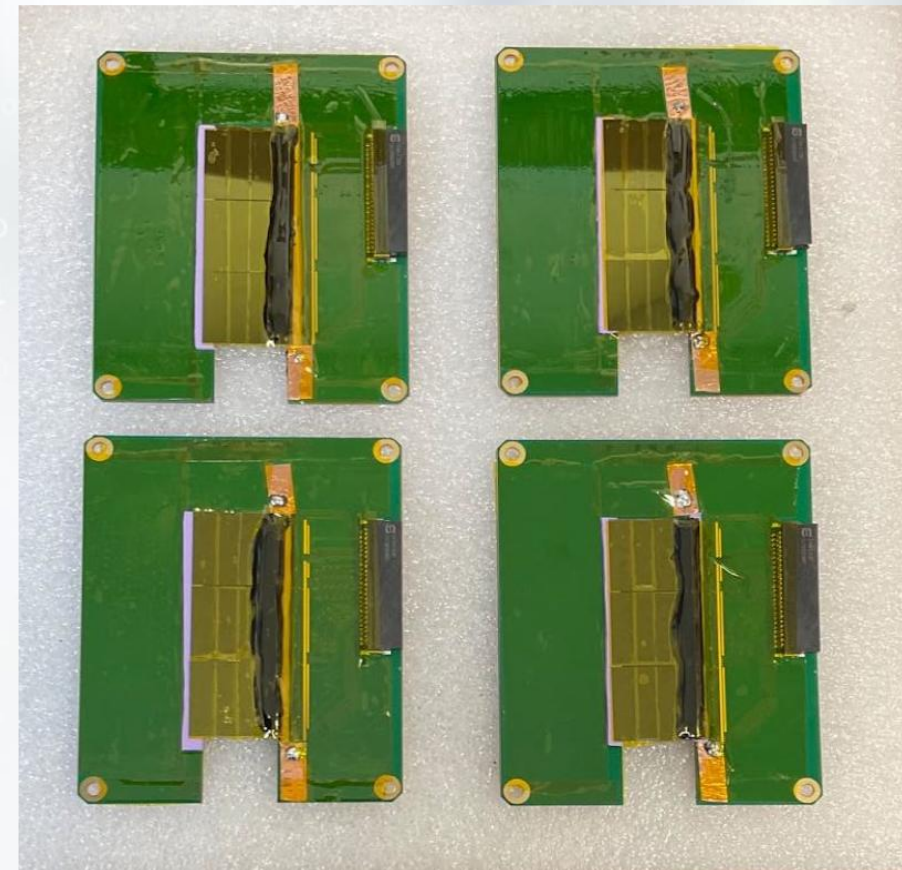


Above: partial assembly with cooling blocks, heat exchanger, and coolant system

Below: prototype heat exchanger + baffle



Figures courtesy of N. Niloy and H. Liu



Above: four copper core PCBs

Left: electron detector vacuum chamber

Figures courtesy of D. Gaskell and SenselCs Corporation

Diamond Detectors

- Two planes of diamond strip detectors
- FLAT-32 analog electronics for detector readout on PCBs
 - Diamonds strips and FLAT-32s from SenselCs
- 120 diamond strips per row x 2 rows per plane x 4 planes = 960 total channels
 - Plan is to run with just 2 planes to start
- FLAT-32 is built-for-purpose
- Will run compatibly with the Manitoba HVMAPS detector planes

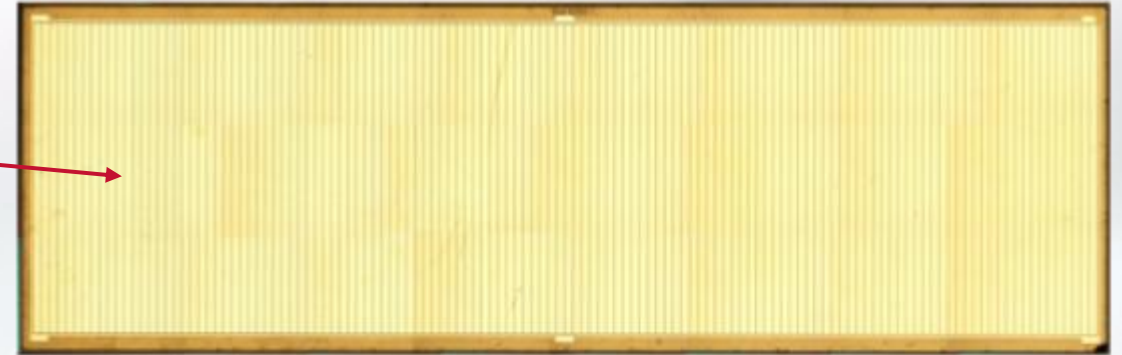


Figure 3: Photo of the strip side of JLab 13A12601 after final processing.

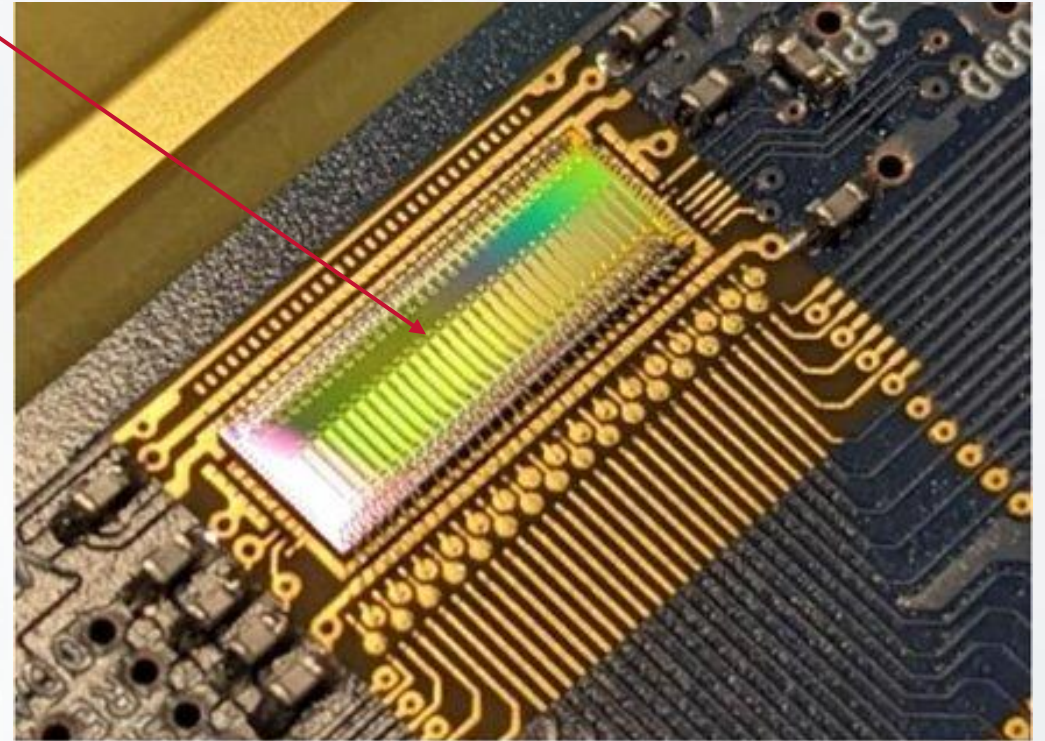


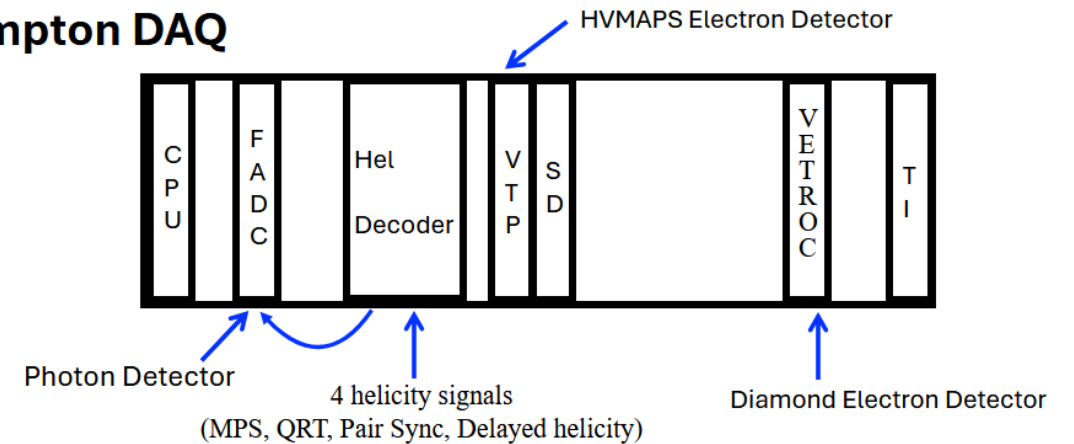
Figure 2: Wire bonded FLAT-32 on the test PCB.

Photon & Electron DAQ

- MOLLER Compton Photon DAQ
 - Internally triggered fADC (no latching scaler!)
 - New fADC firmware
 - Faster trigger rate
 - Lower prescales needed (if prescaling at all)
 - Simultaneous integrating/counting mode (like the CMU DAQ)
- MOLLER Compton Electron DAQ
 - VETROC readout for diamond planes
 - HVMAPS planes get fed to VTP
 - VTP also receives photon fADC information
 - Photon/electron coincidences handled in VTP firmware
- DAQ test stand in EEL

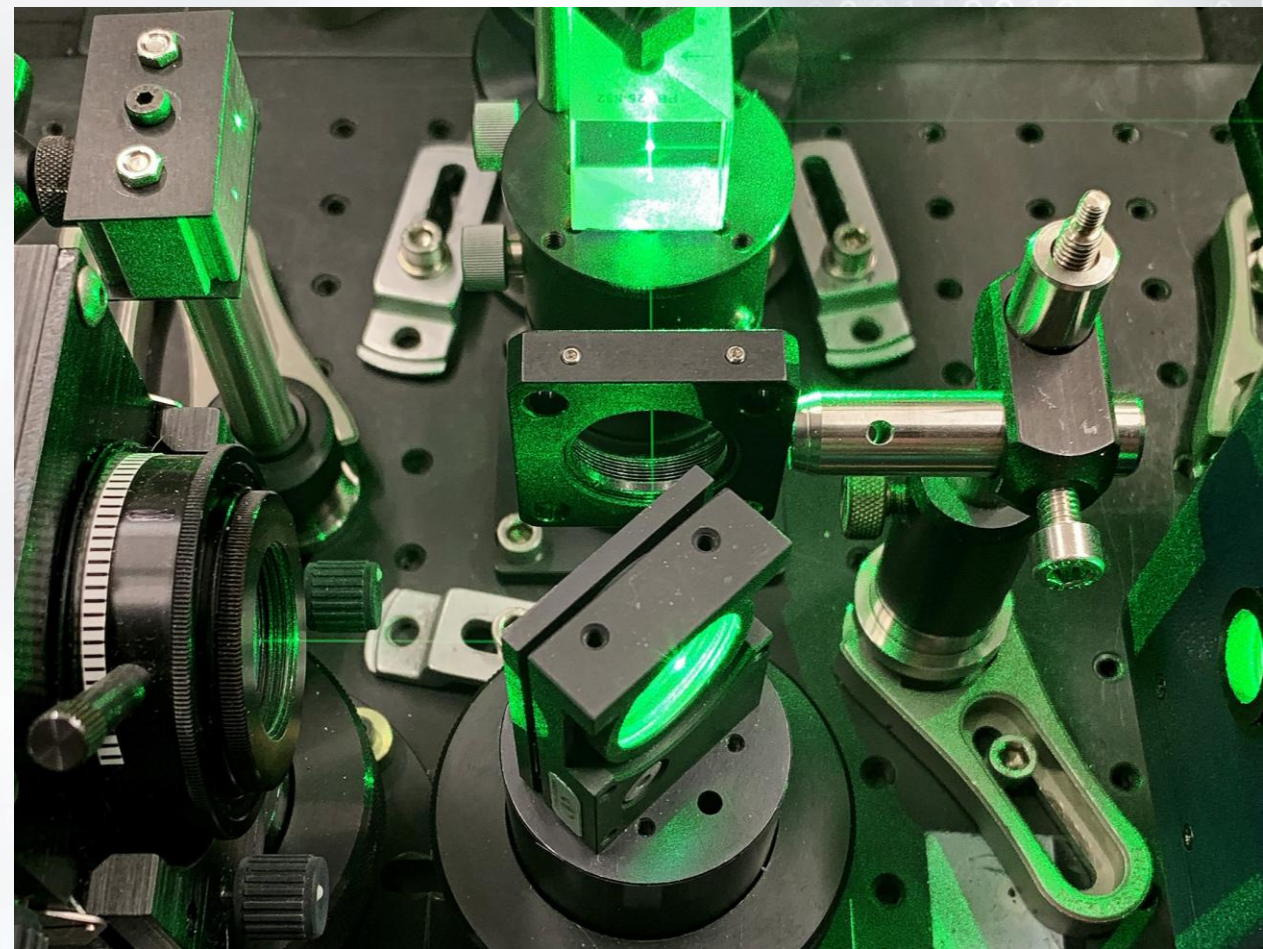
Figures courtesy of H. Liu

Compton DAQ



Summary

- Laser components characterized, in need of new amplifier
- Photon detector from DVCS installed, in principle functioning
- LED pulser system still being revived
- Electron detector components being built and assembled
 - Not fully tested yet
 - HVMAPS not at JLab yet
- DAQ being redone, work ongoing
- Brand new analyzer
- **Compton still on track for MOLLER usage!**



Backup Slides

Analyzer

- New JANA2-based analyzer
 - Replaces CMU-written CompMon
- JANA2 new features
 - Multithreading!
 - Results match decoder based on PODD
 - Support from EPSCI group at Jlab
- Simultaneous photon and electron DAQ analysis
- **HallA-Compton-jana2 will be the Compton analyzer for the new DAQ**

The screenshot shows the GitHub repository page for `HallA-compton-jana2` under the `JeffersonLab` organization. The repository is public and has 2 branches and 0 tags. The file list includes:

File/Folder	Description	Last Commit
config	Add filtering by roc and bank id	last month
examples	modify the tree structure to be flat, so plotting the wavefor...	2 months ago
parser	Moved allowed ROCs configuration printing to service ::Init	last week
scripts	Fix a memory leak and add memory leak checking target to ...	last month
services	Moved allowed ROCs configuration printing to service ::Init	last week
user_parsers	add helicity decoder parser and tree	last week
.gitignore	change "moller" to "compton", and set the tree variables to ...	2 months ago
CMakeLists.txt	Changed ITScaler to TIScaler	last week
Compton_LinkDef.h	Add LinkDef.h and modify the CMakeList.txt, so a vector of v...	2 months ago
JEventProcessor_Compton.cc	New update for Compton analyzer, add the fadc250 pulse tr...	5 days ago