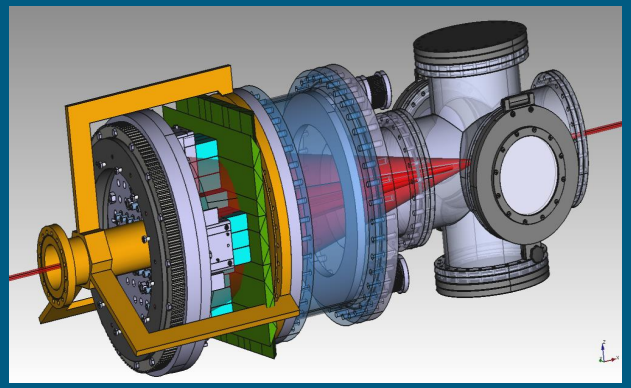
Mitglied der Helmholtz-Gemeinschaft

Polarimeter Electronics and Data Readout

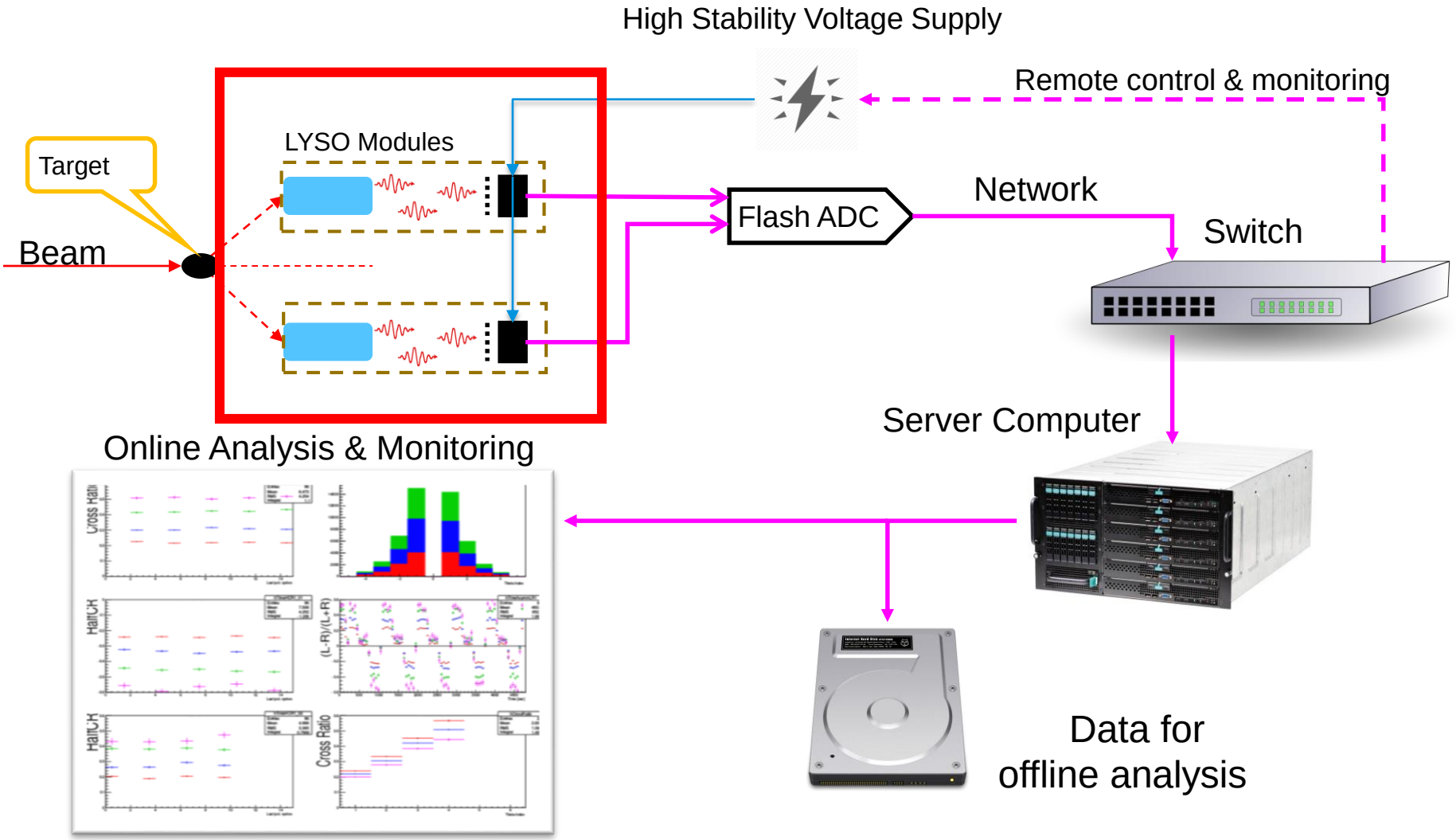


D. Shergelashvili, PhD @ SMART|EDM_Lab, TSU, Georgia

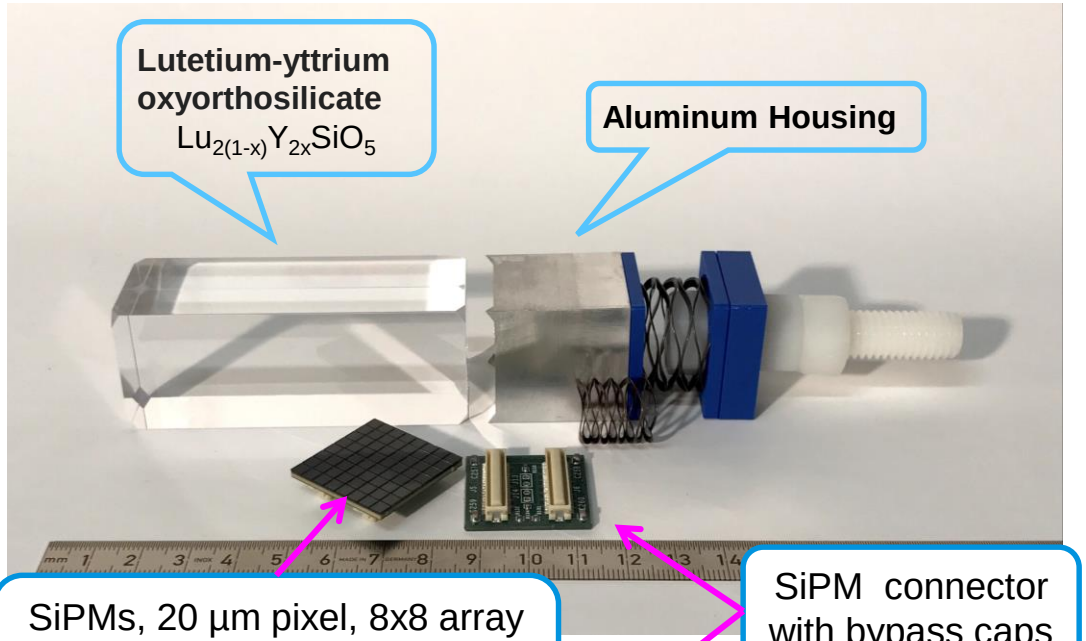
Supv: Dr. David Mchedlishvili @ TSU; Dr. Irakli Keshelashvili @ FZJ

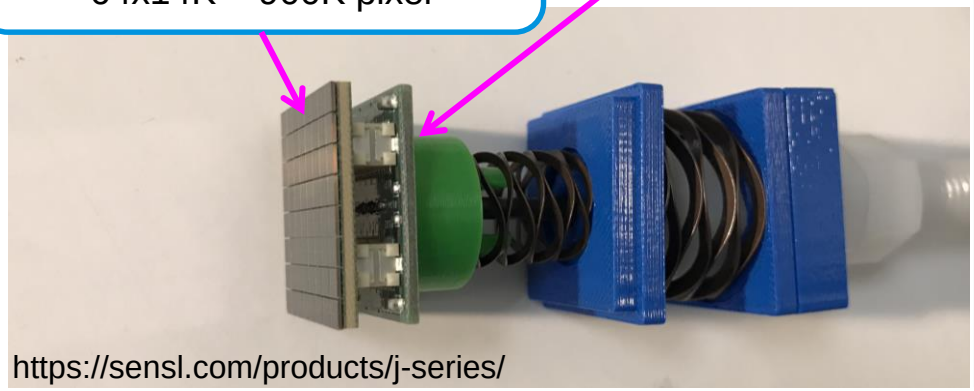
August 23, 2018 – 8th GGWBS

Polarimetry Overview

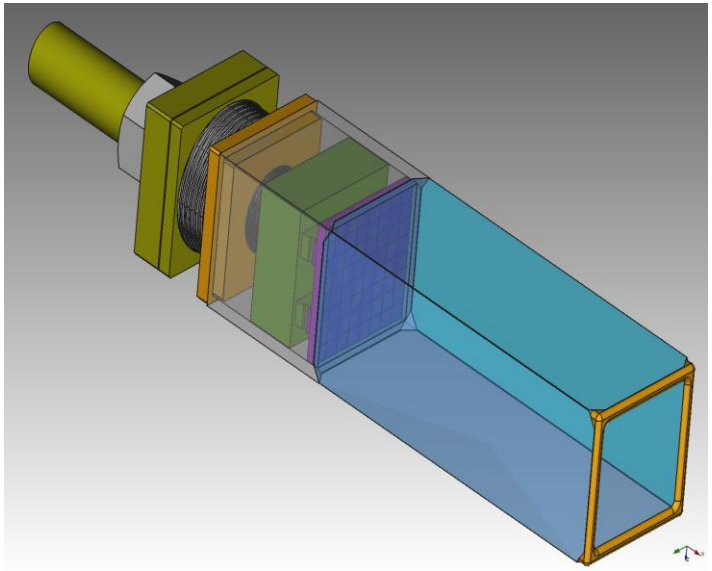


LYSO Module





3D drawing of the module



Parameter	Min.	Typ.	Max.	Units	Notes
Breakdown Voltage (Vbr)		24.5		V	
Recommended overvoltage (Voltage above Vbr)	+1		+6	V	
Spectral Range	200		900	nm	
Peak Wavelength		420		nm	
PDE (Photon Detection Effieciency)		50		%	35um microcell @ Vbr + 6V and 420nm
Gain (anode to cathode readout)		$6.3x10^6$			35um microcell @ Vbr + 6V
Dark Count Rate		50		kHz/mm^2	@ Vbr + 2.5V
Temperature dependence of Vbr		21.5		mV/°C	

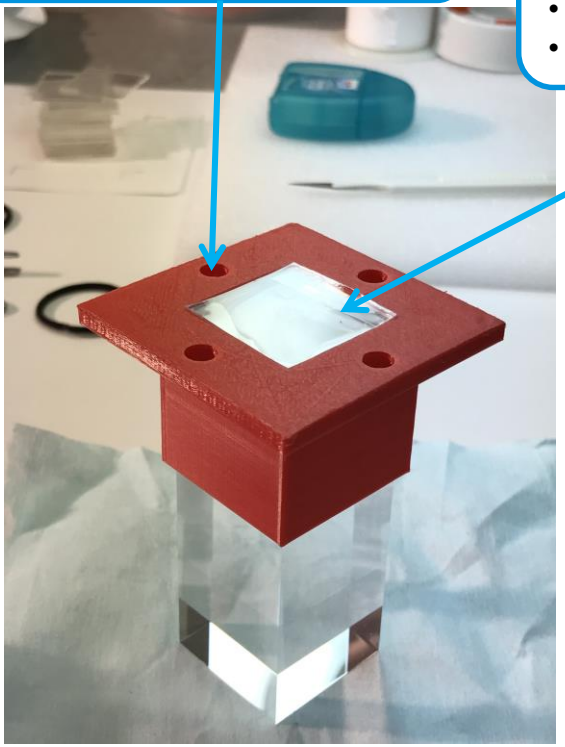
LYSO Modules Assembling

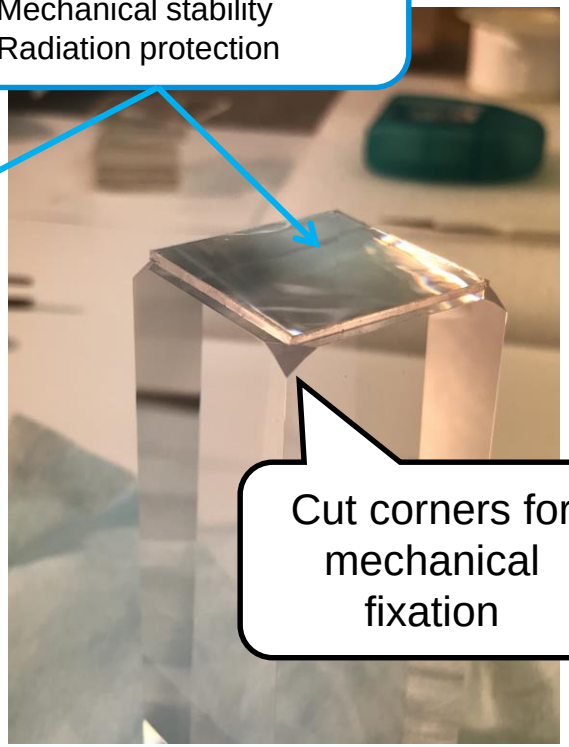
Two layers of foils:
I - Four different inner layers (reflector)
II - Tedlar (outer) foil (light tightness)

1. Teflon – 50 µm
2. Tyvek ~ 100 µm
3. Smooth Mylar - 25 µm
4. Wrinkled Mylar - 25 µm

3D printed plastic for centering silicon

Silicon layer
- Optical coupling
- Mechanical stability
- Radiation protection

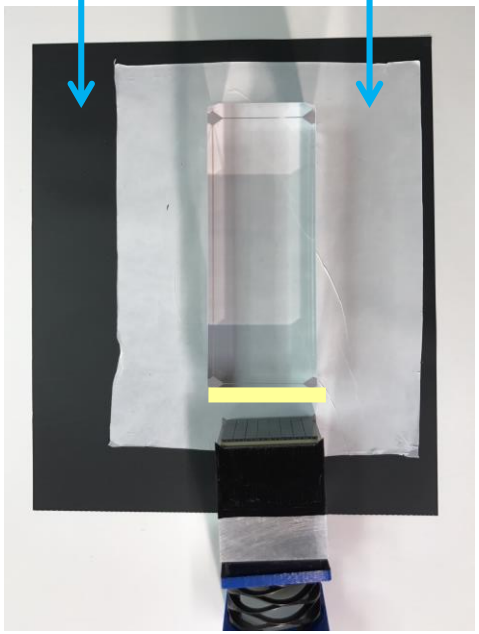




Cut corners for mechanical fixation

Tedlar 50 µm

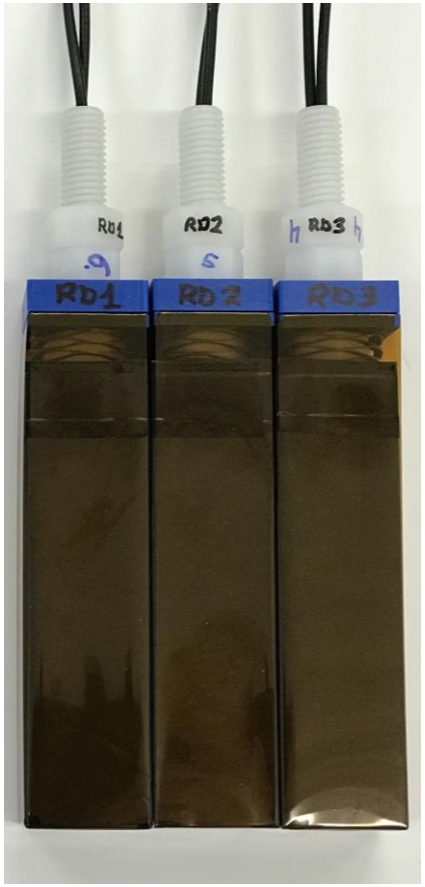
Teflon



LYSO Module Assembling

3rd hand during assembling

Ready for test

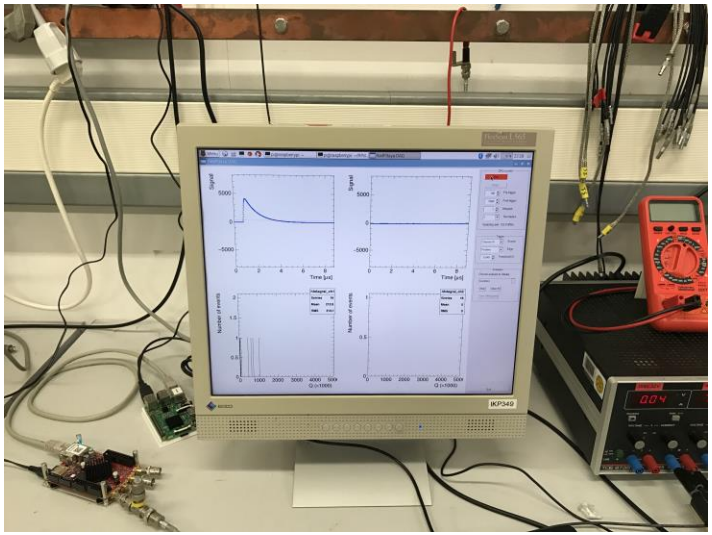


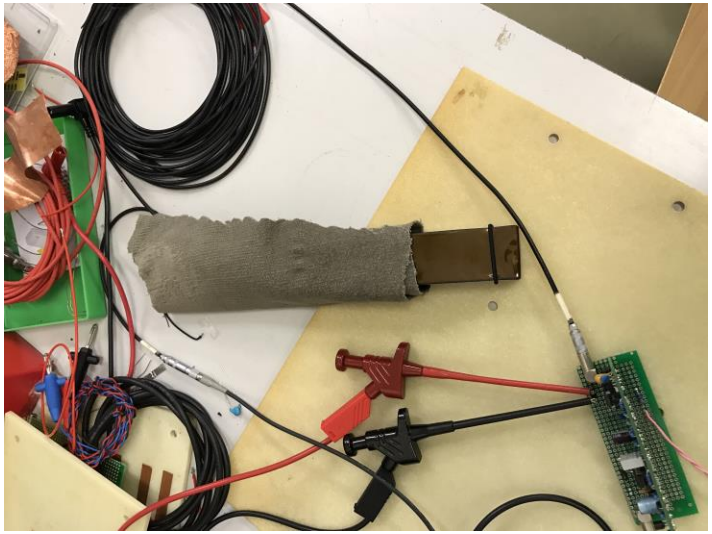
12 cm LYSO module

Enough depth to stop
270 MeV deuterons

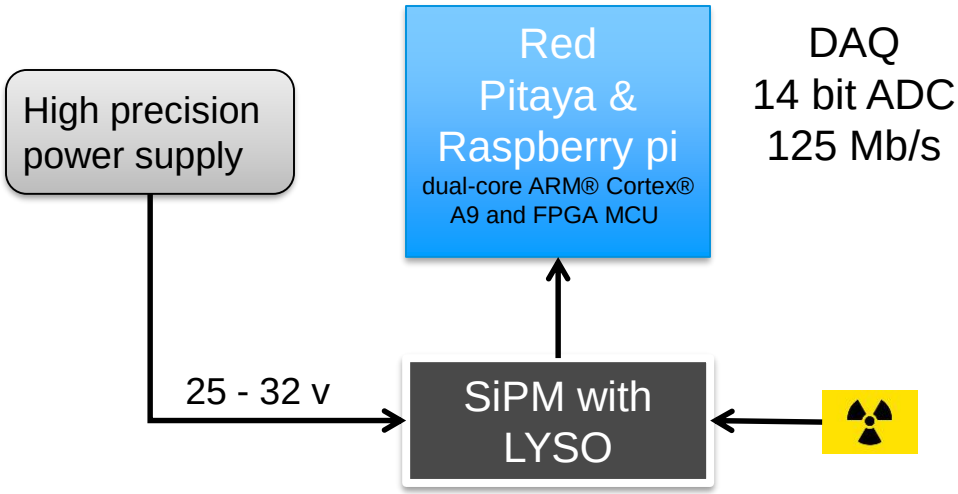
Energy loss can be estimated

LYSO Modules Lab Tests





- Light Tightness
- Measurements of ^{22}Na, ^{60}Co, ^{176}Lu (internal)
- Optimal supply voltages
- Signal offset (current leakage)



Redpitaya DAQ

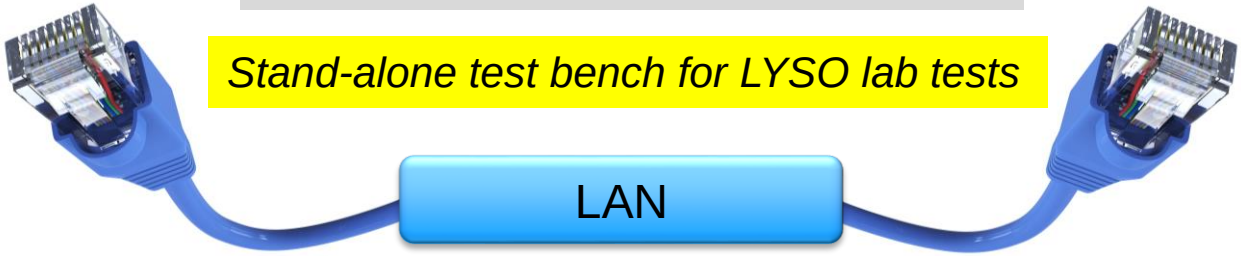
Redpitaya

- ✓ FPGA based 2 ch 125 MS/s DAC and function generator
- ✓ Linux on board
- ✓ C/C++ compiler
- ✓ Communication via LAN

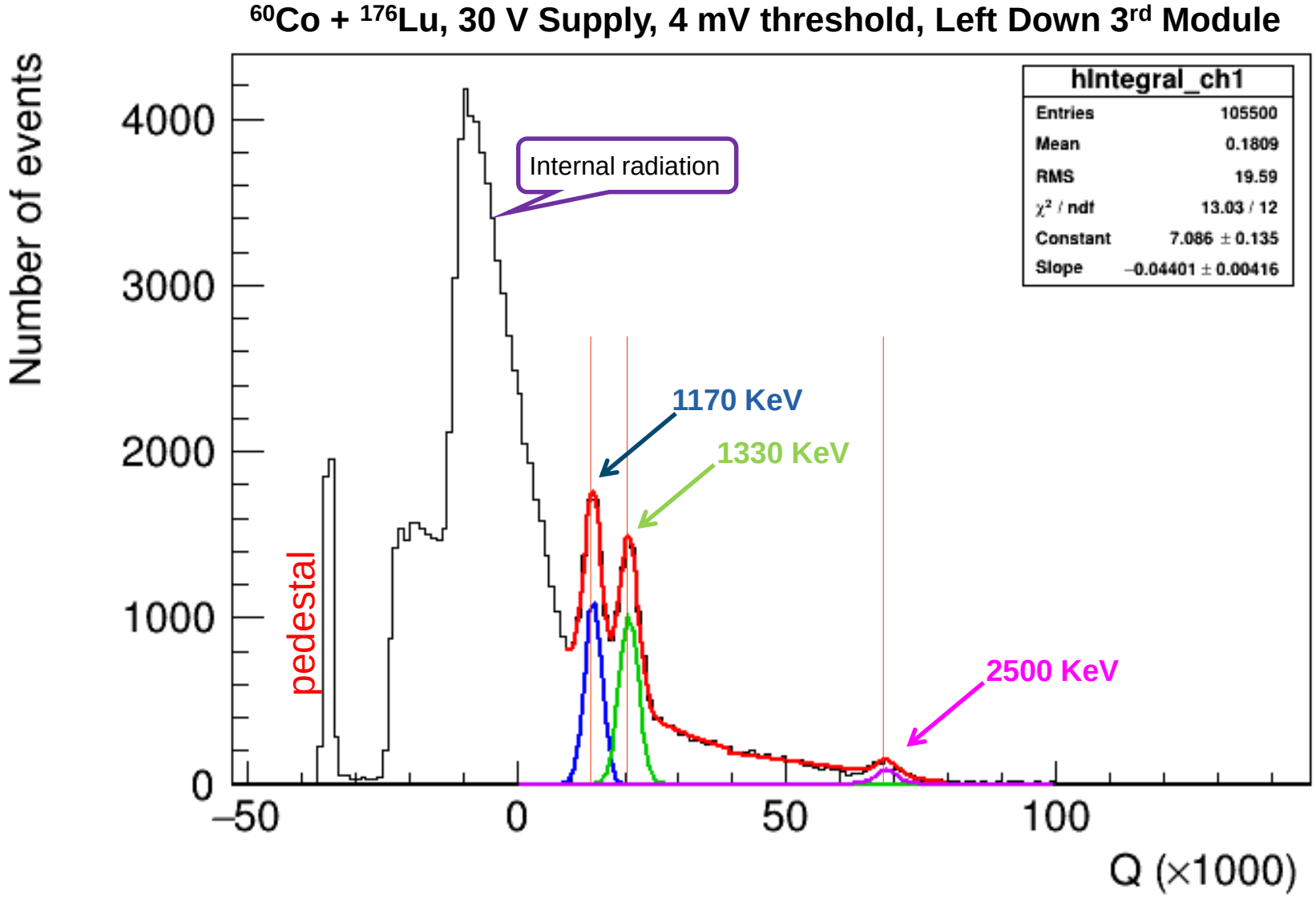
Raspberry Pi

- ✓ Root based online analysis software

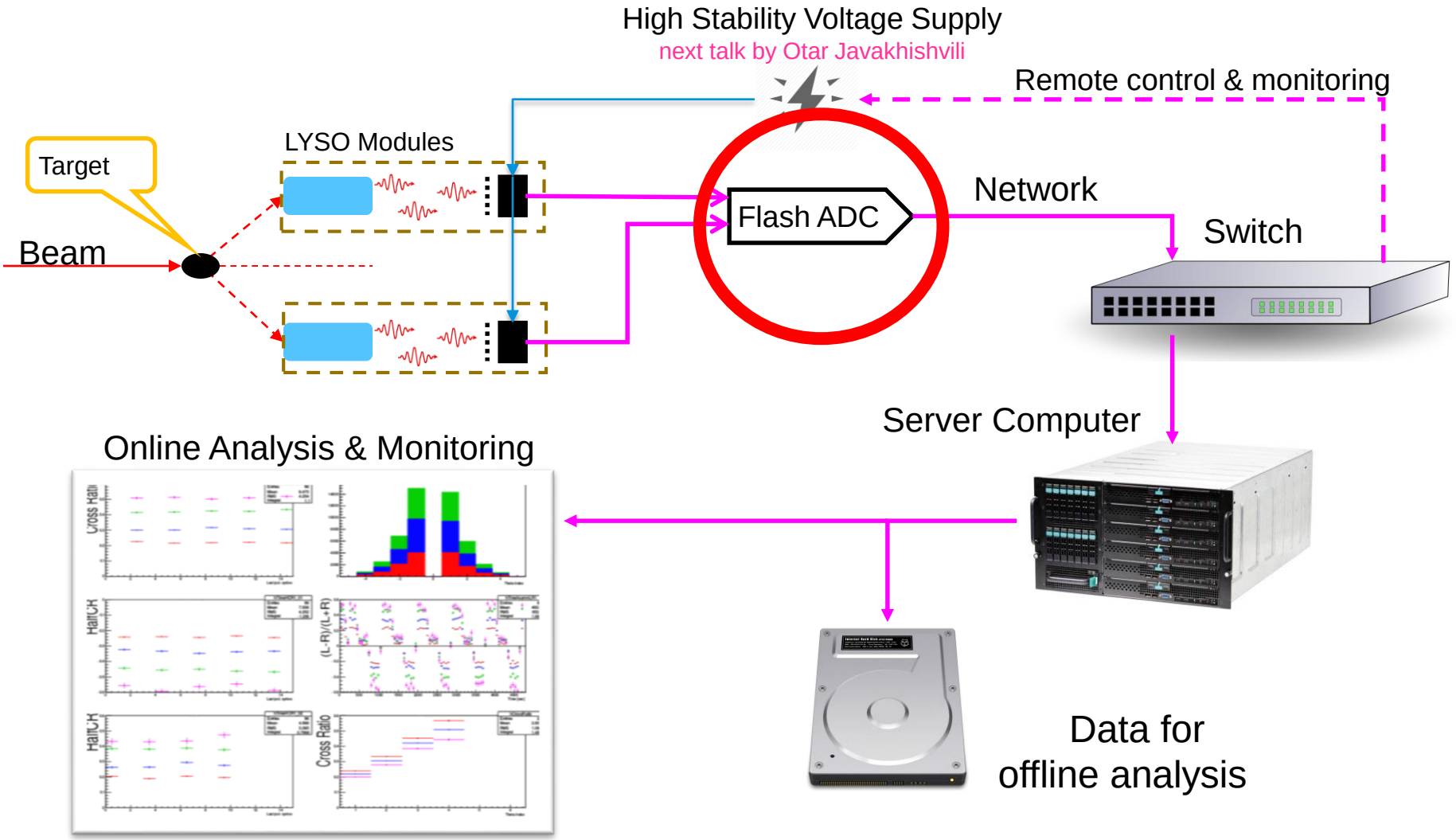
Stand-alone test bench for LYSO lab tests



LYSO Modules Lab Tests Analysis

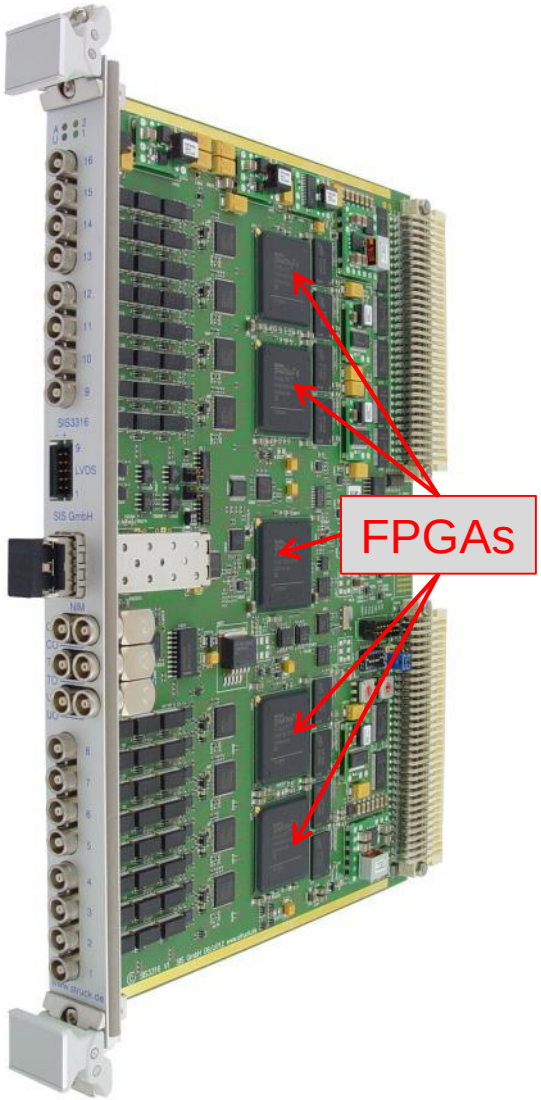


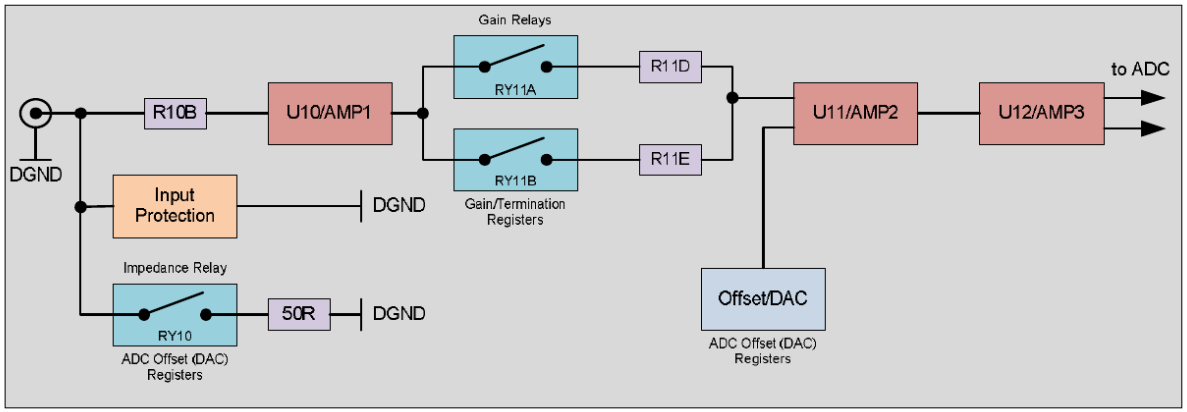
Polarimetry Overview: FADC



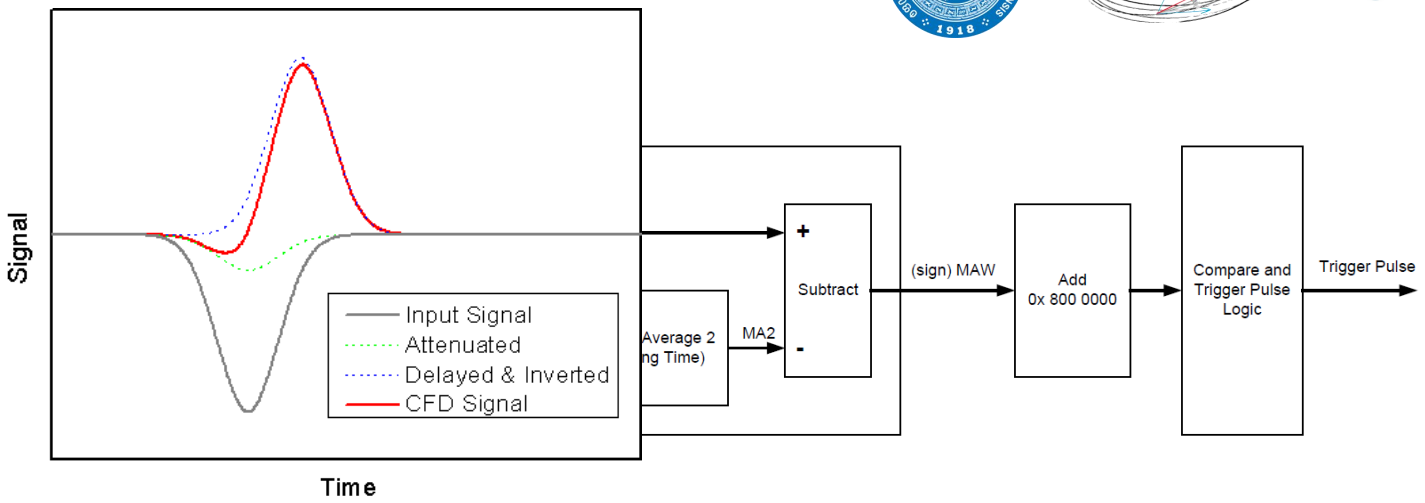
Struck SIS3316 FADC

- 16 channels per module
- 250 MS/s per channel
- 125 MHz analog bandwidth
- 14-bit resolution
- Offset DACs
- Internal/External clock
- Readout in parallel to acquisition
- **Capable of working in a chain**
- Built-in hardware features (Pile-up detection, averaging and more)
- Self triggering



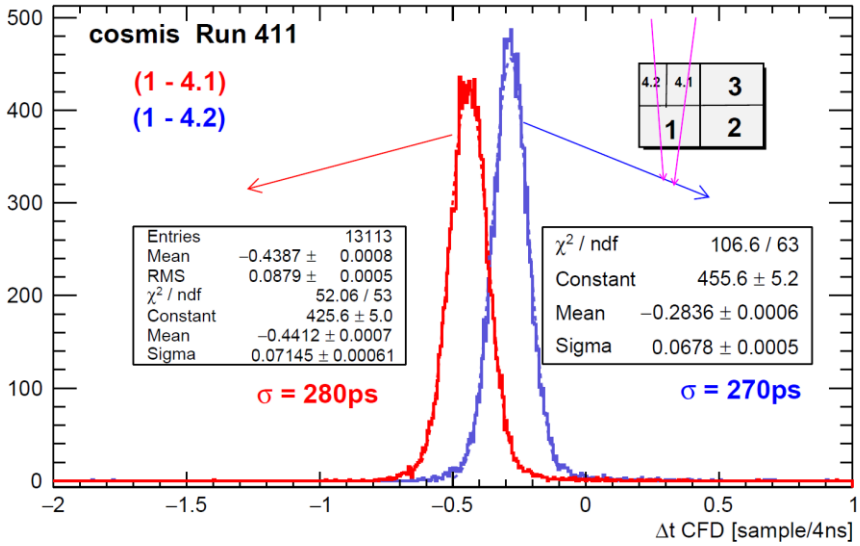


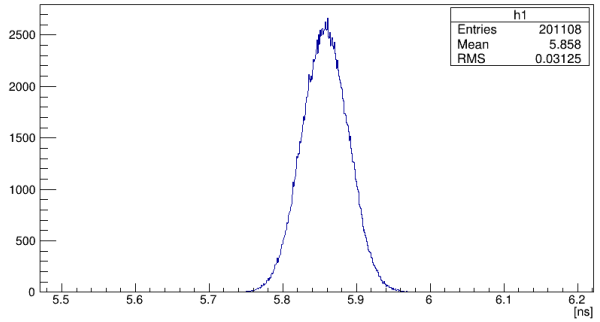
Struck SIS3316 FADC: Time Resolution



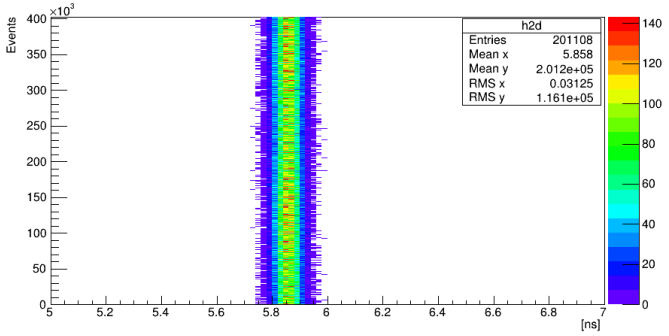
250 MS/s = 4 ns Timestamps, Even Better…

Cosmic Run with PMT & LYSO





Signal delay in 1m cable



Polarimetry Overview: Servers & Scripts

High Stability Voltage Supply

next talk by Otar Javakhishvili

Remote control & monitoring

Target

LYSO Modules

Beam

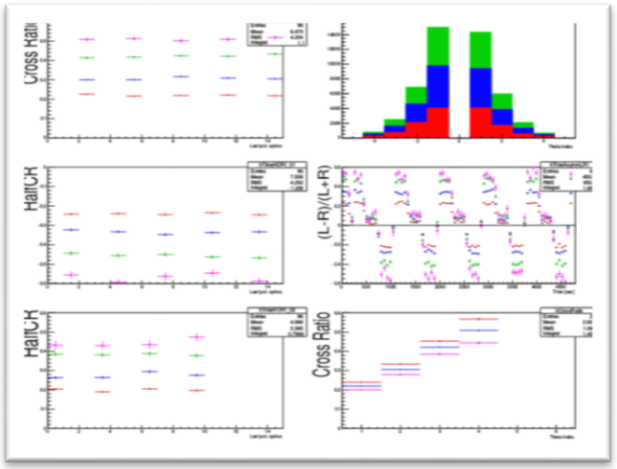
Flash ADC

Network

Switch

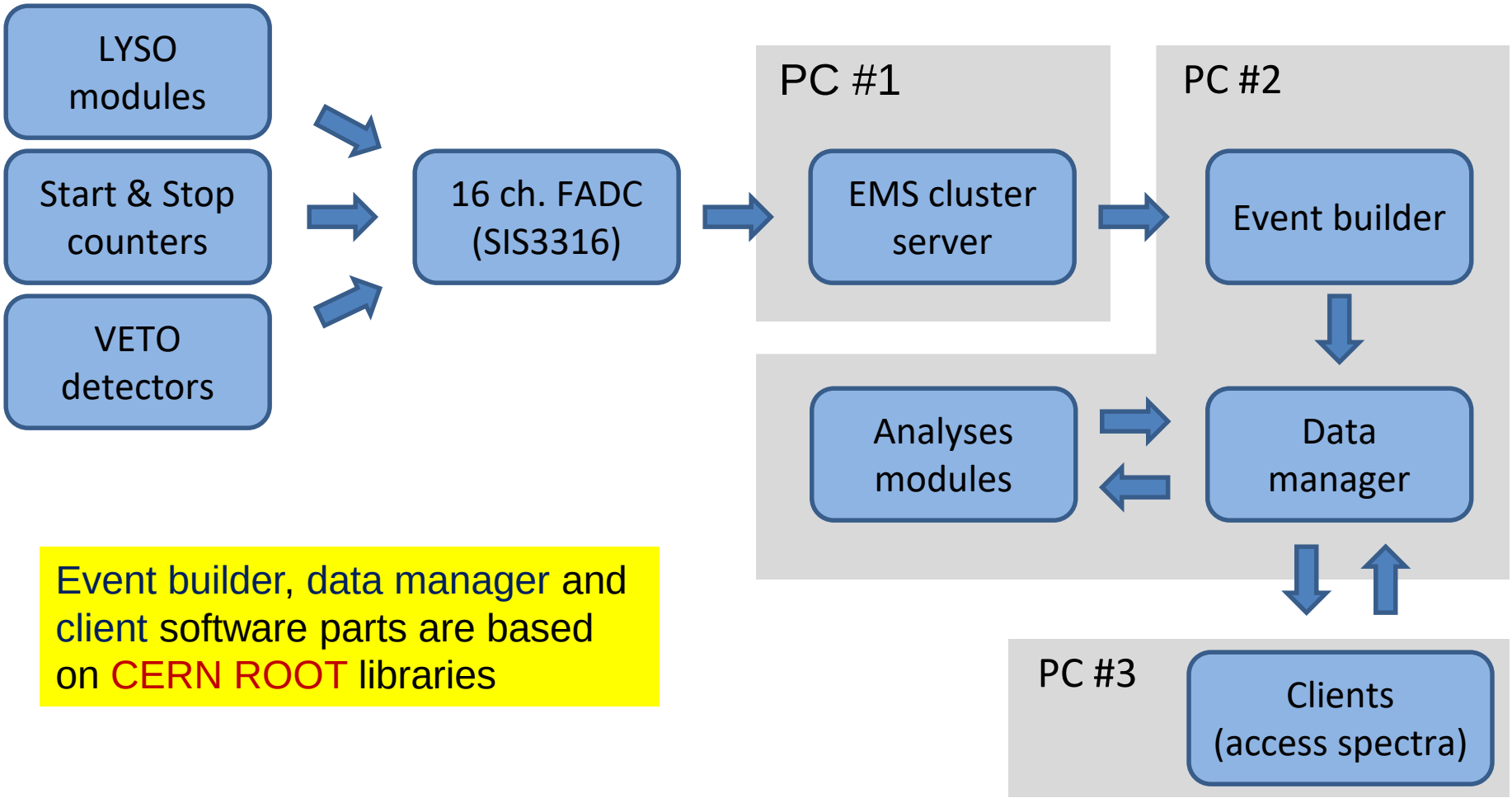
Server Computer

Online Analysis & Monitoring



Data for offline analysis

DAQ & online analysis



Event builder, data manager and client software parts are based on CERN ROOT libraries

DAQ & online analysis

EMS cluster server

- Reads data and structures it
- Saves data stream to file / sends over LAN

Event builder (multi-threaded)

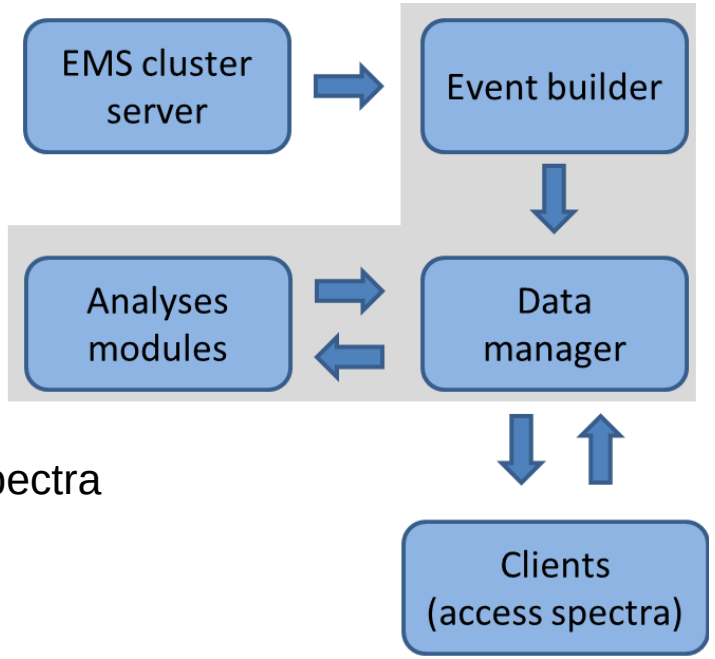
- Reads structured FADC data stream and reorganizes it
- Synchronizes different channels data using timestamps
- Builds events

Data manager (multi-threaded)

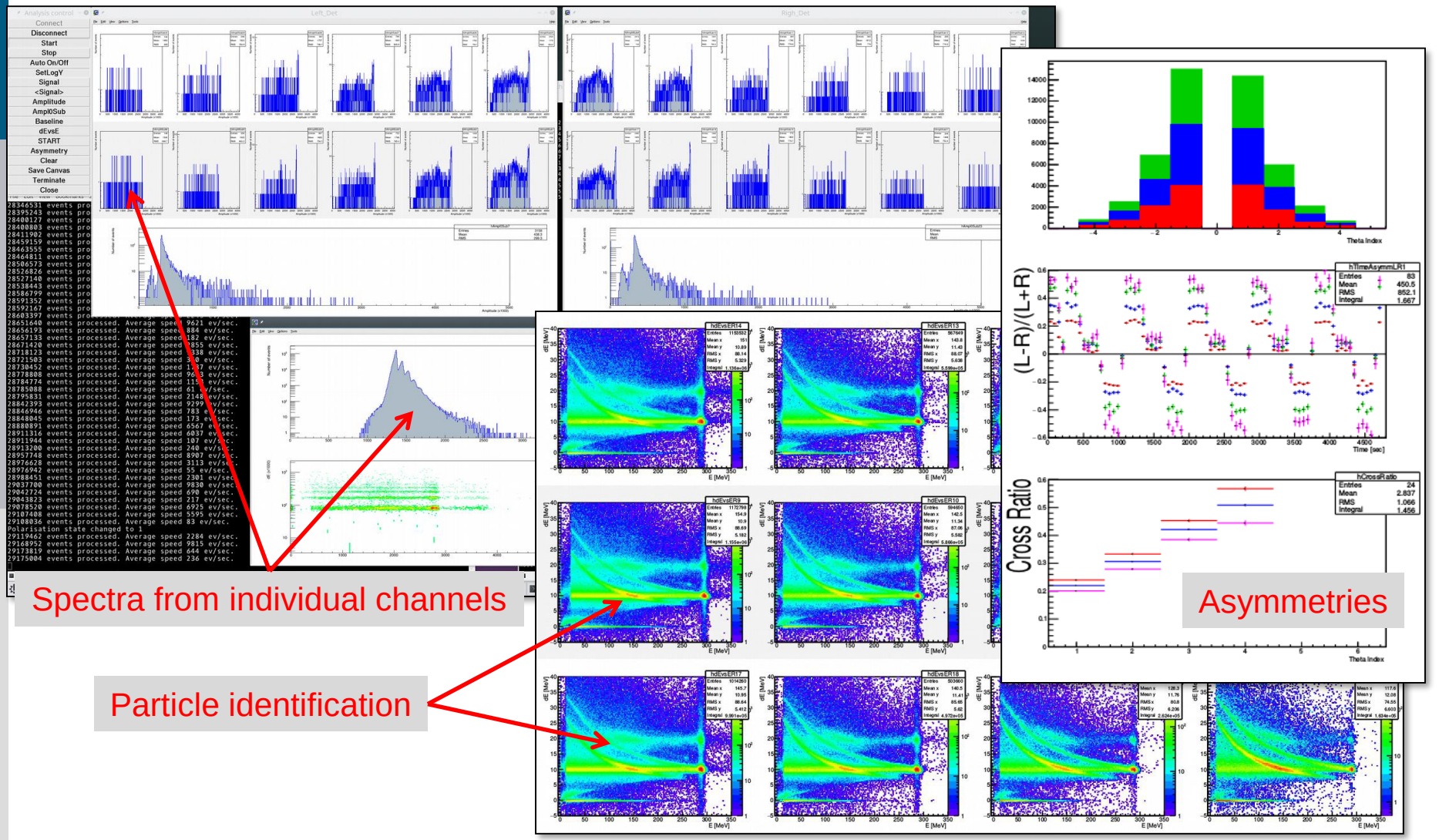
- Reads event stream / file
- Runs analyses modules
- Listens to clients and sends histograms

Client

- Controls data manager
- Gets results from analyses modules and draws spectra
- Handles configuration files



Online analysis results



Summary

- ✓ LYSO module **assembling** and **testing** procedure
- ✓ More then 50 module ware assembled and **tested successfully**
- ✓ First version of modular voltage supply for SiPMs was successfully tested
- ✓ 128 channels voltage monitoring system was made

Outlook

Upgrade HW/SW packages for the read out system

- ❑ Further development of online analysis and readout system
- ❑ Flash ADC configuration set-up (user friendly ☺ , in progress)

This work was supported by the Shota Rustaveli National Science Foundation (SRNSF)

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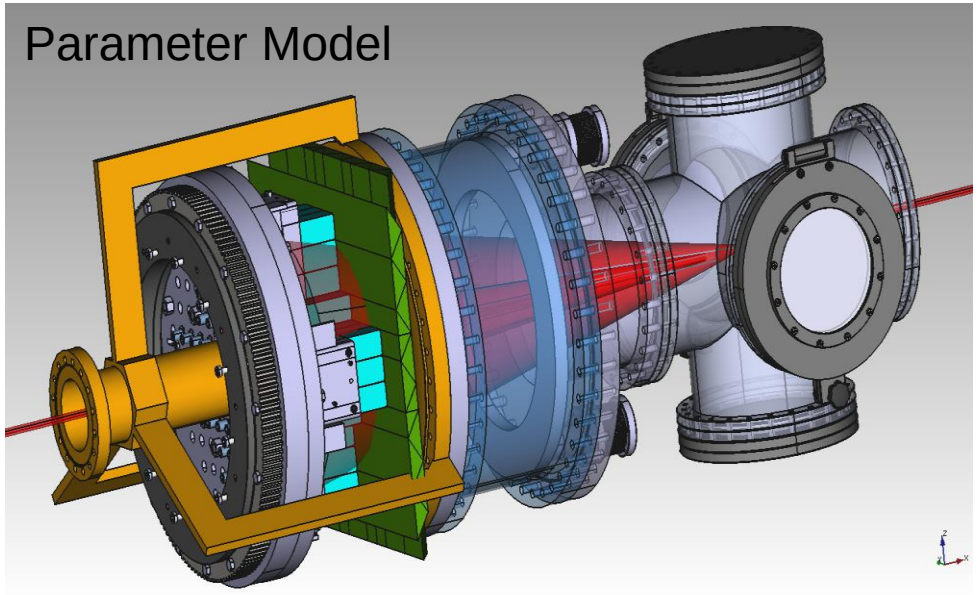
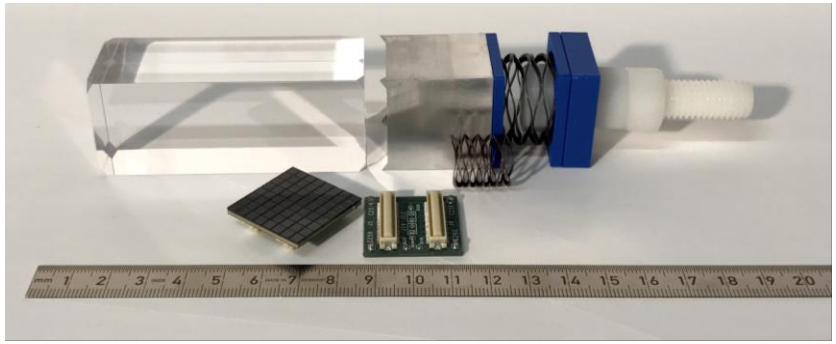
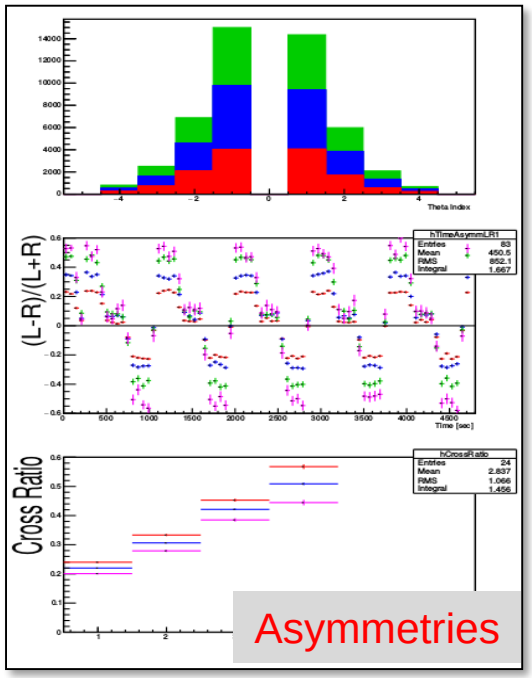
Thank You

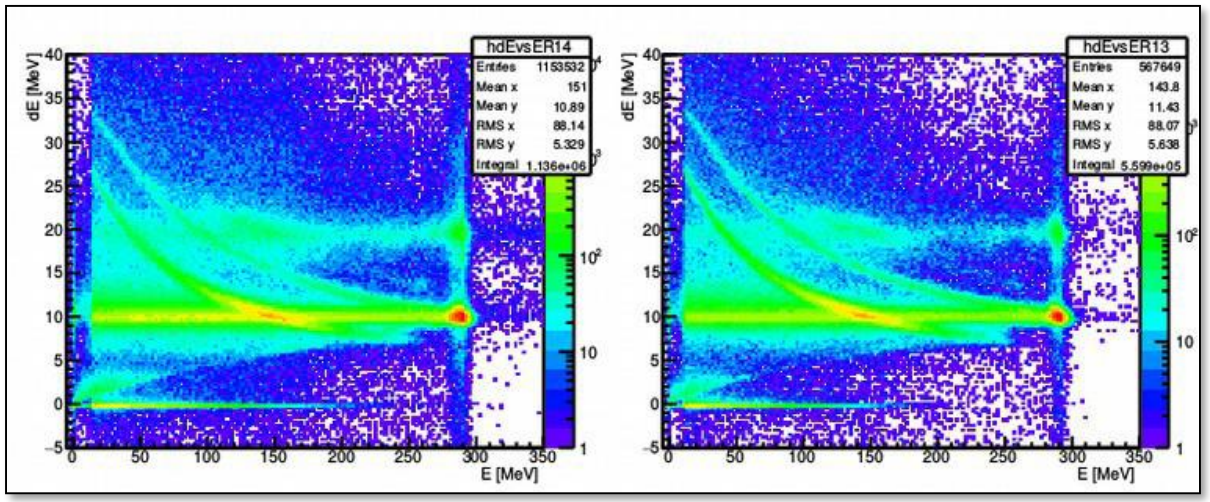
Parameter Model



LYSO Module





Asymmetries

Online Analysis