Status of the FOOT detectors

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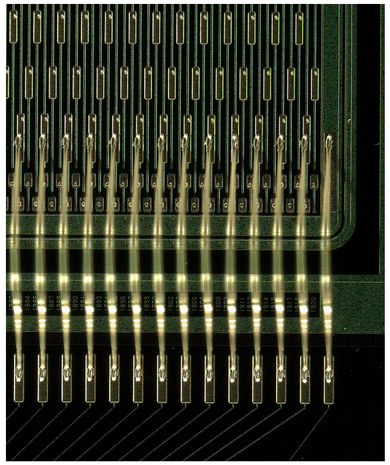
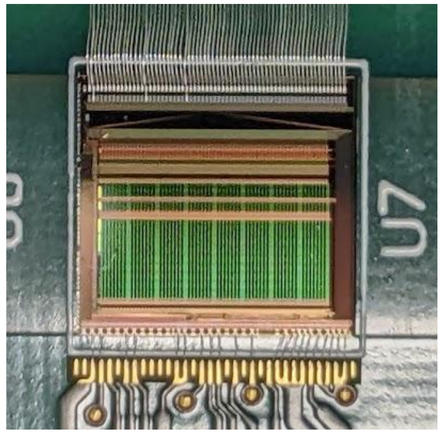
FOOT silicons for measuring fast protons and light ions

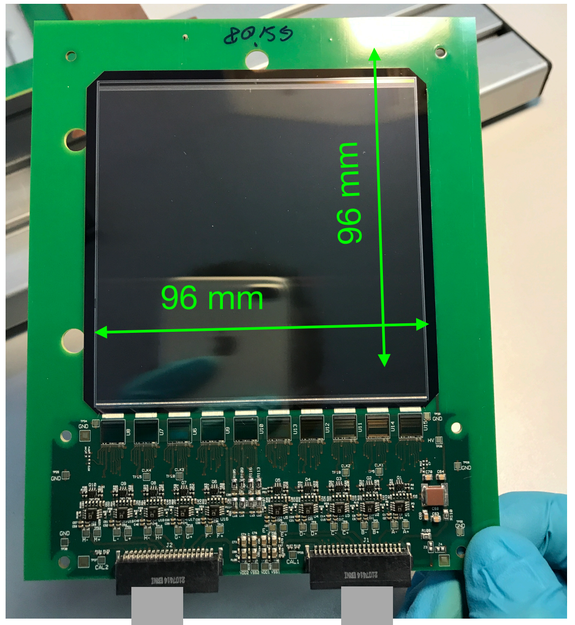
Sensor type:	**single-sided**
Dimension:	96 x 96 mm^2
Thickness	150 μm
Implant pitch	50 μm
Readout pitch	150 μm, 640 ch
Readout strips	640
Max trigger rate	Up to ~6 kHz
ASIC	IDE1140 (VA140), IDEAS, Norway
Readout:	ADC board (Perugia) + de10nano FPGA

Every 3rd strip is bonded



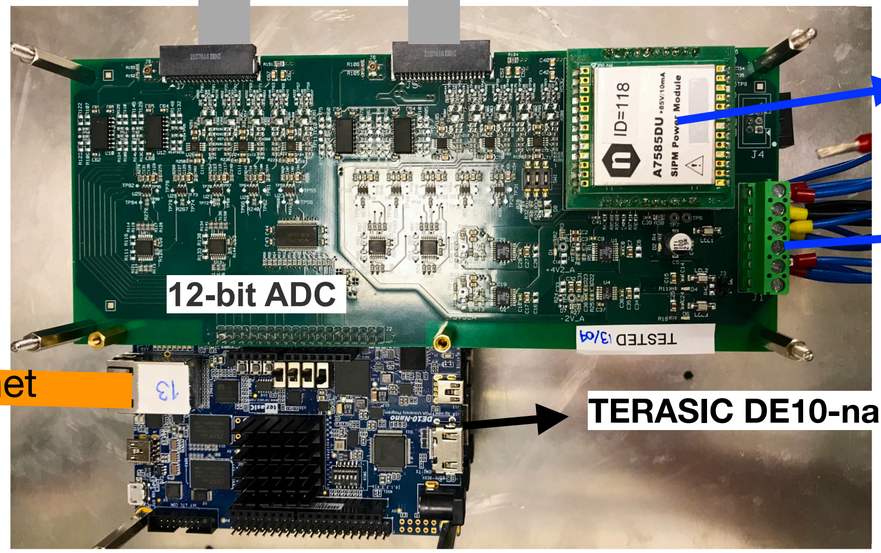
64ch CSA ASIC





vacuum feed-through

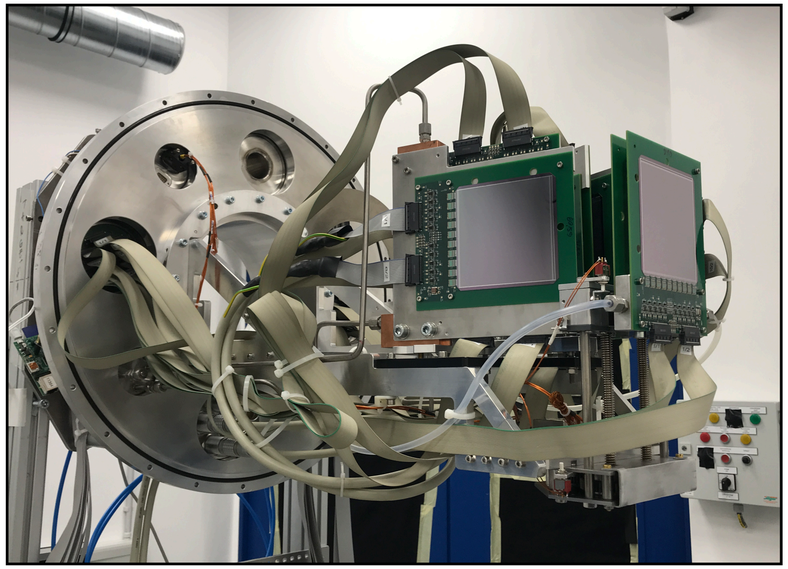
signal cables



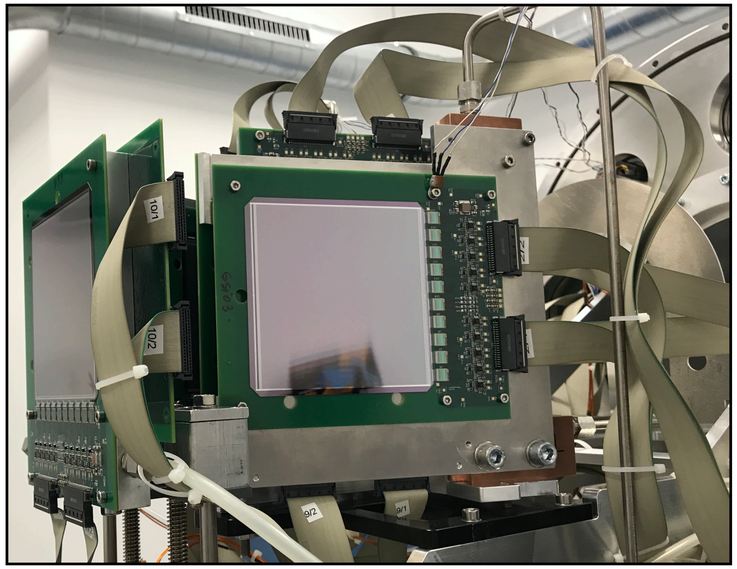
CAEN DC power unit for silicon bias (controlled by external ARDUINO)

Low-voltage from DC supply

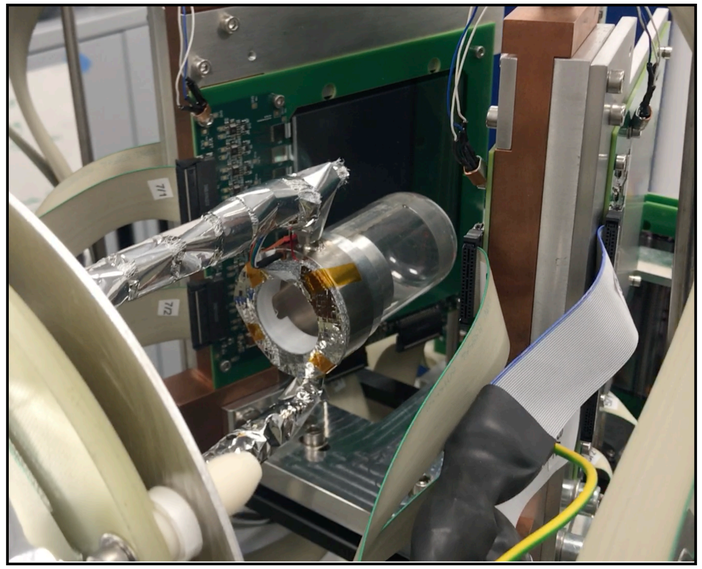
Final two-arm configuration in 2022
10+2 FOOTs + 50 mm LH_2 target

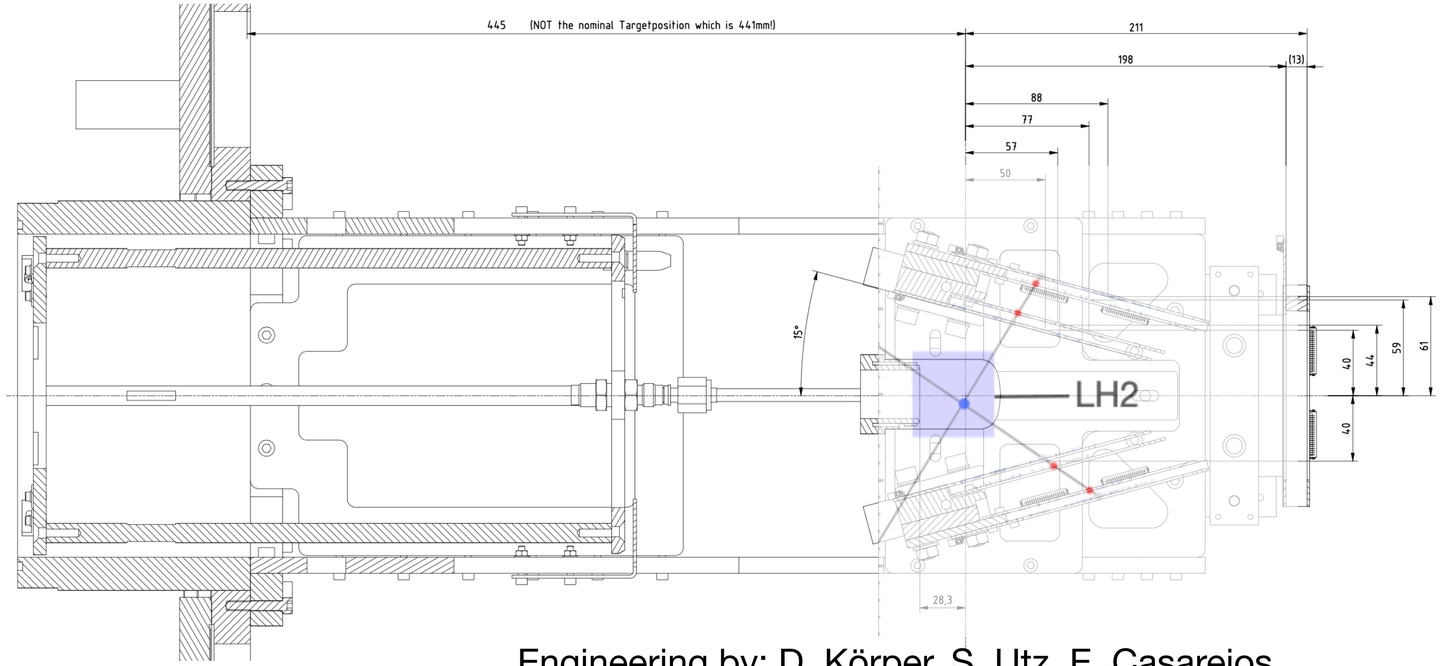


Step-motor to move inbeam detectors



Active cooling of FE-boards





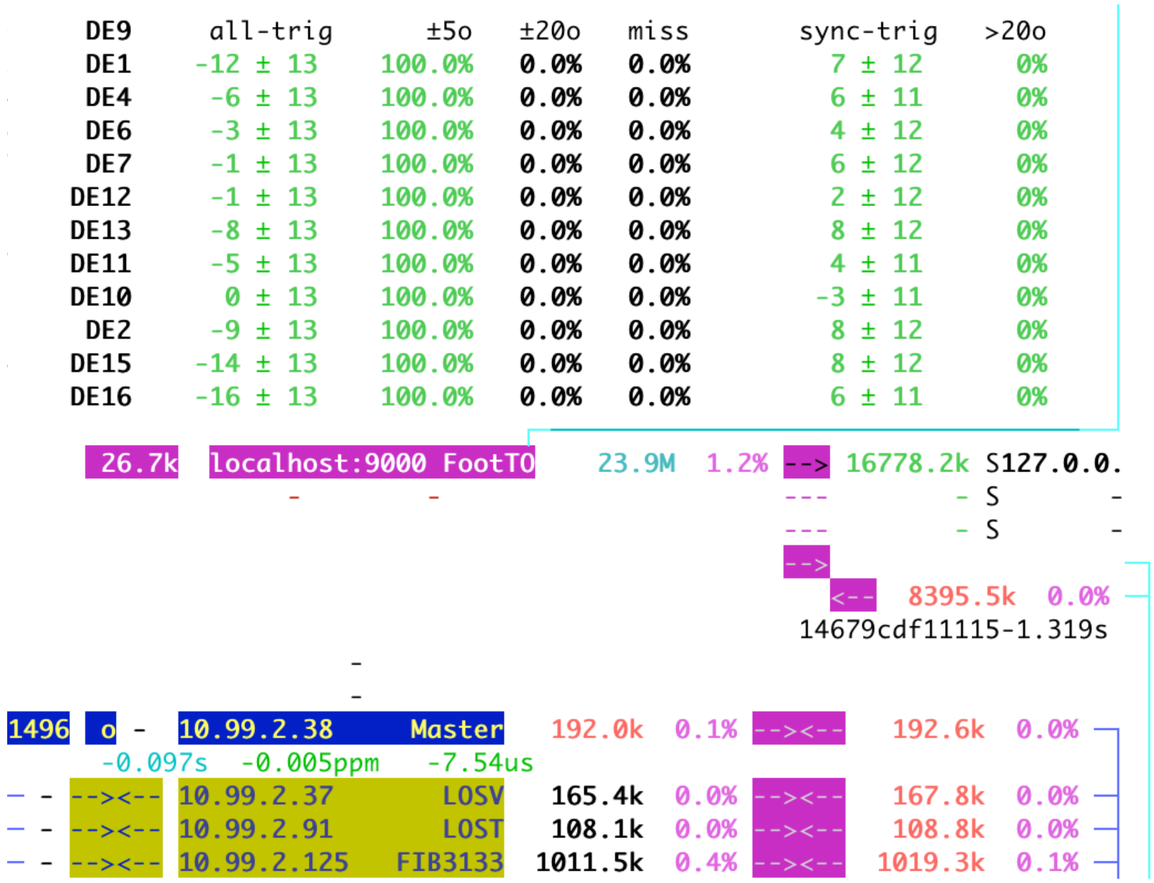
From R3BRoot simulations by A. Revel

Acc. (p,2p)	20%
Res. Theta	2mrad
Res. Vertex_Z	0,17mm
Res. MissM (p,2p)	4,5MeV
Acc. (p,2pn) t,u>0.5GeV/c2	35%
Res. MissP (p,2pn)	3,8MeV

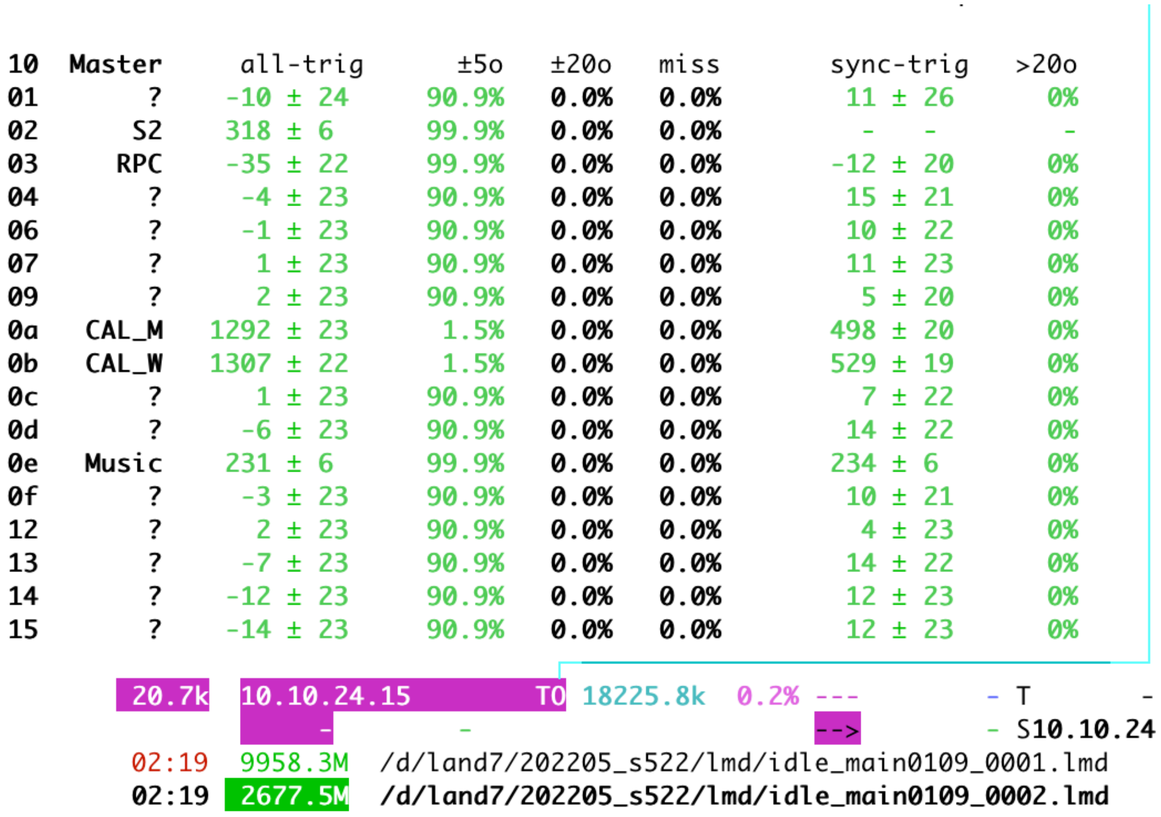
Engineering by: D. Körper, S. Utz, E. Casarejos

DAQ tree viewer with 12 FOOT

Local DAQ node



Common DAQ



Available detectors/electronics

- 10 for R3B + 6 for FRS
  - 3 are currently in Perugia for fixing broken bonds, will be picked up soon

- All necessary cables/connectors are available since 2022

- 5 additional sensors from HAMAMATSU are delivered to GSI
    - Will be transported to Perugia for FE assembly and bonding, ASICs are ready for all 5 dets
    - Expected to be ready in autumn 2023

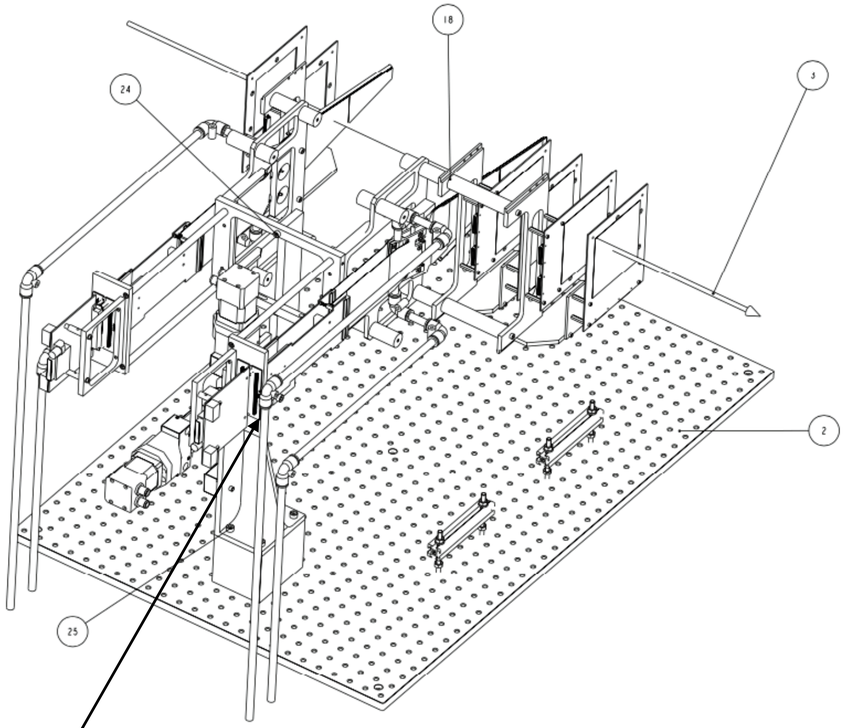
- (DE10-nano + ADC boards + CAEN HV) x 15 - some ADC/HV have problems, will be tested

- New IR laser for testing silicons is available in the detector lab (safety checks are passed)
    - Mechanics for the test is not yet assembled
    - A system for moving the laser beam on the detector surface has to be prepared

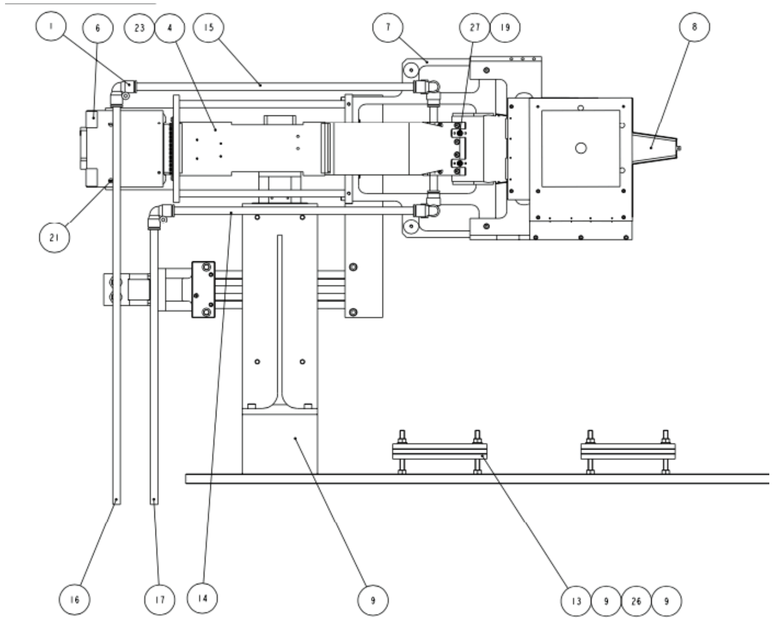
- 8+2 detectors are available for the upcoming beamtime

Jülich test in July 2023

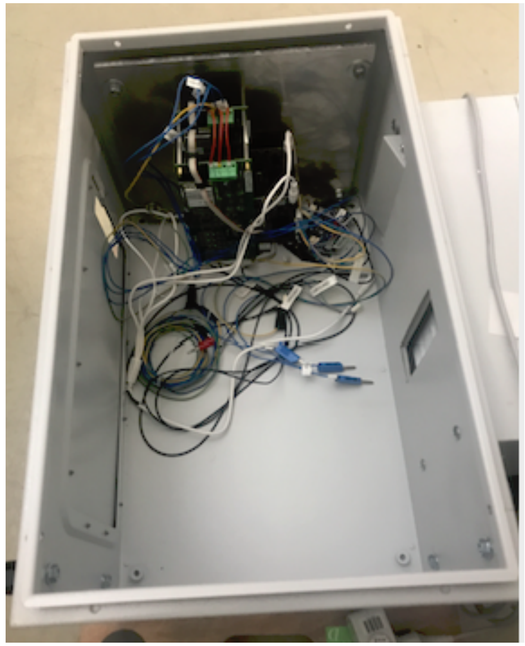
Similar to FOOT-L3T setup from 2021 test in Jülich



Moving arm

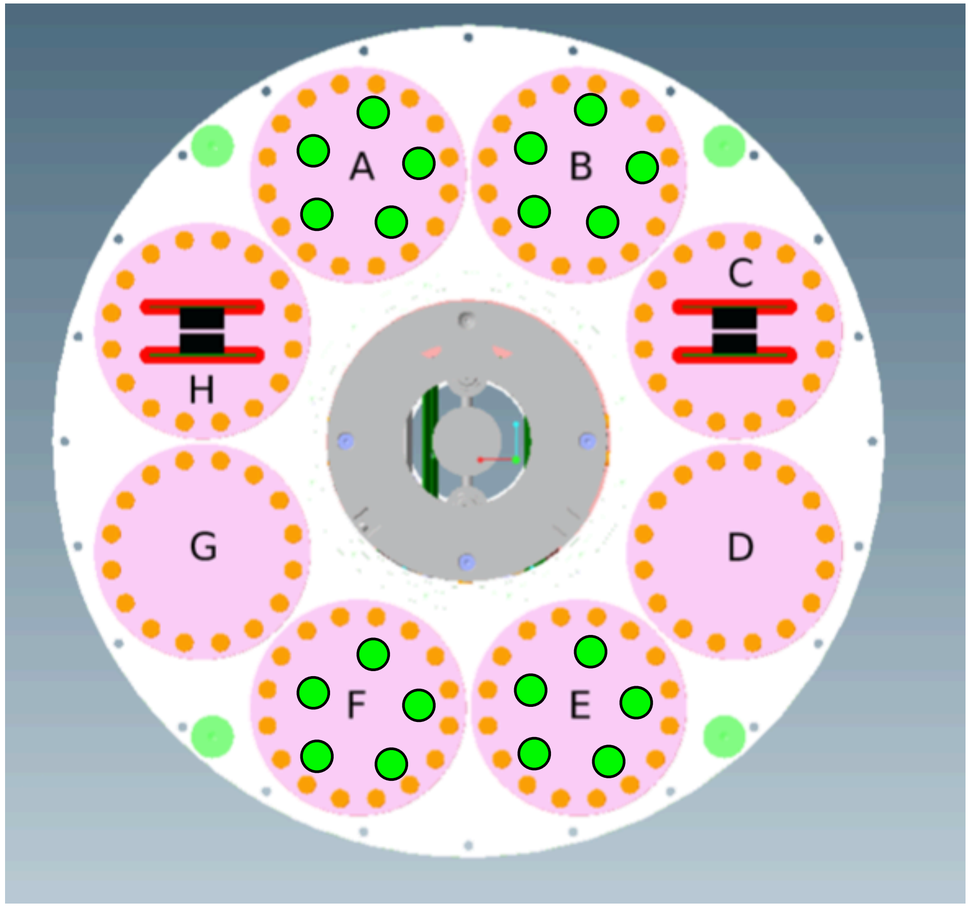


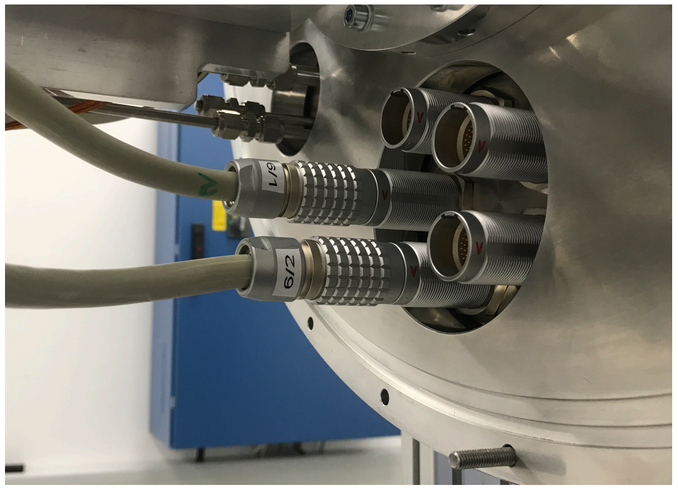
- Electronics box for two FOOTs

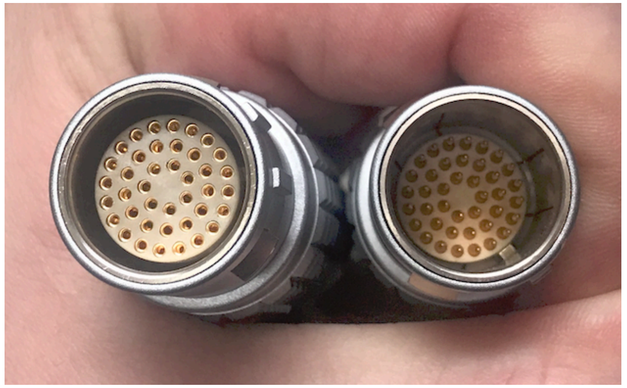


- Only 2 FOOTs (X,Y) are now foreseen for the test
- Each detector will be mounted in individual protection box

New cables for the upcoming experiments







- Replacement of the temporary used flat cables
- All new LEMO cables are delivered (with ERNI connectors on the det side)
- Tested for only one FOOT during 2022 beamtime
- LEMO vacuum feedthroughs are available, 3 additional flanges will be prepared
- **The cables are bulky and stiff! May need to be shortened on the vacuum side**

1 FOOT = 2 LEMO

1 flange = 5 LEMO

10 FOOTs = 20 LEMO = 4 flanges

Outlook

- Further analysis and investigations under different conditions are needed:
  - Varying trigger rates, physical rates and amplitudes of signal into ASICs
  - Testing with infrared laser
  - Trying alternative ASIC <—> FPGA communication
- Understanding “strange” signals in edge channels of every ASIC
- Increasing possible trigger rate as much as possible
  - At present full readout cycle is ~80 us. In the experiment operated at max ~6 kHz (deadtime set to ~150 us)
- Testing readout with FEBEX4 (N. Kurz, K. Koch) instead of ADC - understanding dependence of the baseline on the trigger rate
- Possibility of getting a test board from IDAS (ADC+FPGA+firmware) with the Mezzanine board for the ASIC
- Modify/improving FE circuit?
- At present, no zero suppression is implemented in the DAQ —> large data size
- Hybrid configuration with ALPIDE detectors for the upcoming experiments?