OLYMPUS 1st Data Taking

Motivation – Two Photon Exchange

Testbeam 22 @ DESY

OLYMPUS – Experimental Setup

First Data Taking

What is it all about?

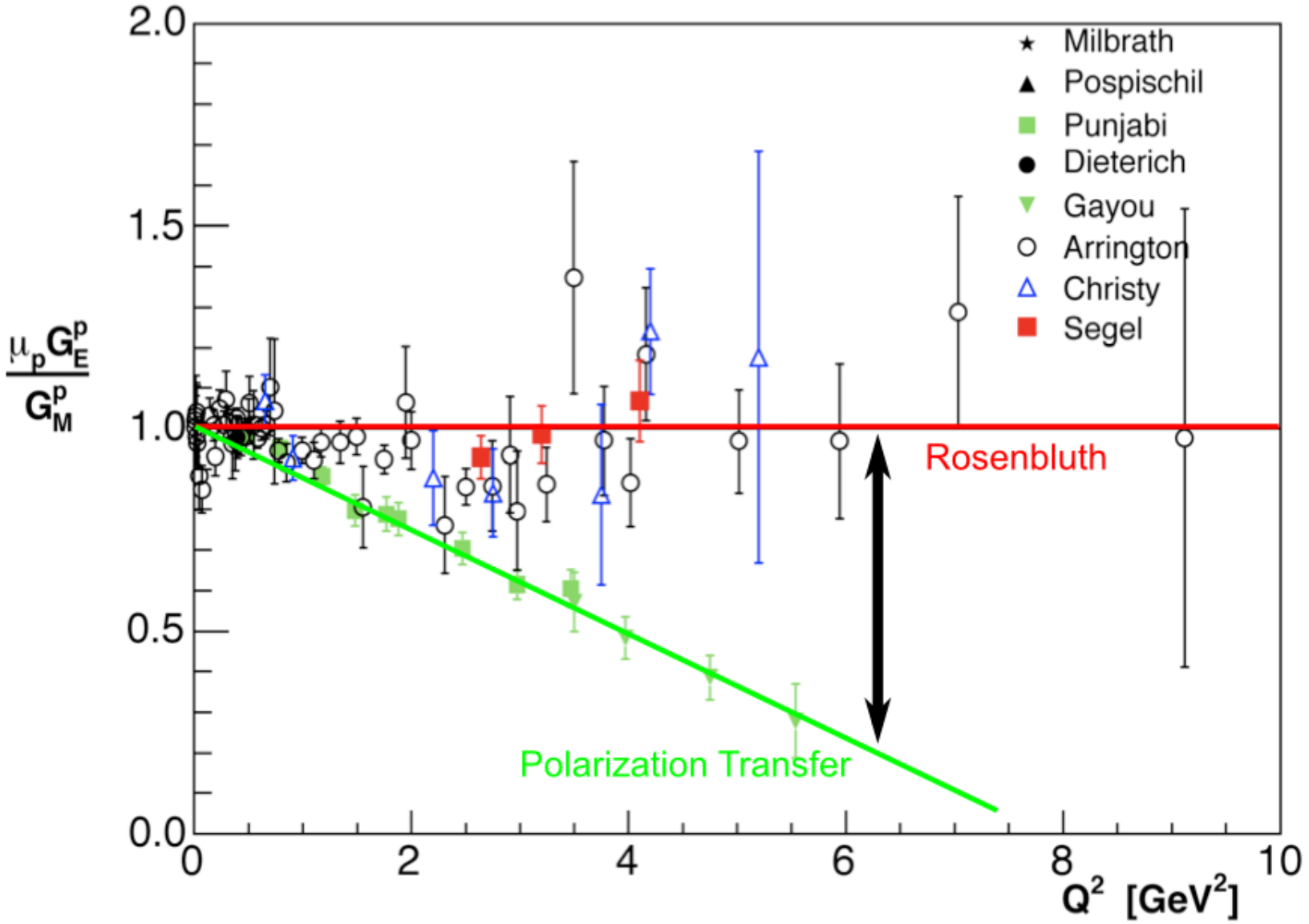
What does the proton look like inside?

→ use electromagnetic probe (electron scattering)
→ measure distribution of charge and magnetization
→ electric and magnetic form factors

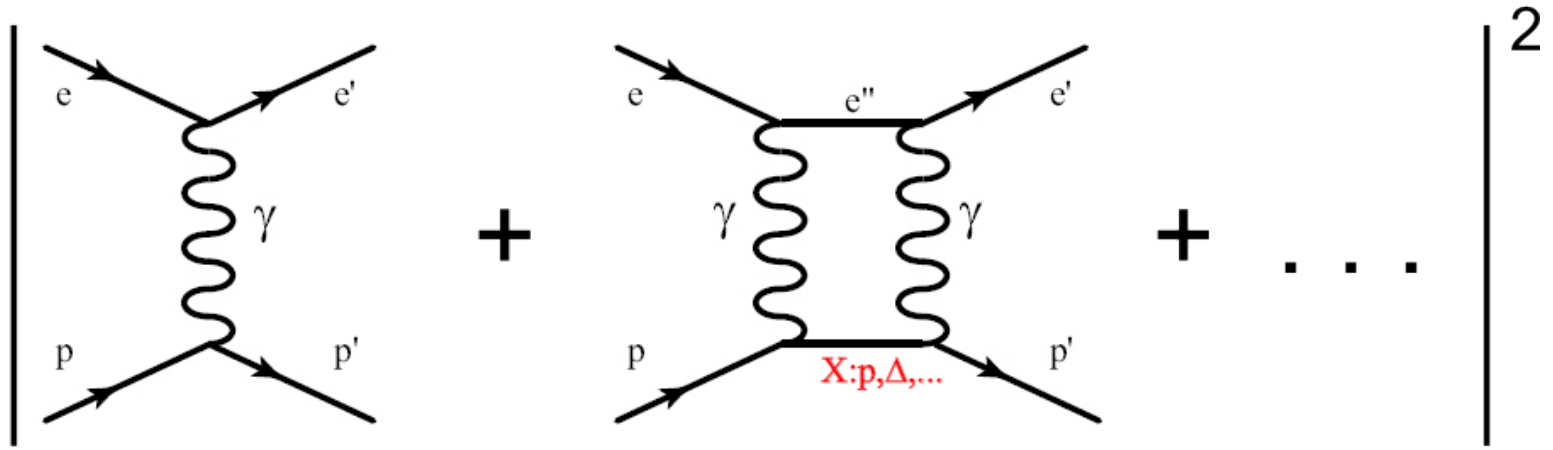
Rosenbluth: $$\sigma_R = G_M^2 + \frac{\epsilon}{\tau} G_E^2$$

Polarization Transfer: $$\frac{P_t}{P_l} = -\sqrt{\frac{2\epsilon}{\tau(1+\epsilon)}} \frac{G_E}{G_M}$$

What is it all about?



Two Photon Exchange (?)

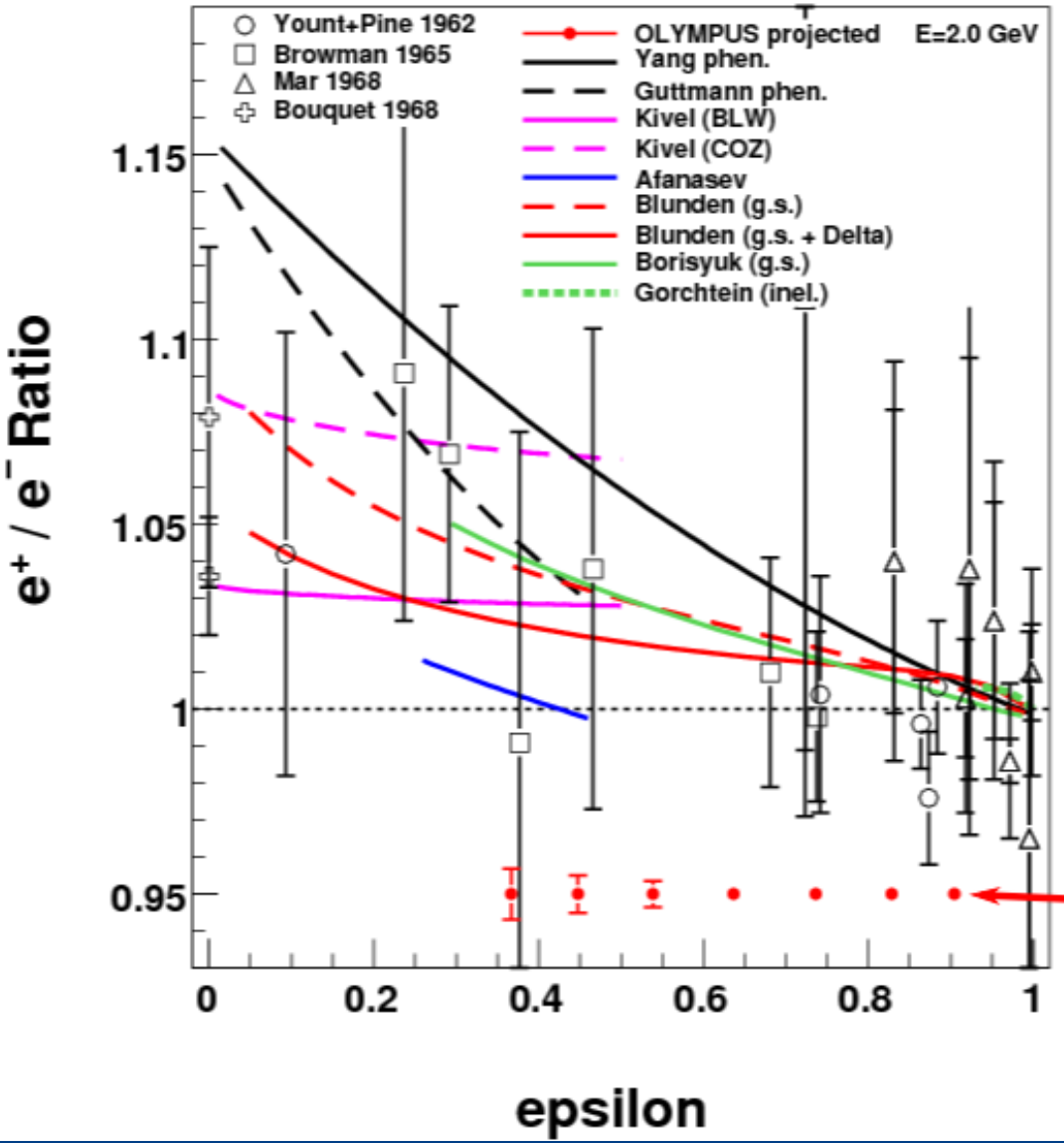


$$\sigma(e^- p) = (1\gamma)^2\alpha^2 - (1\gamma)(2\gamma)\alpha^3 + \ldots$$
$$\sigma(e^+ p) = (1\gamma)^2\alpha^2 + (1\gamma)(2\gamma)\alpha^3 + \ldots$$

Do elastic ep scattering, but switch beam species: electrons / positrons
→ direct access to the real part of the two-photon amplitude

Two (multiple) photon exchange is a *possible* explanation for the discrepancy

OLYMPUS projected accuracy



Detector Installation in DORIS: mid-July

Further testing of detector components during DORIS synchrotron runs and service weeks

1st Data Taking Run: Feb 2012
2nd Data Taking Run: Nov/Dec 2012

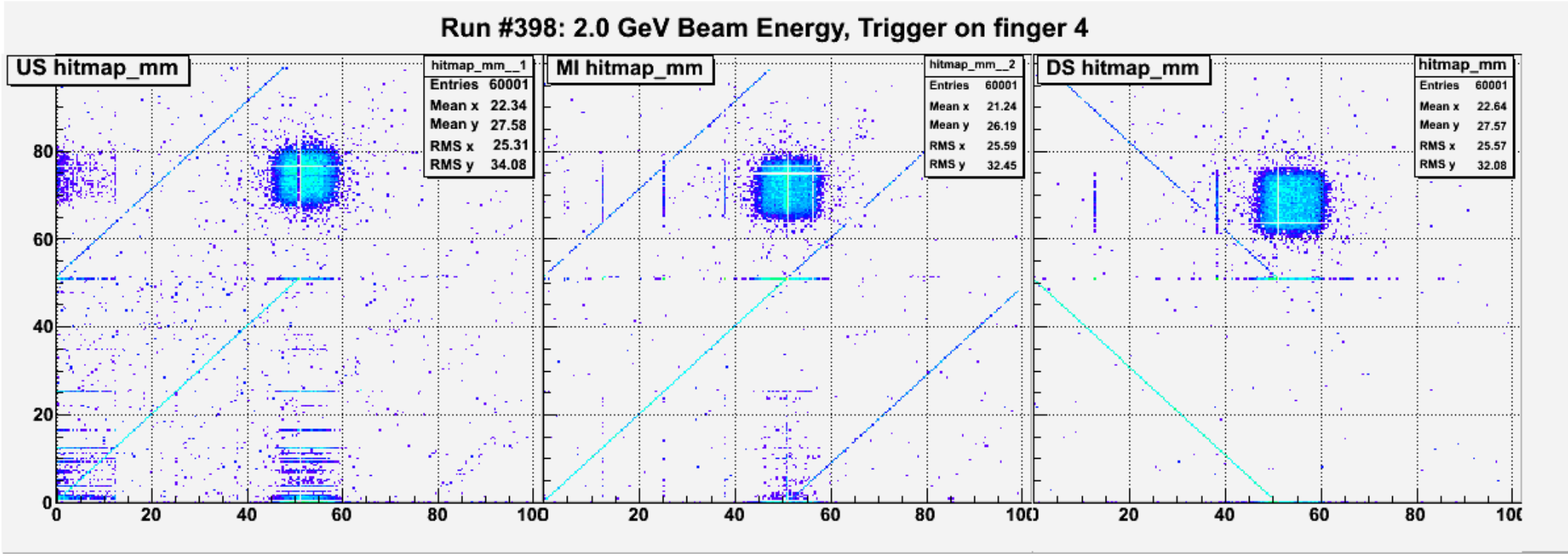
OLYMPUS projected accuracy

Beam Energy: 2.0 GeV
$0.37 < \varepsilon < 0.9$
$0.6 < Q^2 < 2.2$ GeV/c
500h @ $2 \cdot 10^{33}$ /cm²s

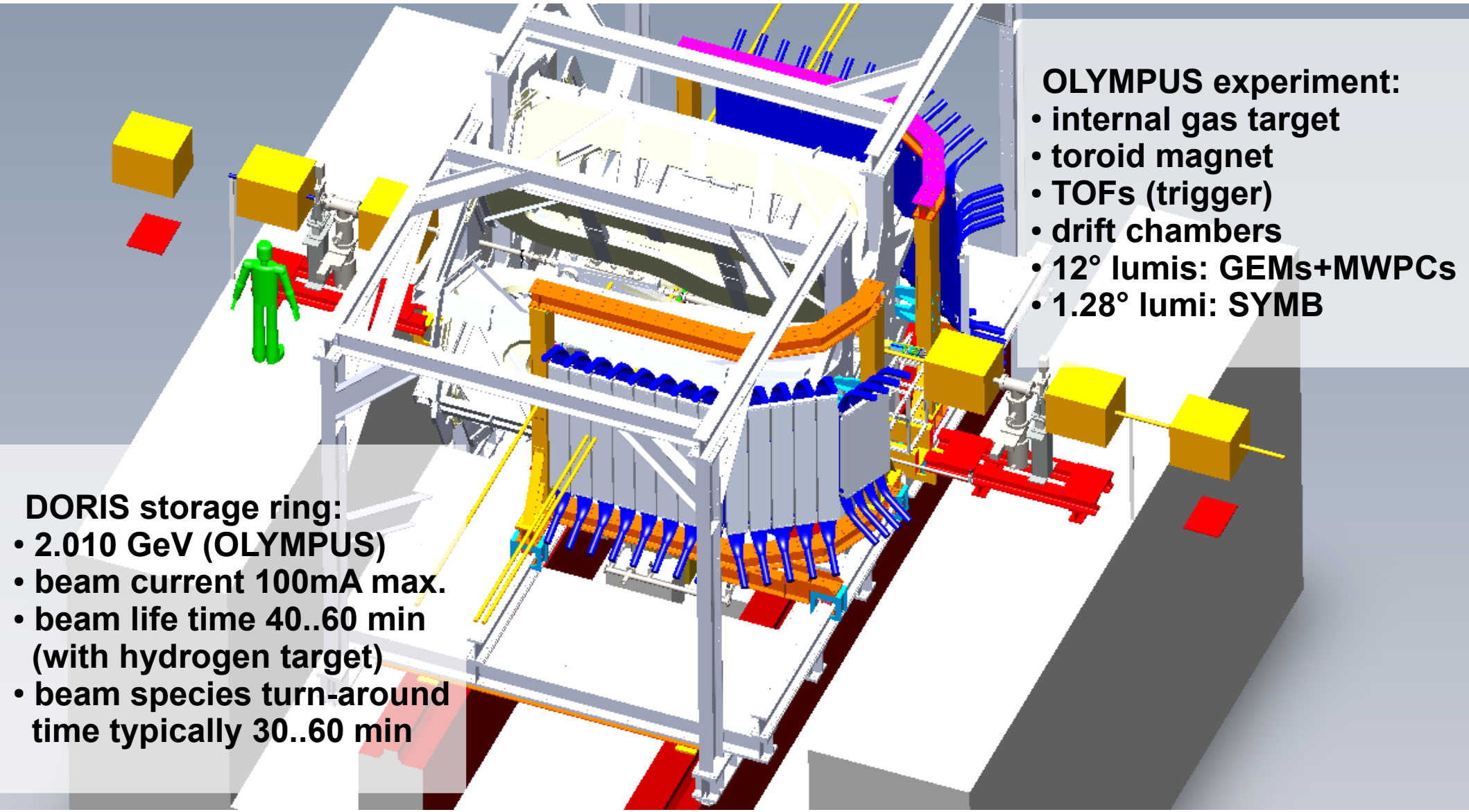
Testbeam 22 @ DESY

Testbeam 22 @ DESY

- tested all 9 GEM detectors (operational, gas tight → relative gains measured)
- verification of stable operation of all high voltage dividers
- established readout with APV chips using prototype VME module
- HV, position scans, beam energy scans, beam species
- successful operation & readout of one full telescope (1500 detector channels)



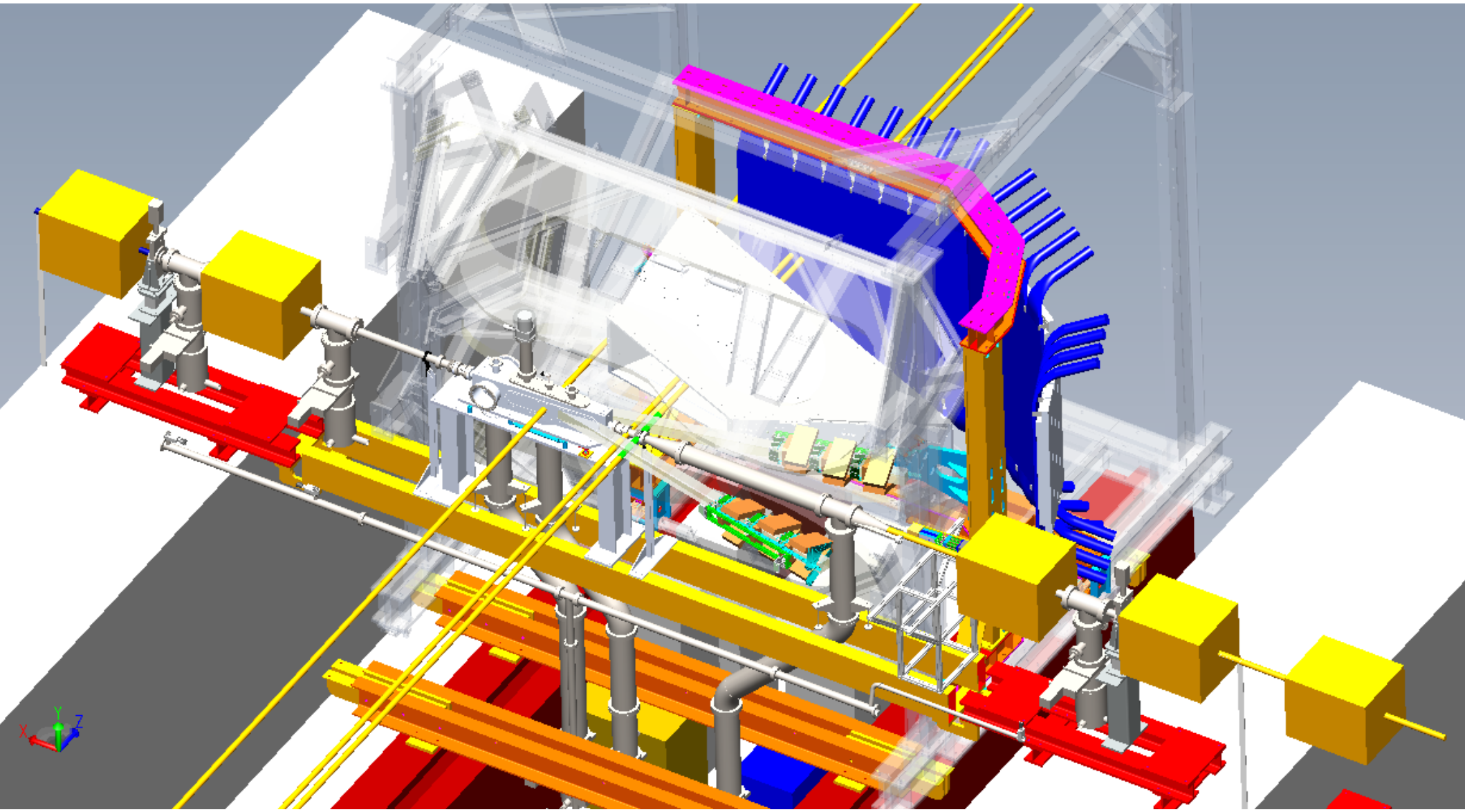
The OLYMPUS experiment



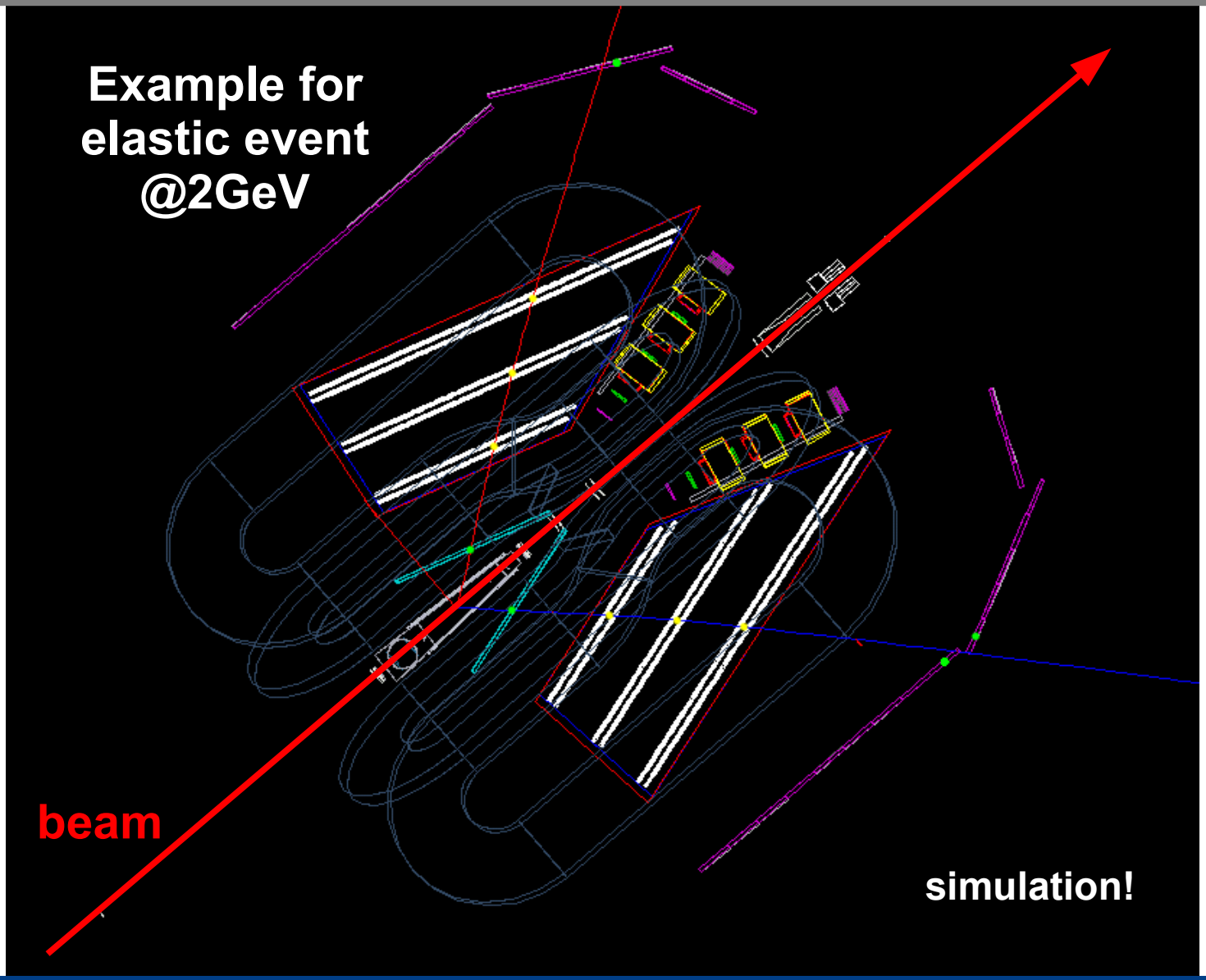
OLYMPUS experiment:
- internal gas target
- toroid magnet
- TOFs (trigger)
- drift chambers
- 12° lumis: GEMs+MWPCs
- 1.28° lumi: SYMB

DORIS storage ring:
- 2.010 GeV (OLYMPUS)
- beam current 100mA max.
- beam life time 40..60 min (with hydrogen target)
- beam species turn-around time typically 30..60 min

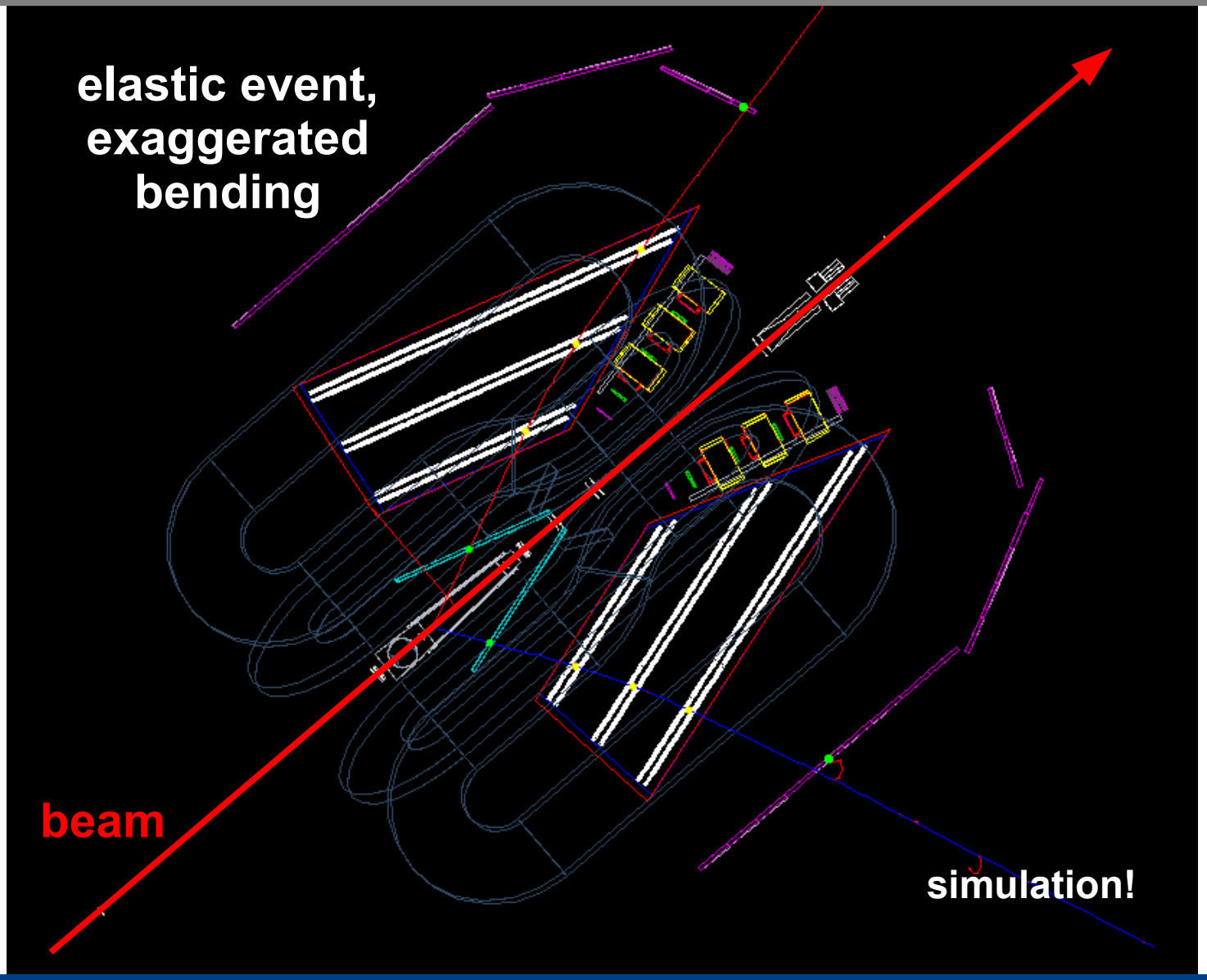
The OLYMPUS experiment

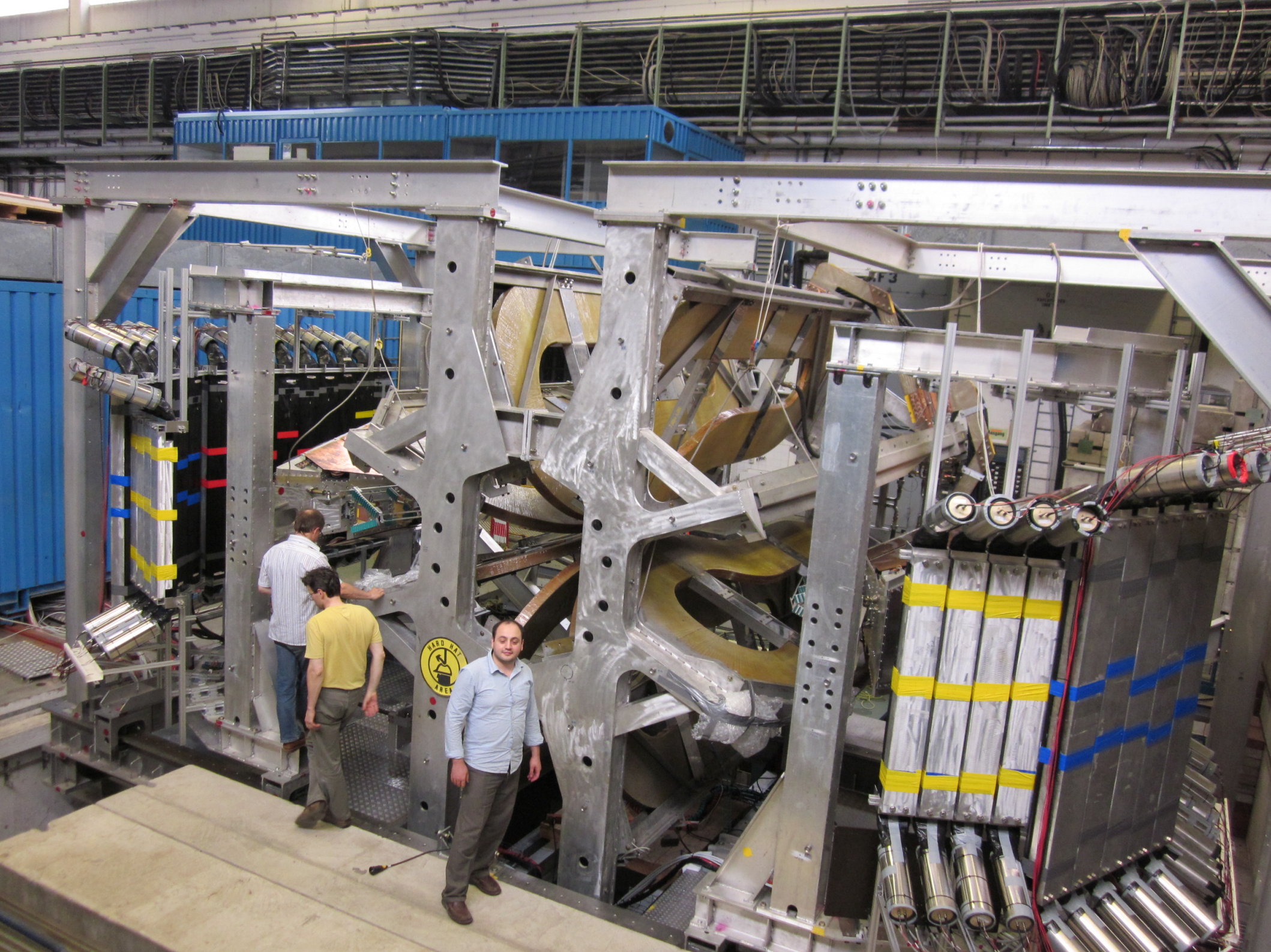


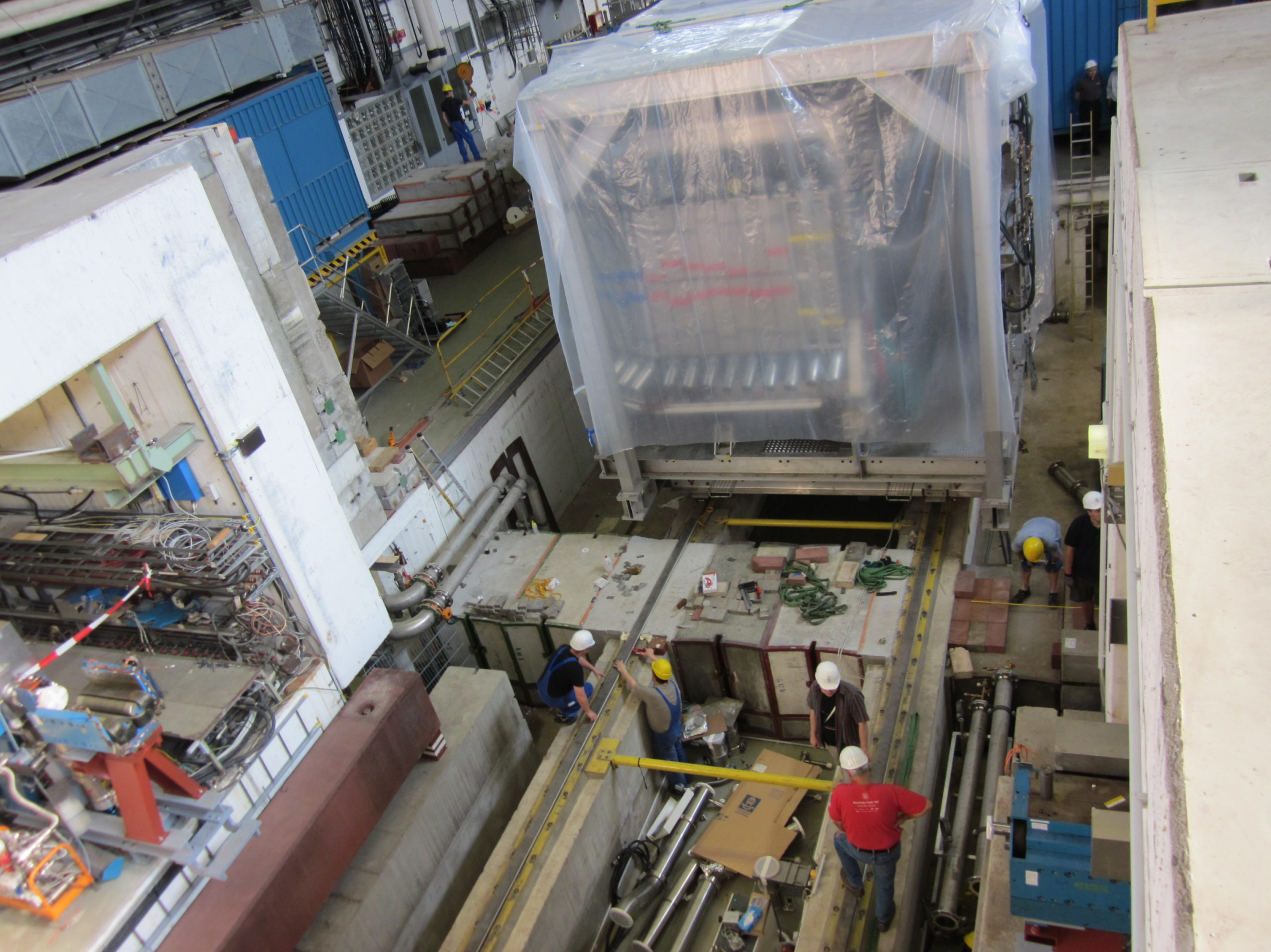
The OLYMPUS experiment

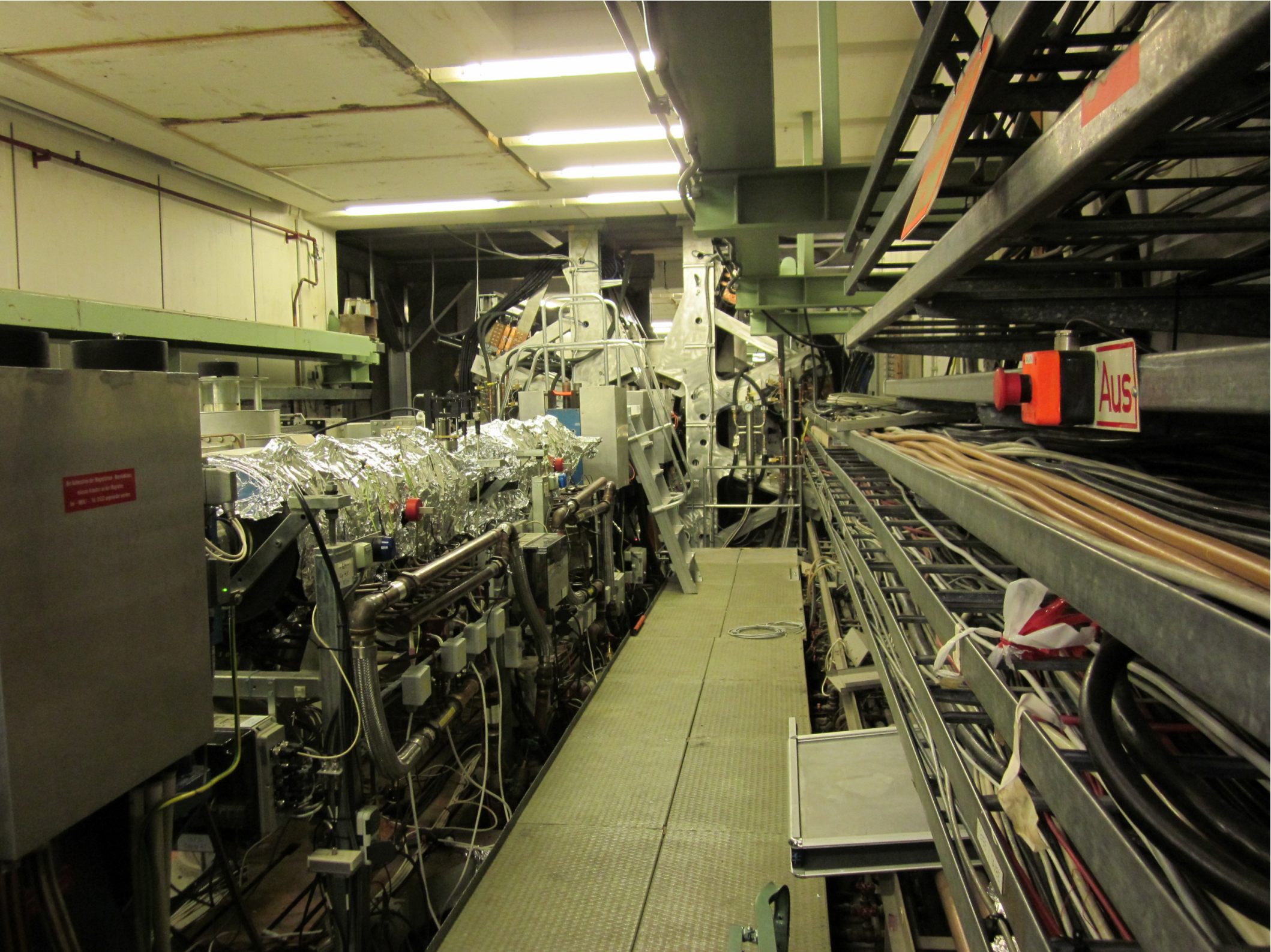


The OLYMPUS experiment

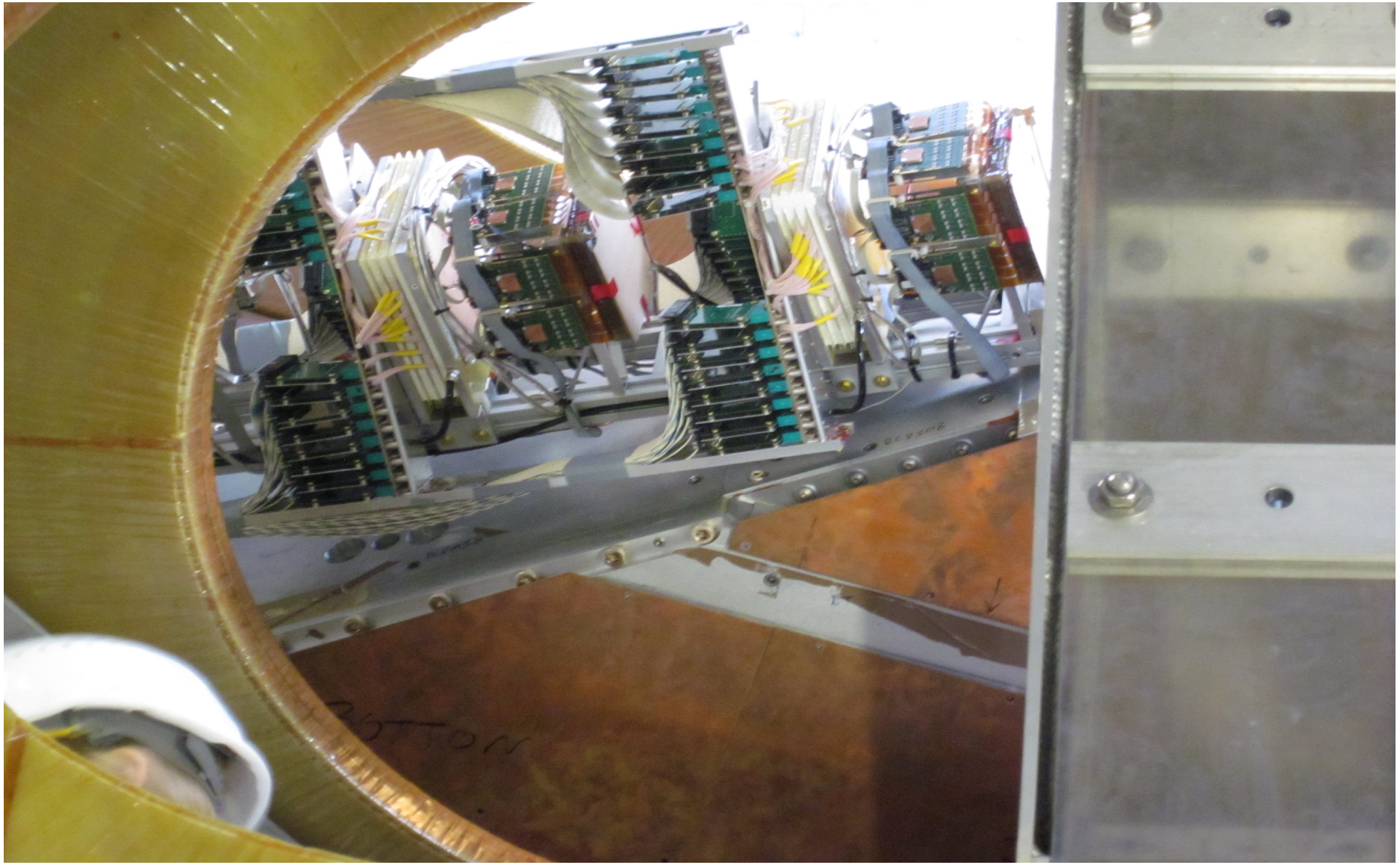







Aus

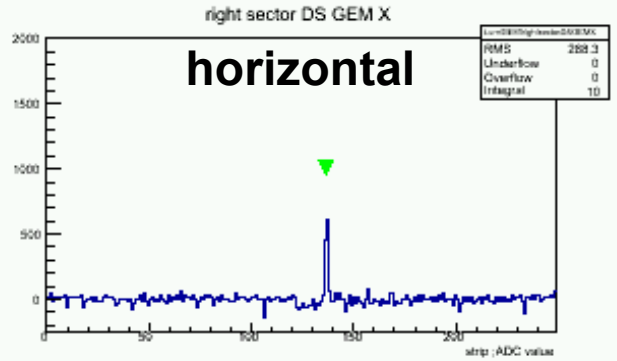
12° Luminosity Monitors

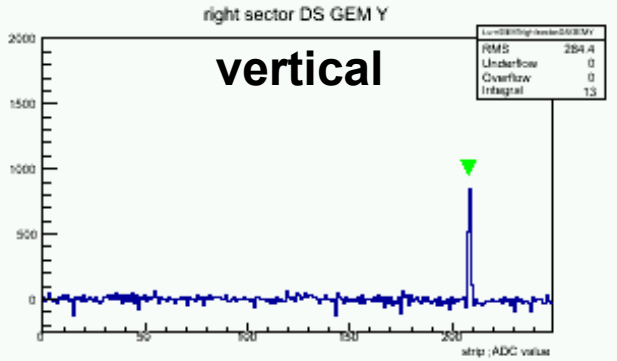


12° Luminosity Monitors

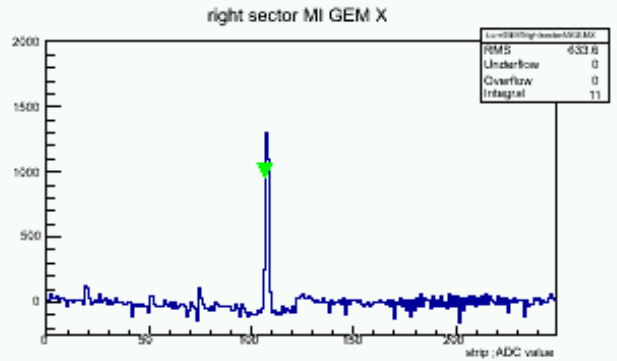
horizontal **vertical**

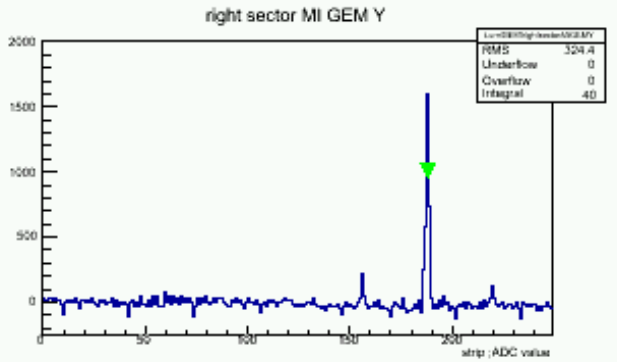
downstream



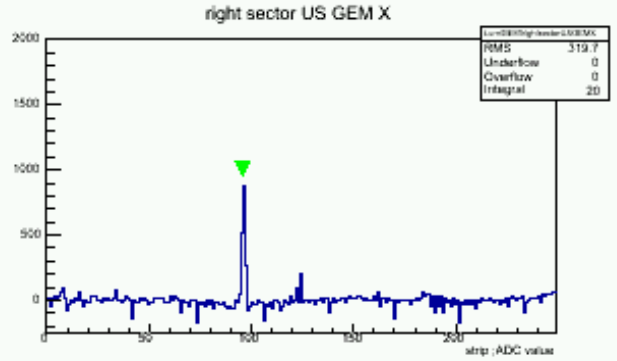


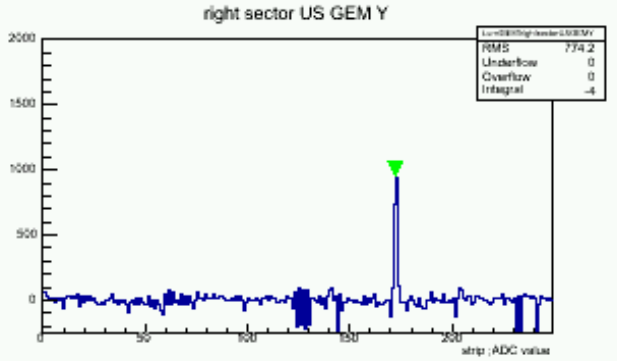
middle



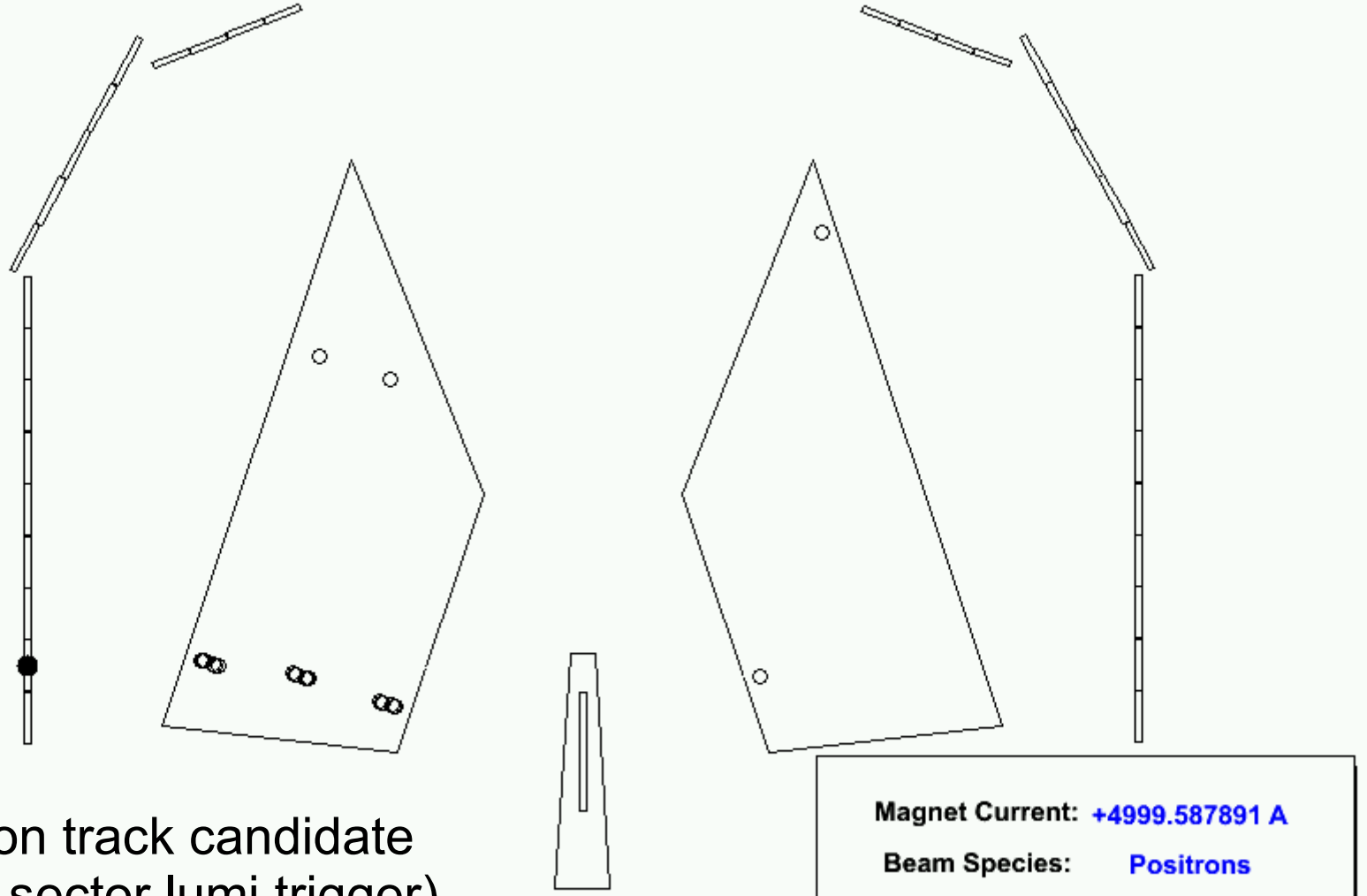


upstream



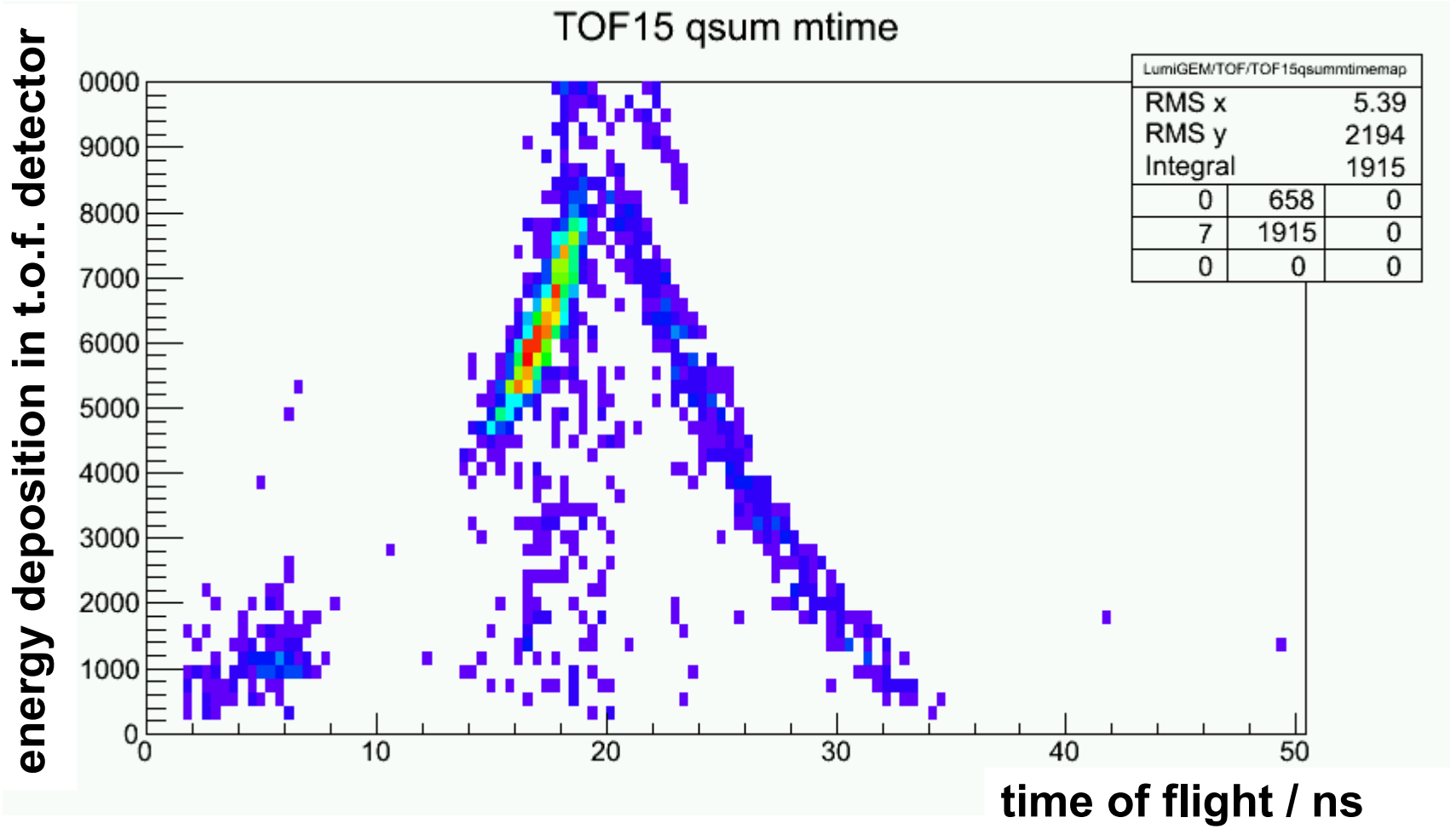


12° Luminosity Monitors



proton track candidate
(right sector lumi trigger)

12° Luminosity Monitors

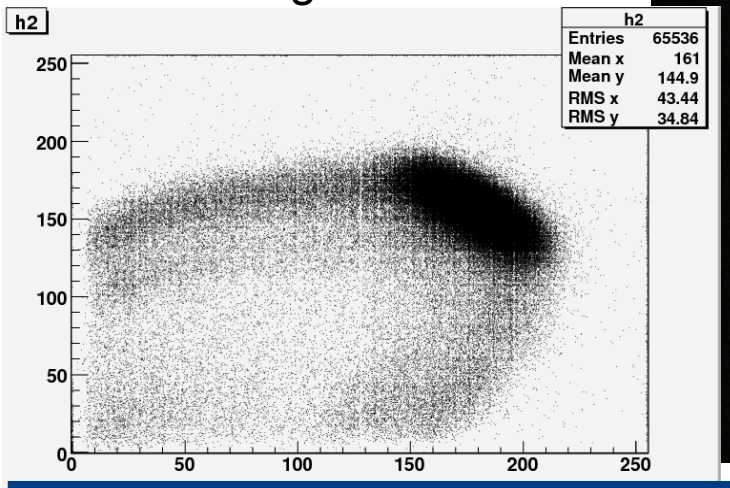


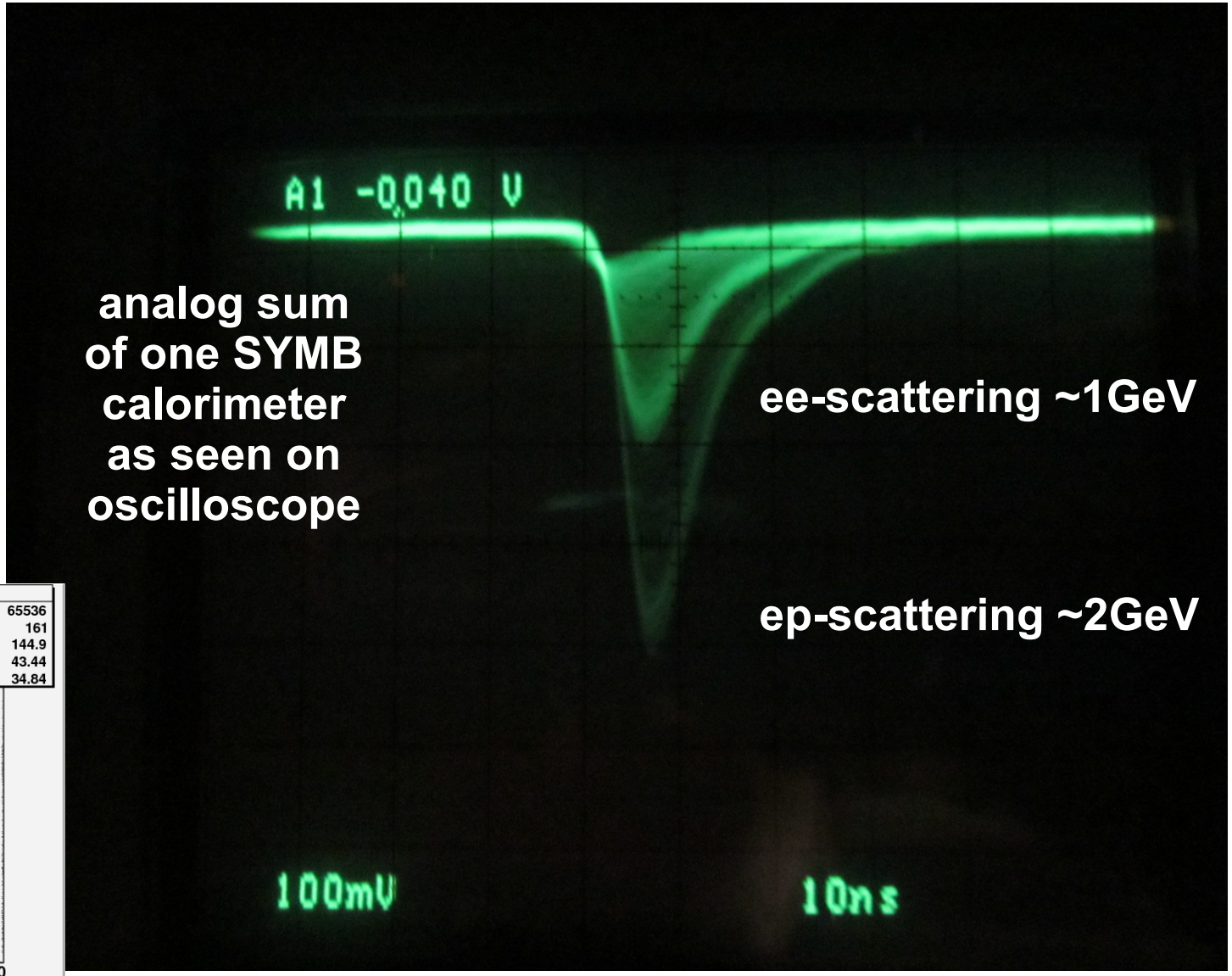
Evidence for protons corresponding to leptons in 12 degree luminosity monitors
→ identification by time of flight and energy deposition

Symmetric Moeller/Bhabha

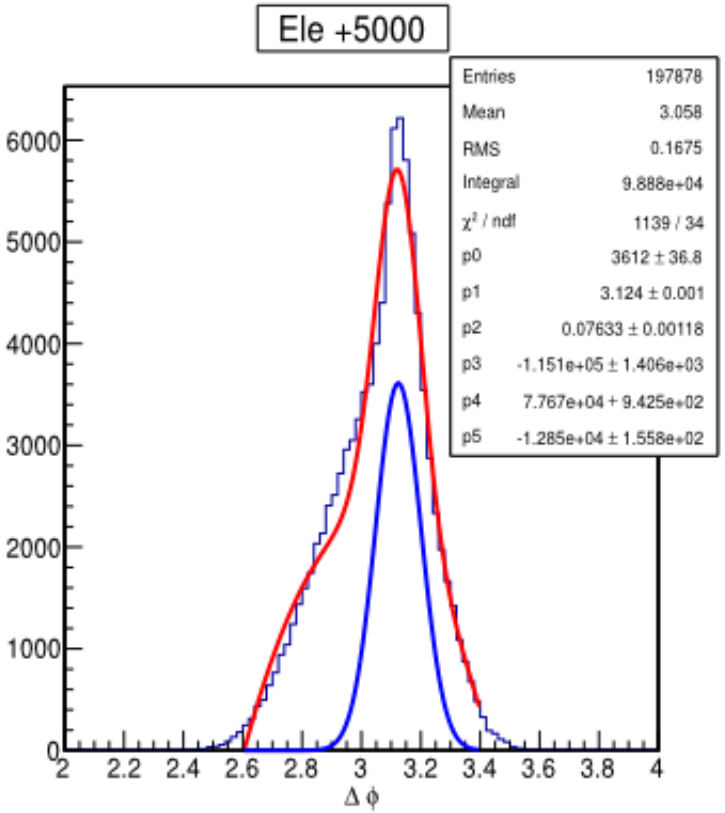
Two fast Cherenkov calorimeters (1.28°):
- Moeller scattering (electron beam)
- Bhabha scattering +annihilation (positron beam)

QED process, Dirac particles!
→ can be calculated
→ even two photon exchange!

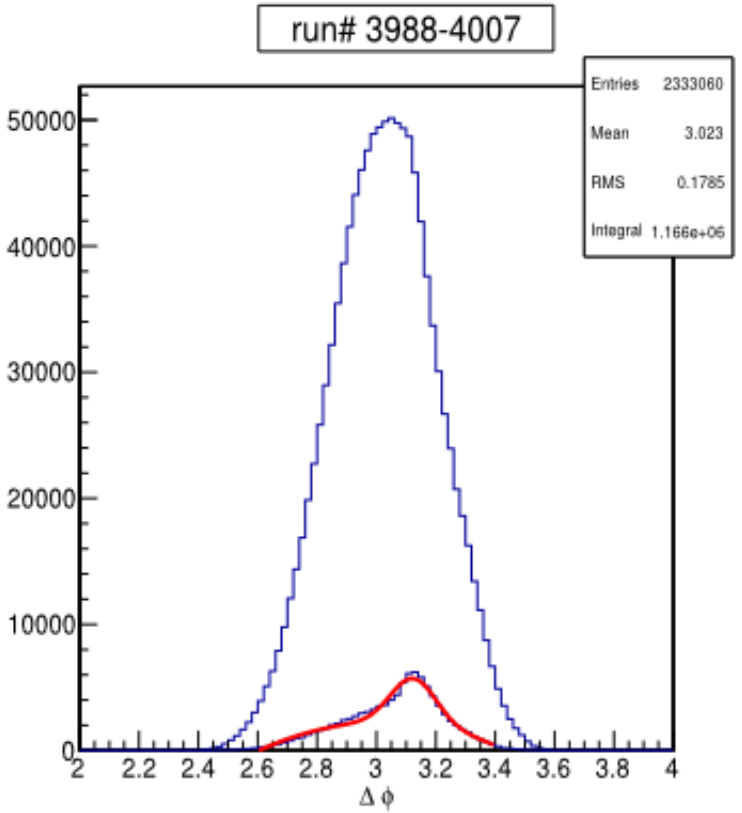




Coplanar Events in TOFs



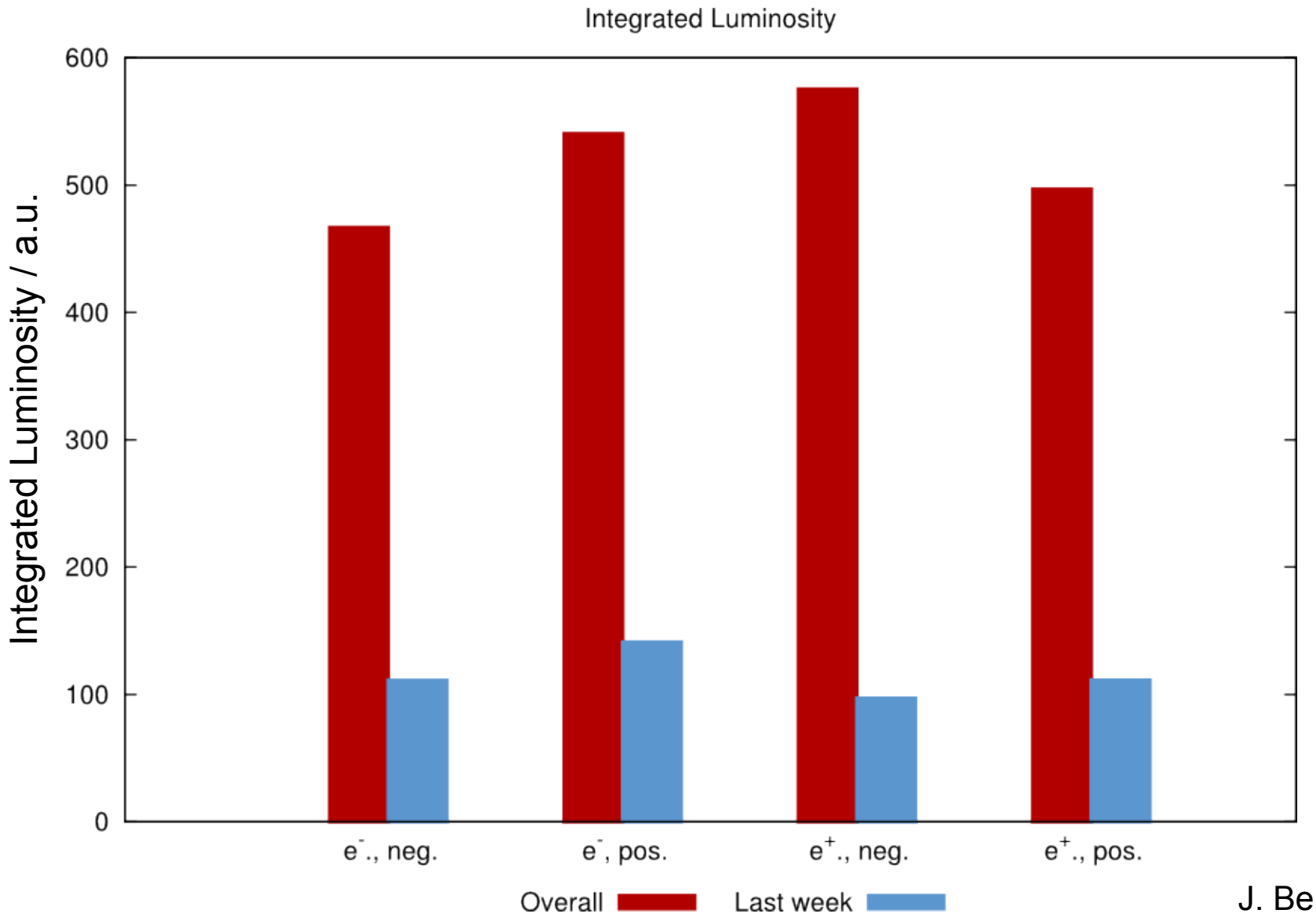
fit to describe background



elastic candidates (incl. background) vs. all events

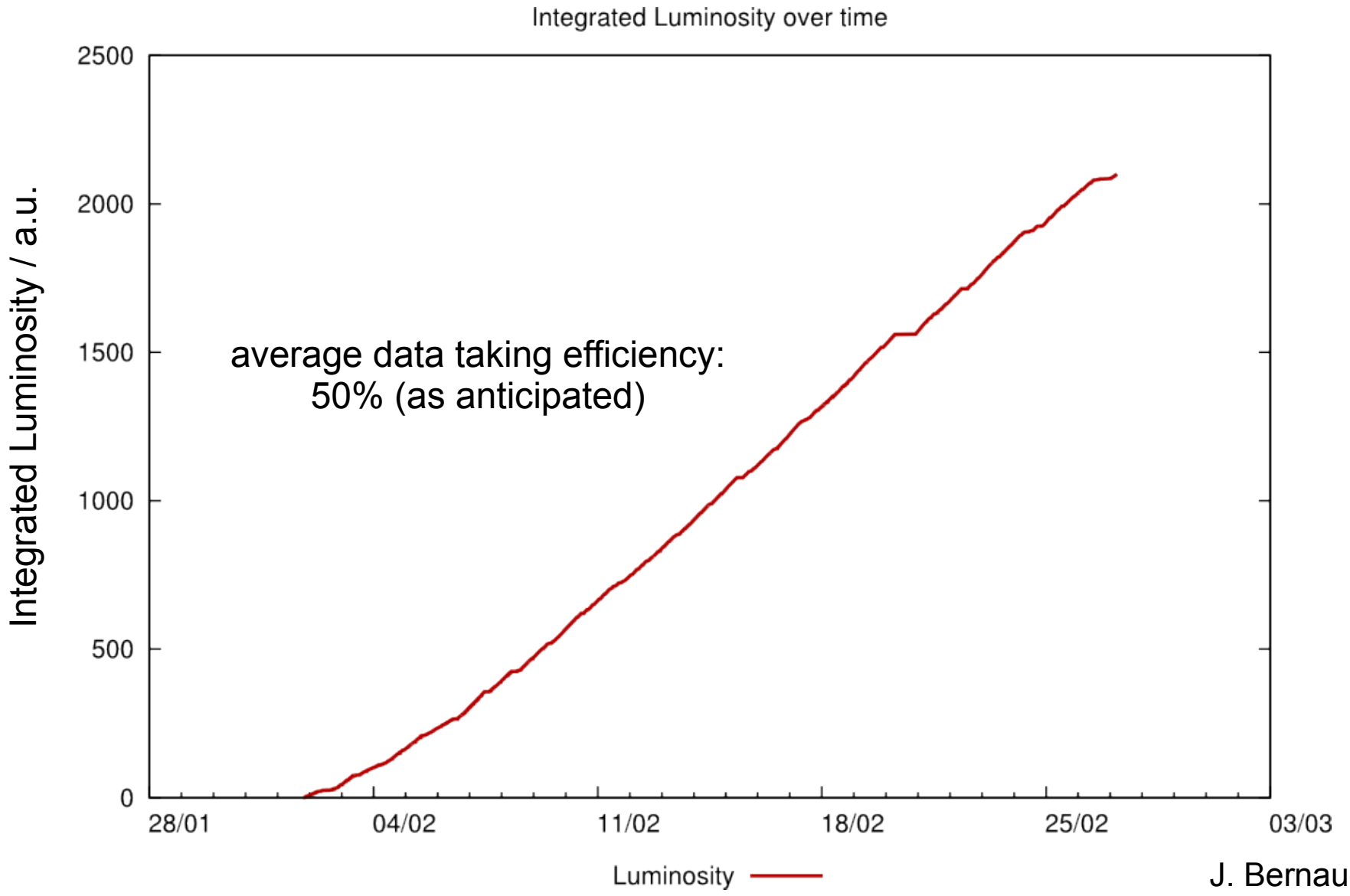
N. Akopov, Yerevan

Integrated Luminosity



J. Bernauer

Integrated Luminosity



J. Bernauer

Summary and Outlook

First data taking February 2012

- Anticipated data taking efficiency reached
- Beam species was flipped once per day
- Magnetic field was flipped every 6 hours (quadruplets of 24 hours)
- Work on data analysis and Monte Carlo ongoing

Upgrades during 2012

- GEM tracker
- 12° lumi trigger
- Cherenkovs(?)

Second data taking November/December 2012