The OREO (ORiEnted calOrimeter) beamtests

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On behalf of the OREO collaboration

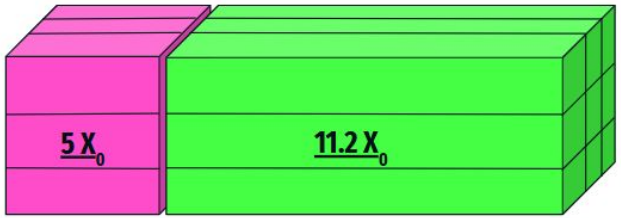
DRD6 collaboration meeting
Oct. 30-Nov 1, 2024

MiB - Ferrara
LNL - LNF

2024

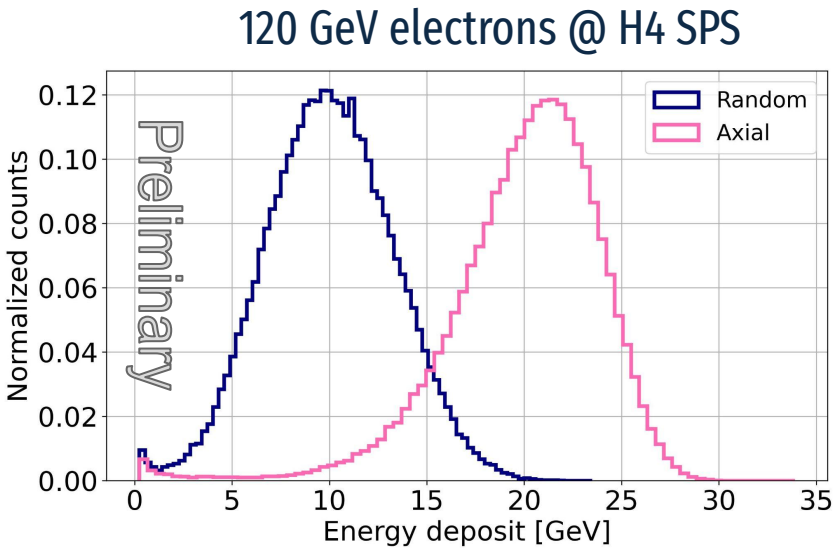
OREO - ORiEnted calOrimeter

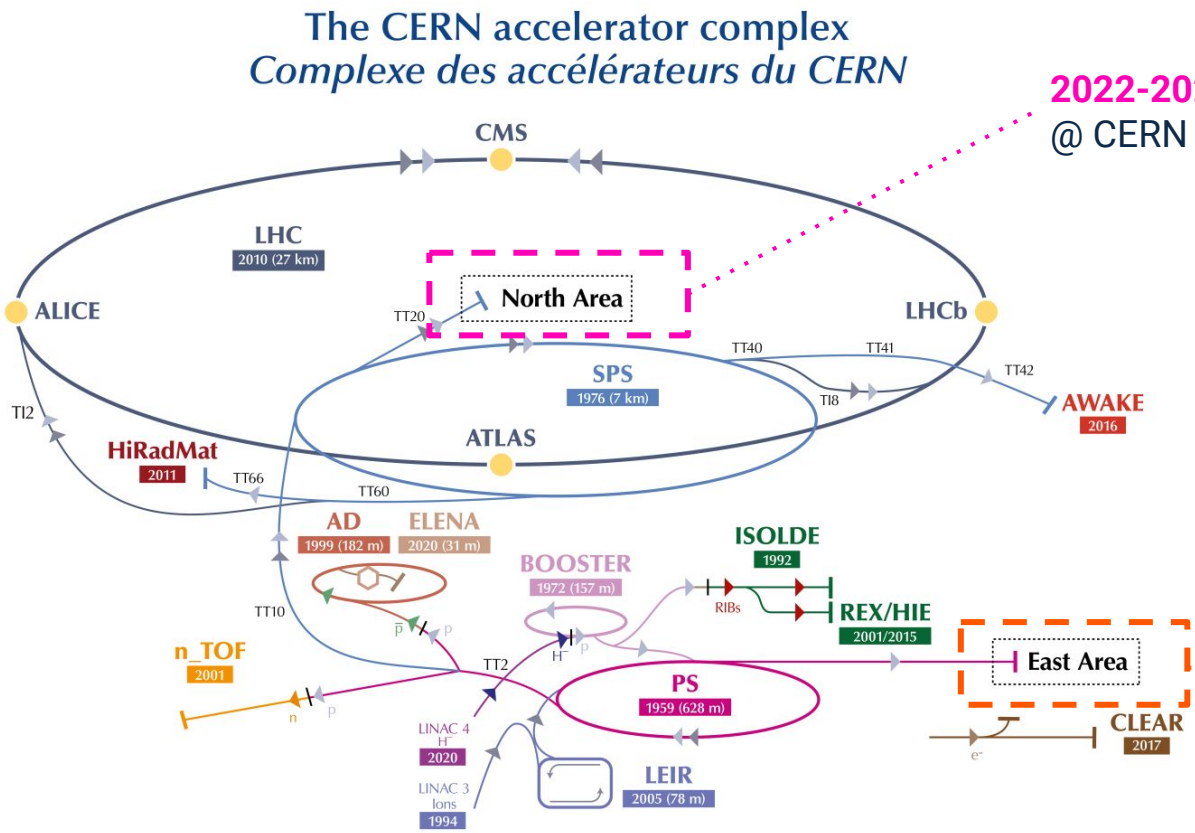
R&D financed by INFN CSN5
Included in H2020AidaInnova
WP8 task 3.1



3x3 matrix of **oriented $PbWO_4$ Ultra Fast** readout by SiPMs with:

- An **oriented layer of 5 X_0**
- A non oriented layer of 11.2 X_0





2022-2023-2024 → H2 & H4 beam line
@ CERN SPS, North Area

2023-2024 → T9 beam line
@ CERN PS, East Area

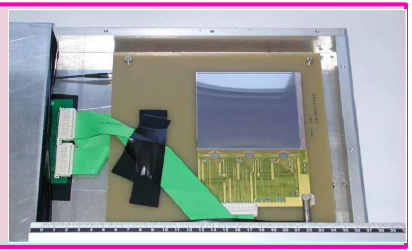
The OREO team:

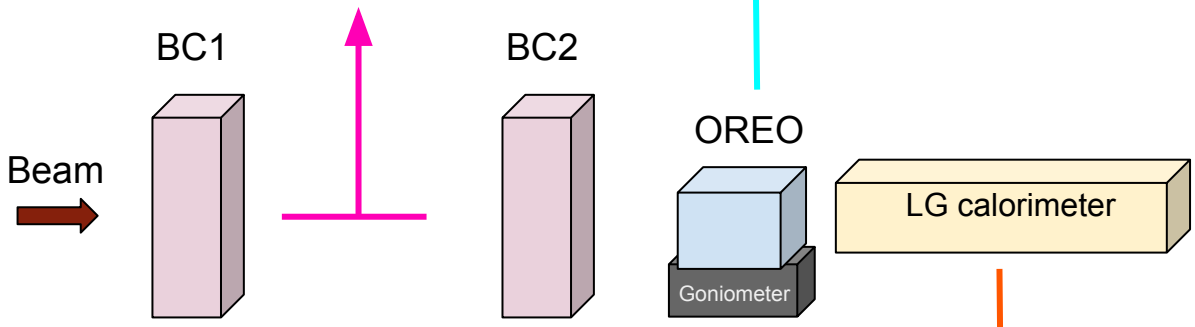
R&D, DAQ, electronics and mechanics

MiB - Ferrara
LNL - LNF

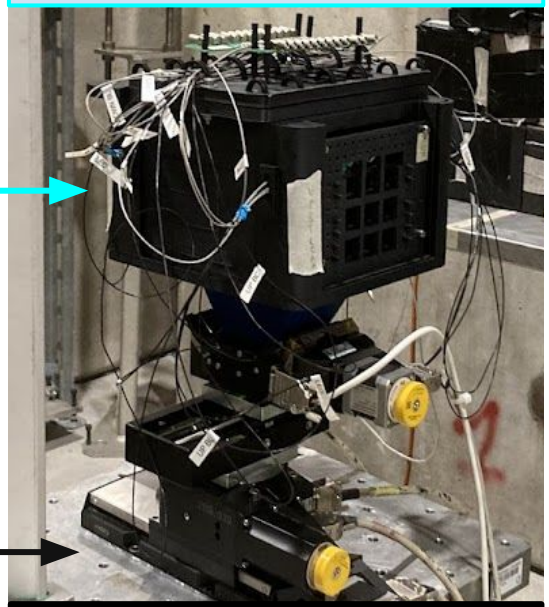
The experimental setup

Tracking system: two doubleside silicon microtrip detectors with a spatial resolution of a few μm in both x and y direction

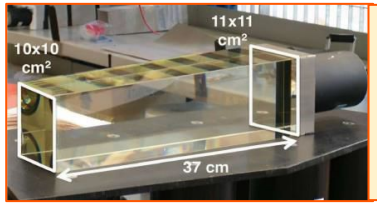




OREO PROTOTYPE

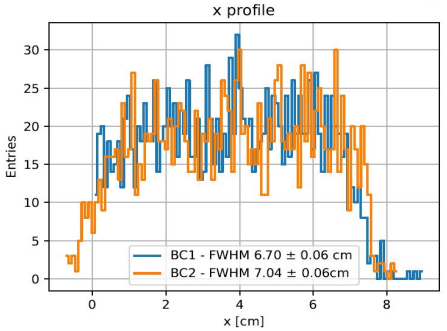


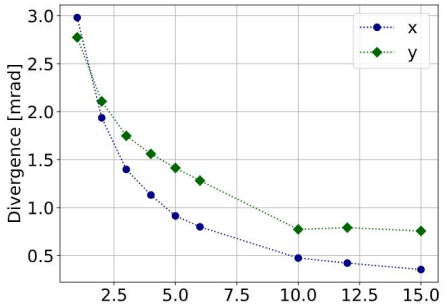
High precision goniometer

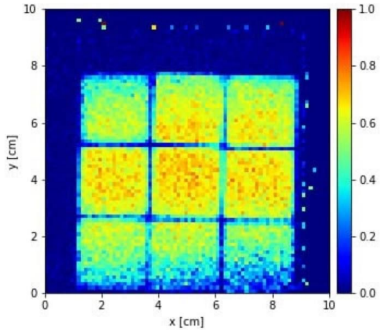


Lead Glass calorimeter

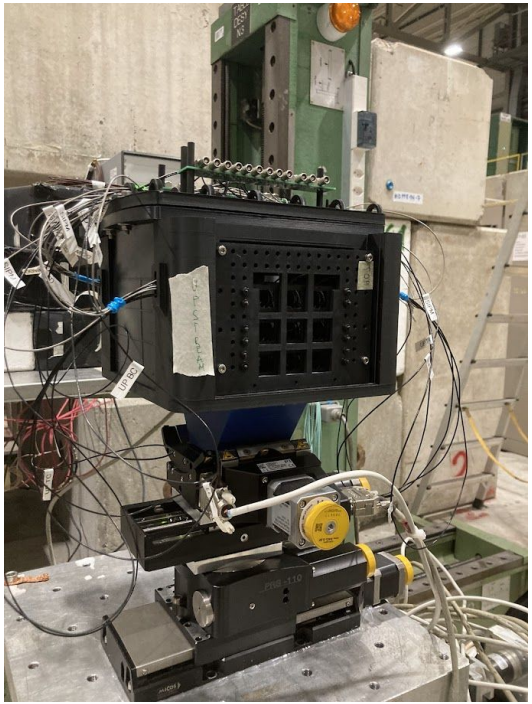
The tracking system

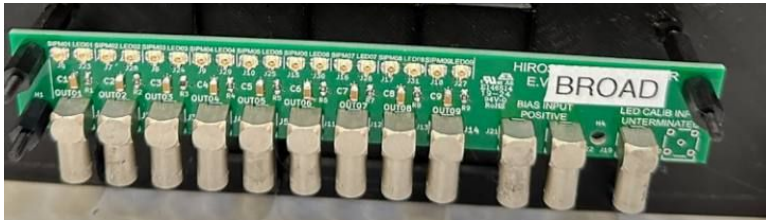


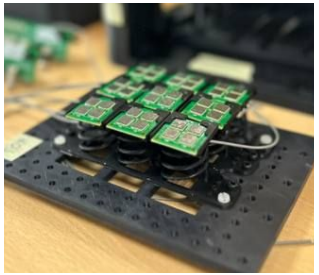


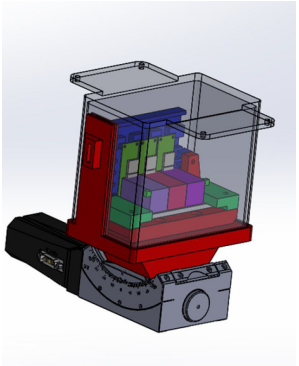


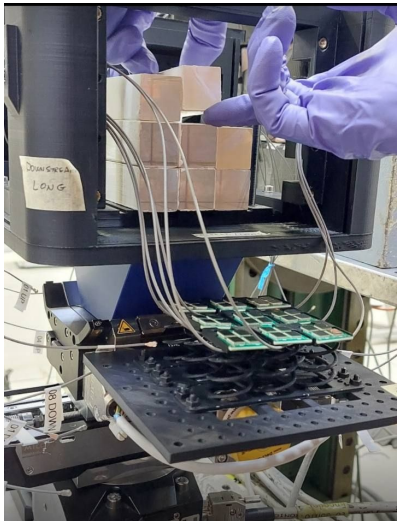
Custom mechanics and electronics



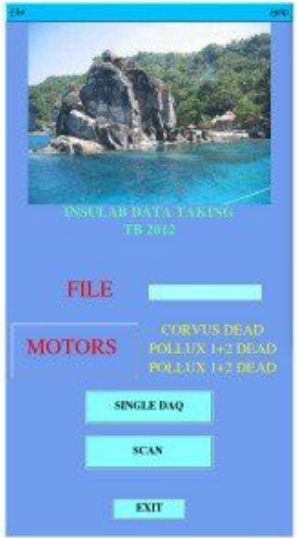




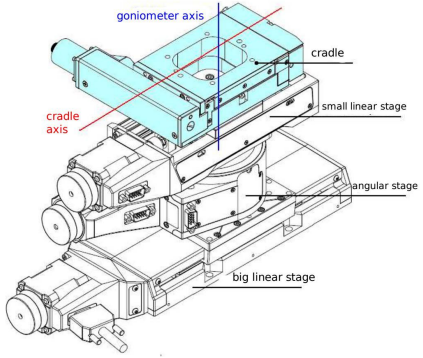




Custom data acquisition

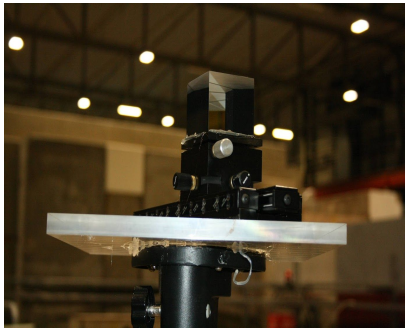


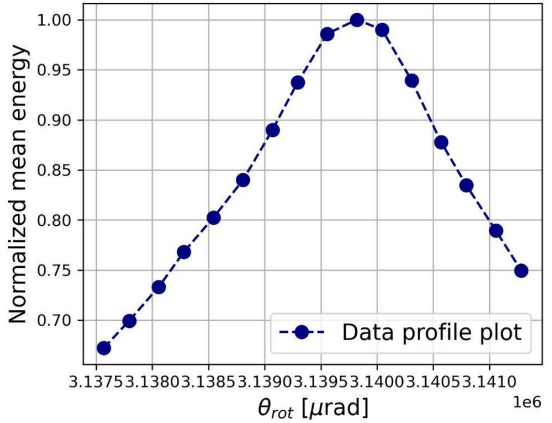
High precision goniometer

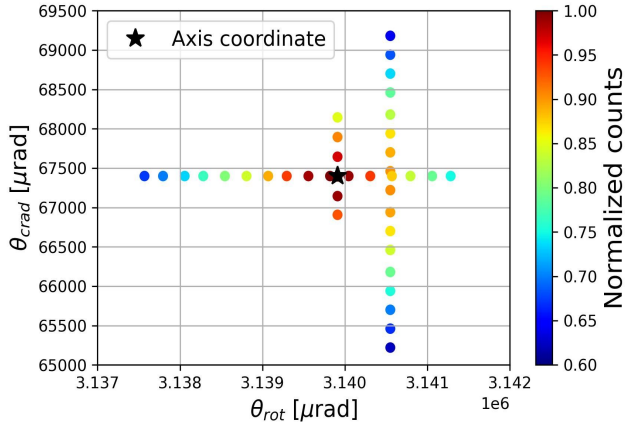


- Two linear stages for the horizontal movement, with a 1.5 µm accuracy, 2 µm bidirectional repeatability and a 5 µm resolution.
- A rotational stage with an accuracy of the order of a few µrad;
- A cradle stage with a maximum load of 8 kg and a precision of 1 µrad.

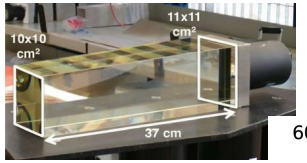
Crystals alignment

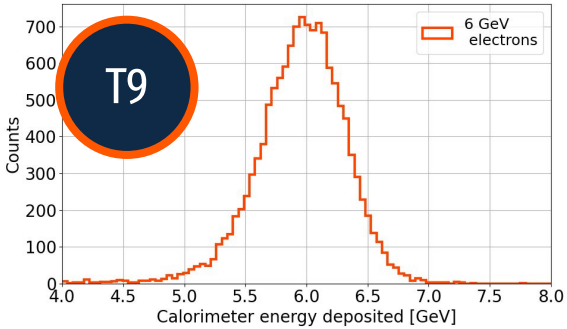


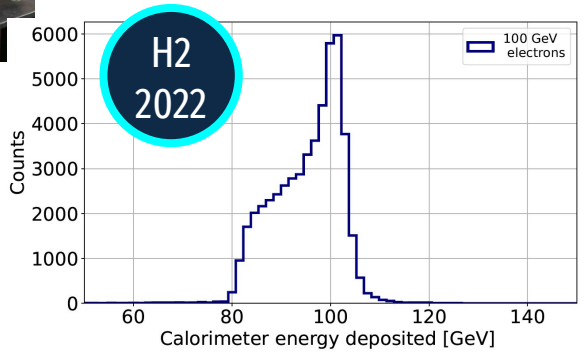


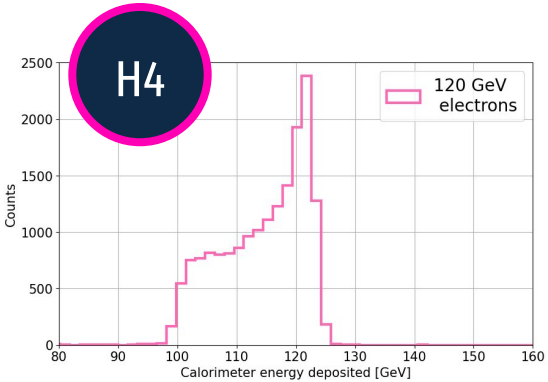


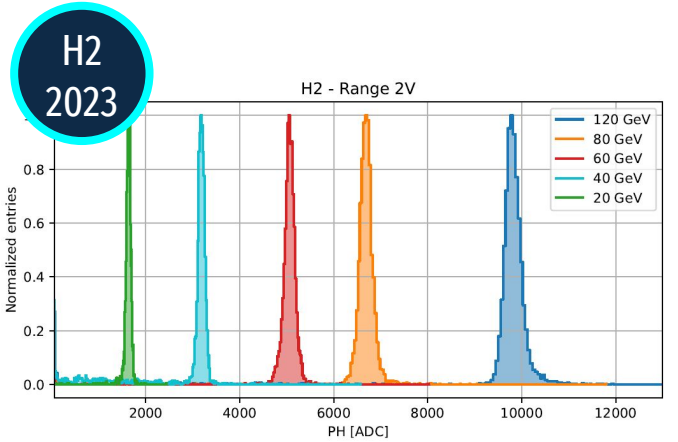
Lead Glass calorimeter



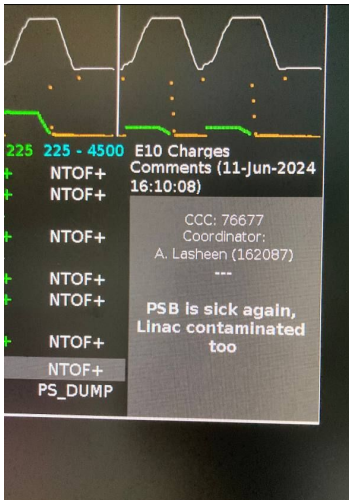




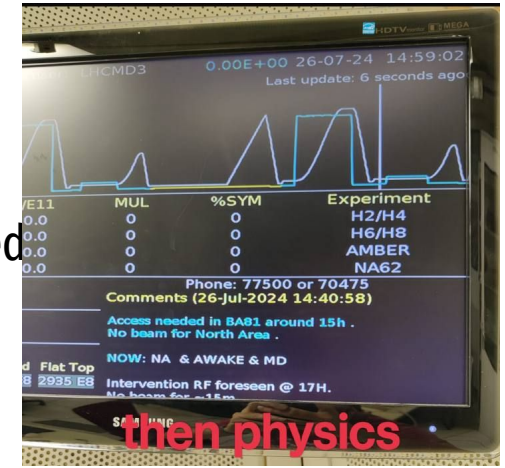


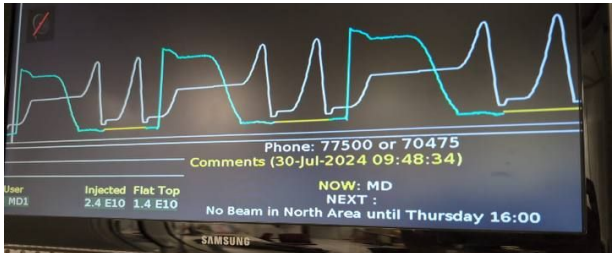


Most common causes of problems and time losses:

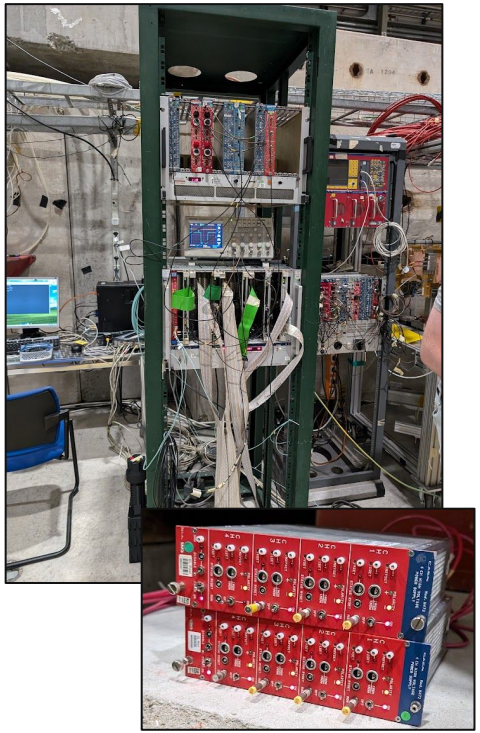


- Beam duty cycle → quite easy life on T9 PS, not so easy on SPS→ at least 2 weeks needed
- DAQ problems→ long beamlines
- Safety visit planned in advance
- Pallet movement planned in advance
- Alway have spare detectors



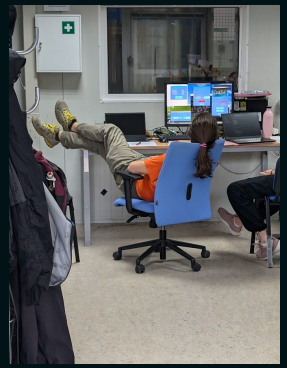


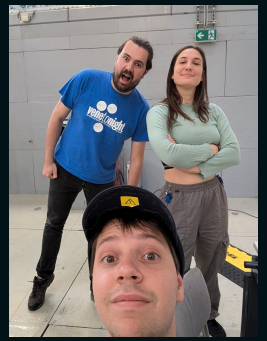
Typical beamline/pool equipment that we use:



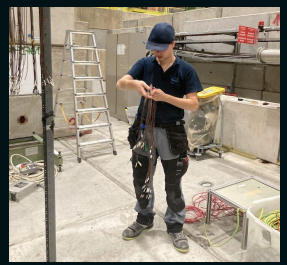
- Digitizer
- Nim modules
- Desy table
- Xsca
- Extra beam pipes
- Magnet if needed
- Delay box
- Power supply
- T9 Cherenkov counters –> trigger


CARS
DEBUGGER

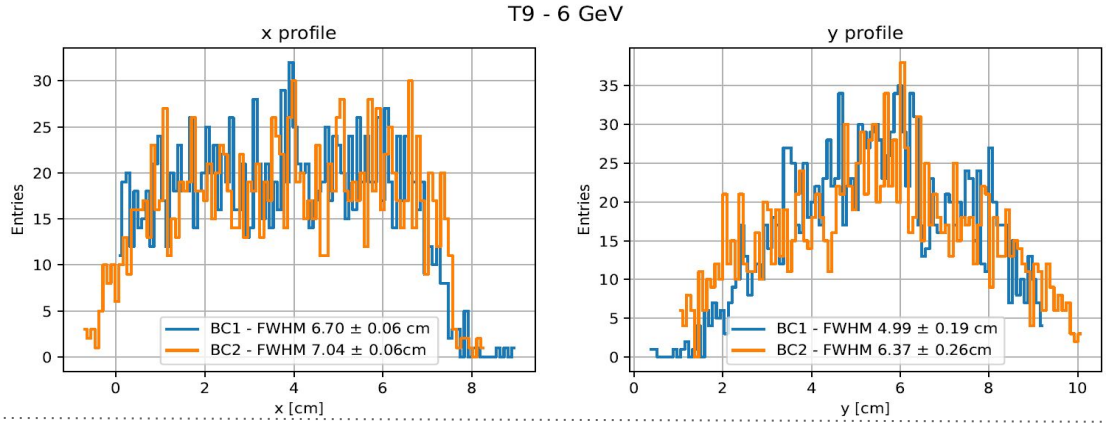


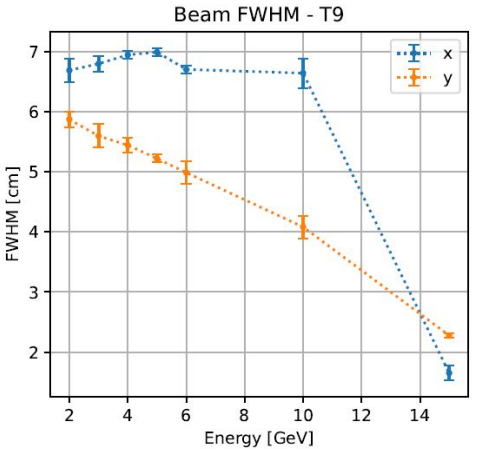



GOLIATH
DANGER
BE-EA

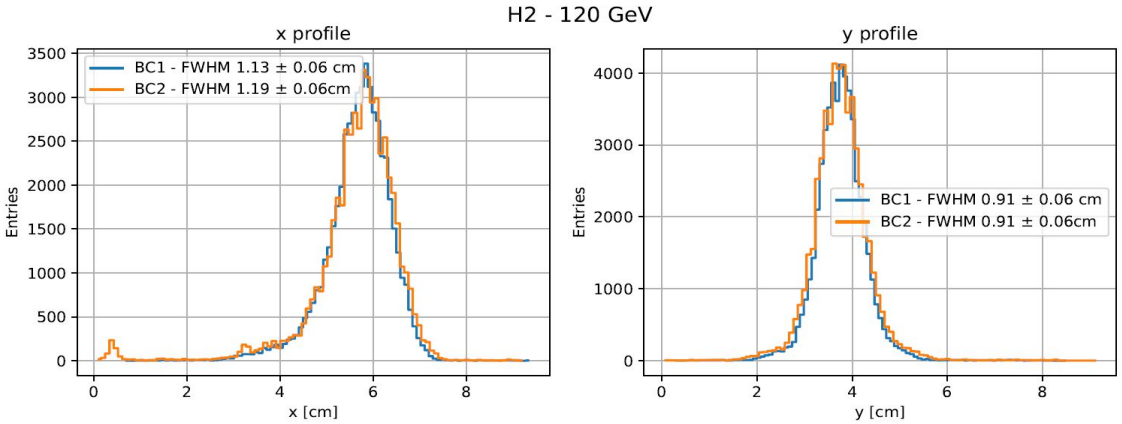


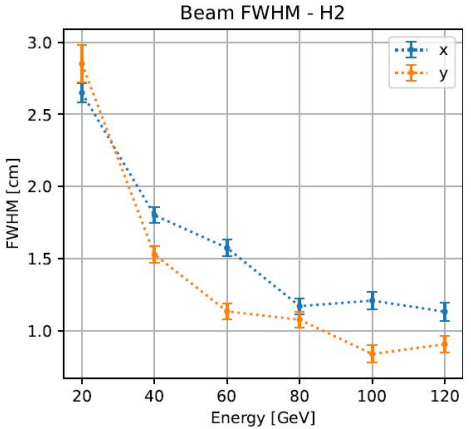
Beam profile





T9



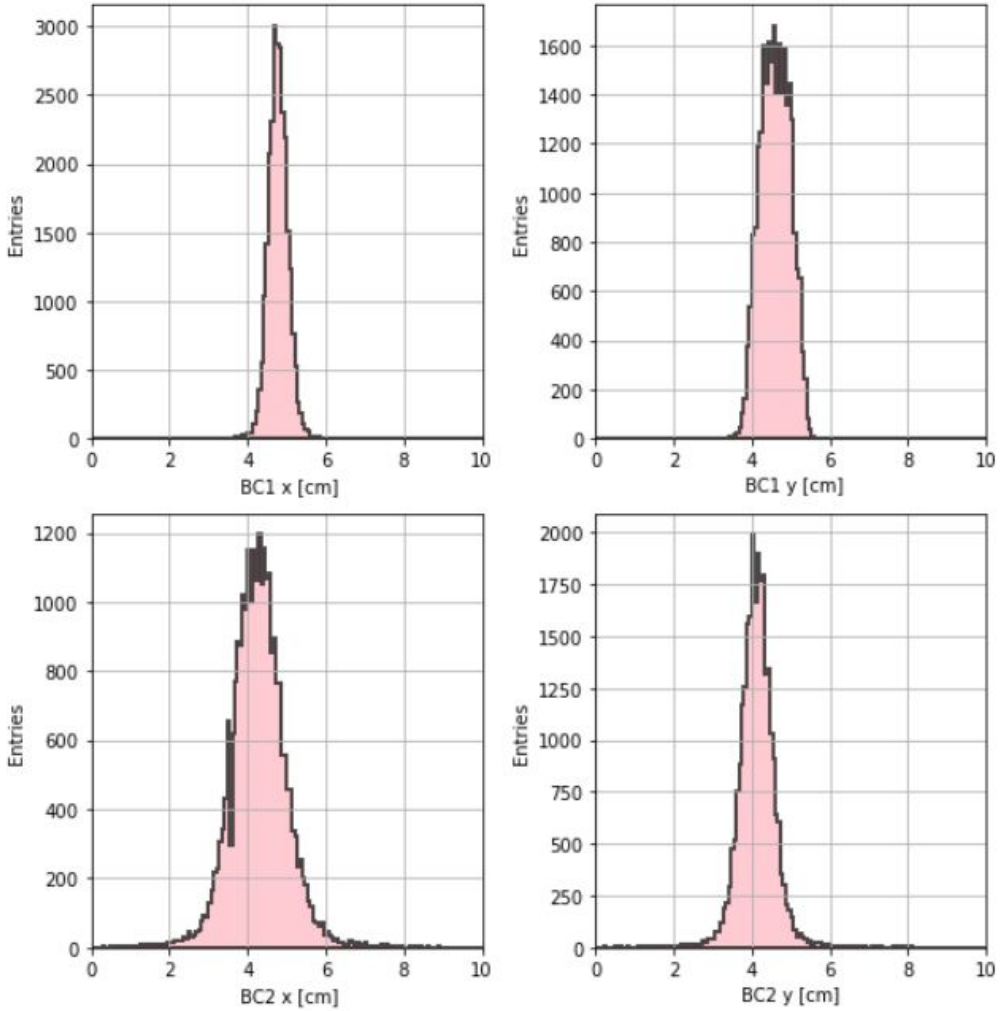


H2

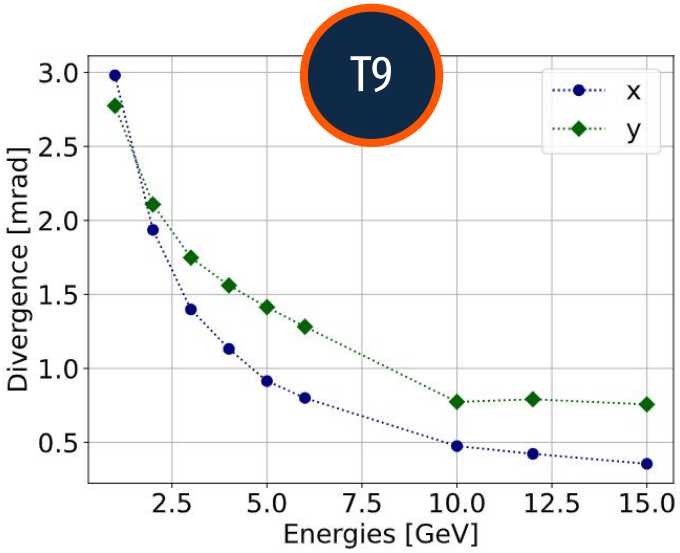
Beam profile

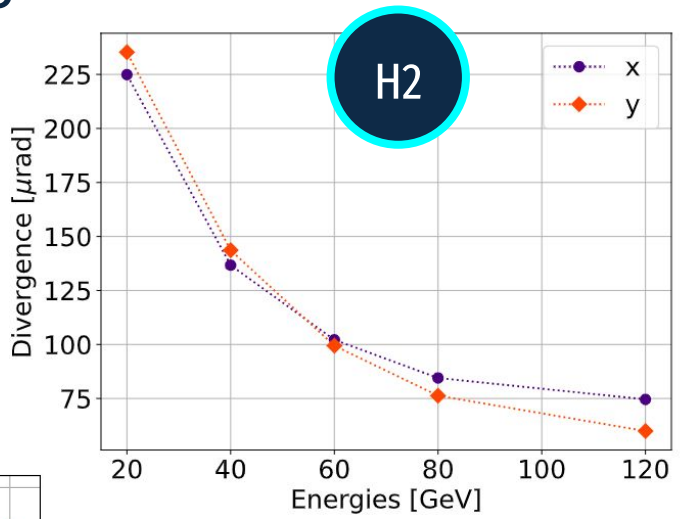
H4

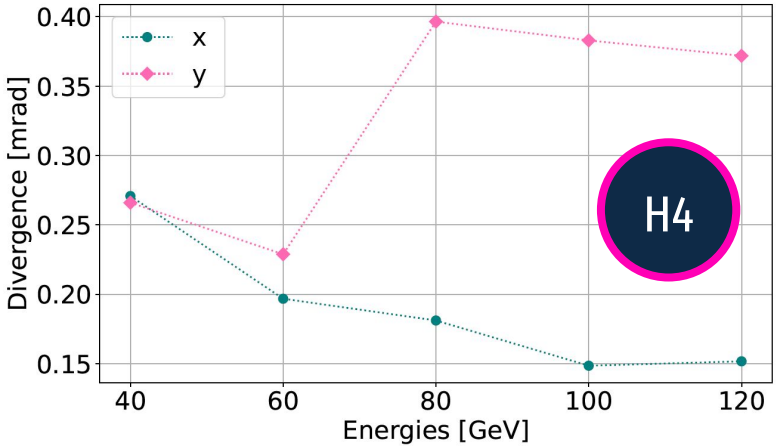
120 GeV electron beam



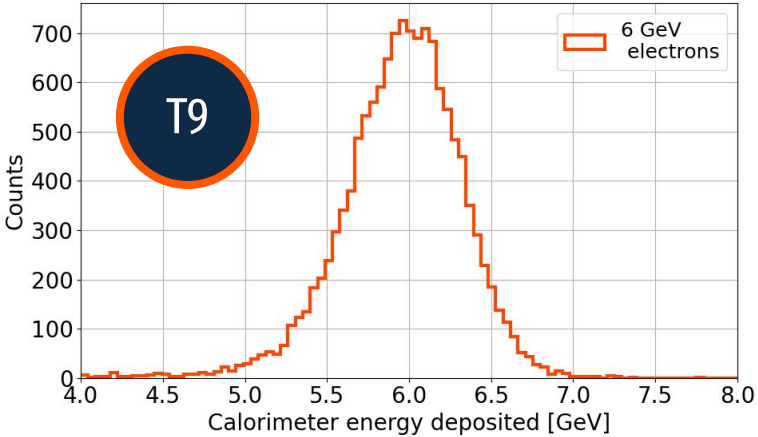
Beam divergence

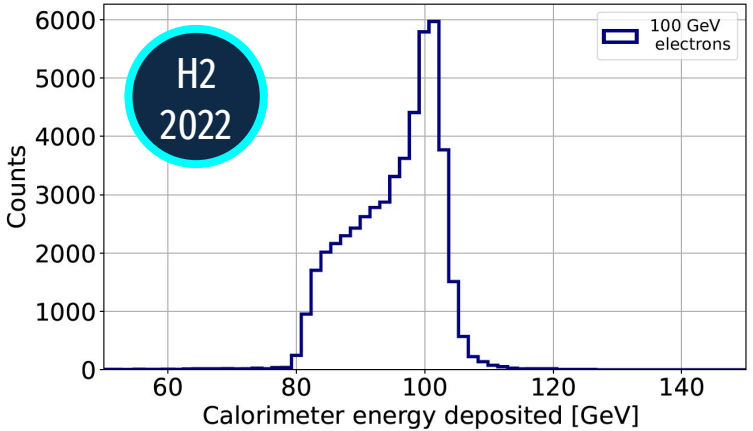


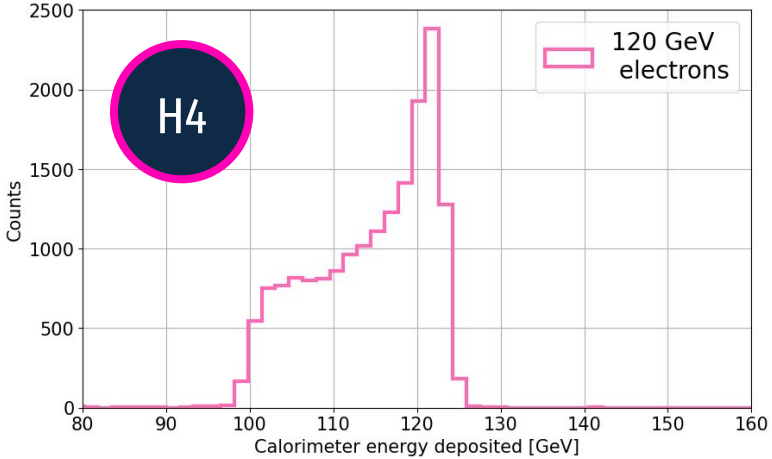


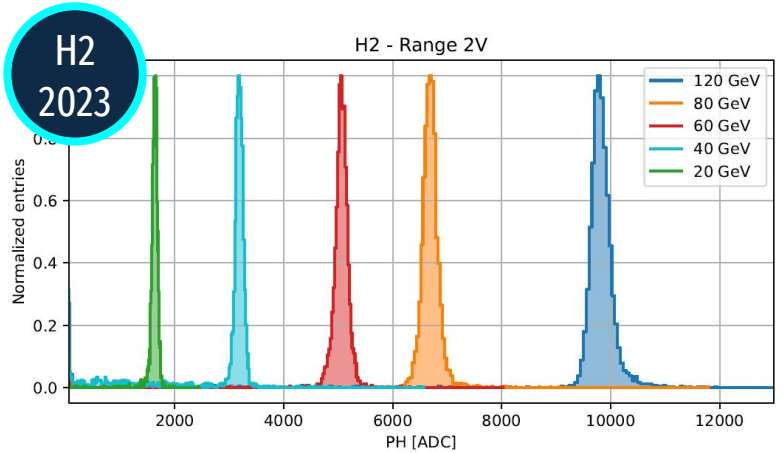


Energy deposited in the Lead Glass calorimeter



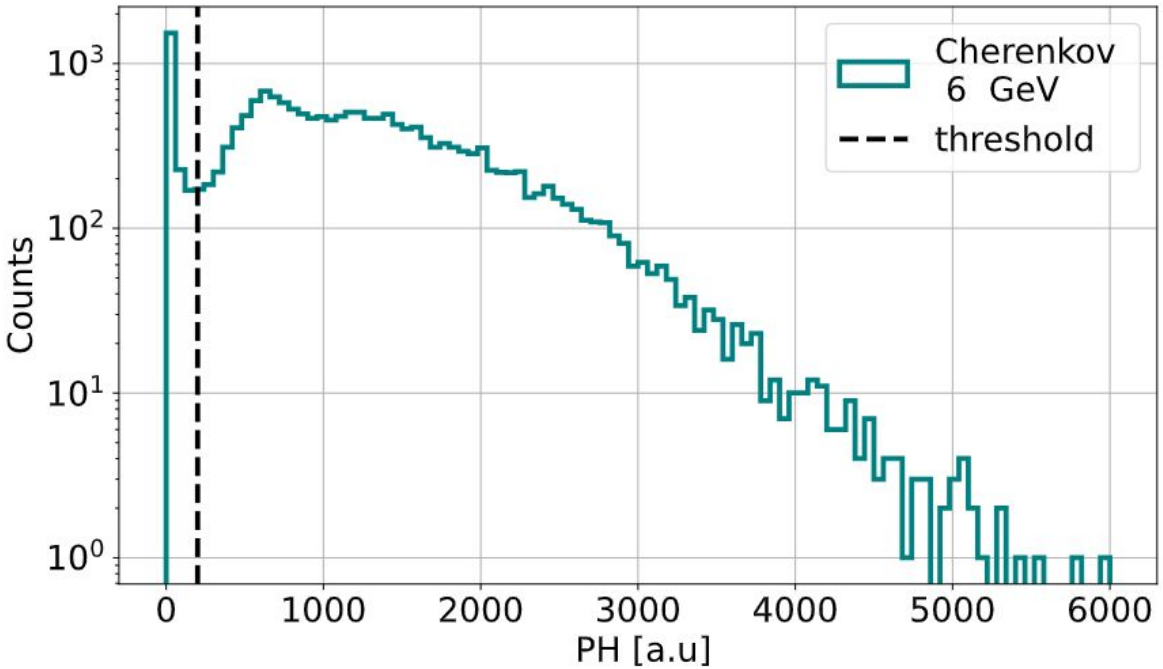




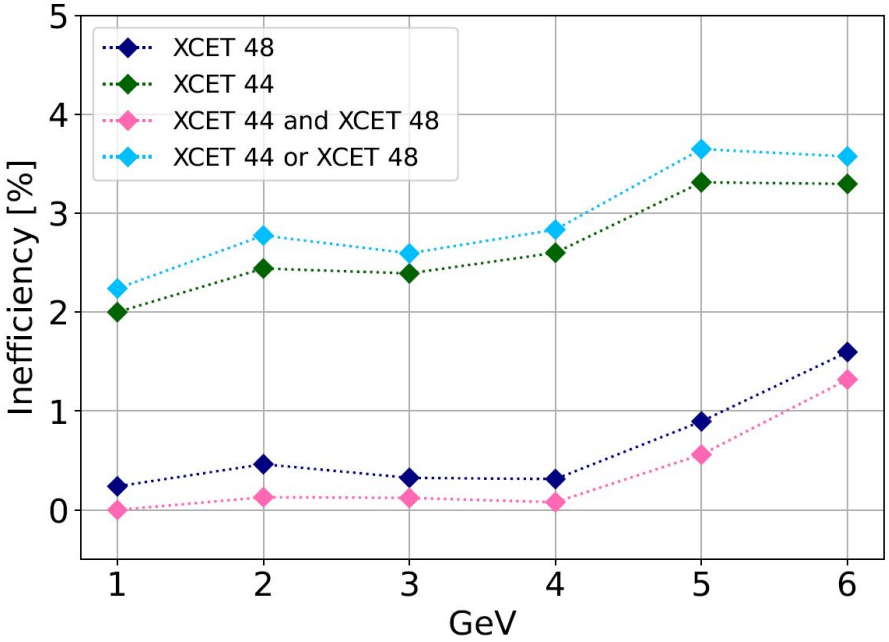


T9

The T9 beamline is equipped with **two Cherenkov counters**, which allow for particle discrimination based on their gas



Inefficiency: Fraction of electrons not identified by the Cherenkov detector



Purity: Fraction of particles identified as electrons by the Cherenkov detector that are actually electrons