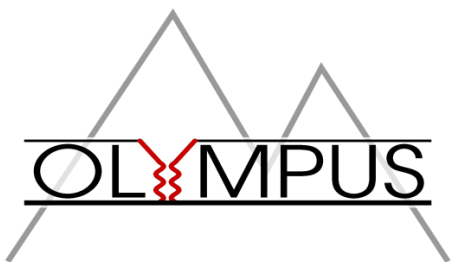


OLYMPUS LUMINOSITY MONITORING*

ÖZGÜR ATES
HAMPTON UNIVERSITY

19-23 March 2012-DPG Meeting in Mainz, GERMANY

*Supported by NSF grants PHY-0855473 and 0959521, and DOE Early Career Award DE-SC0003884



CONTENTS

- Luminosity Monitoring
- 12 Degree Luminosity Monitors(GEM+MWPC)
- Production, Testing, Installation of GEM LuMo.
- Analysis of Test Beam Data@22 in DESY
- First Look of Data taken in the First Set of Runs

19-23 March 2012-DPG Meeting in Mainz, GERMANY

Luminosity Monitoring

Triple Super Ratio:

Run the Experiment for the “4 different states”

$i = e^- \text{ vs } e^+ \quad j = \text{toroidal magnet polarity}(+-)$

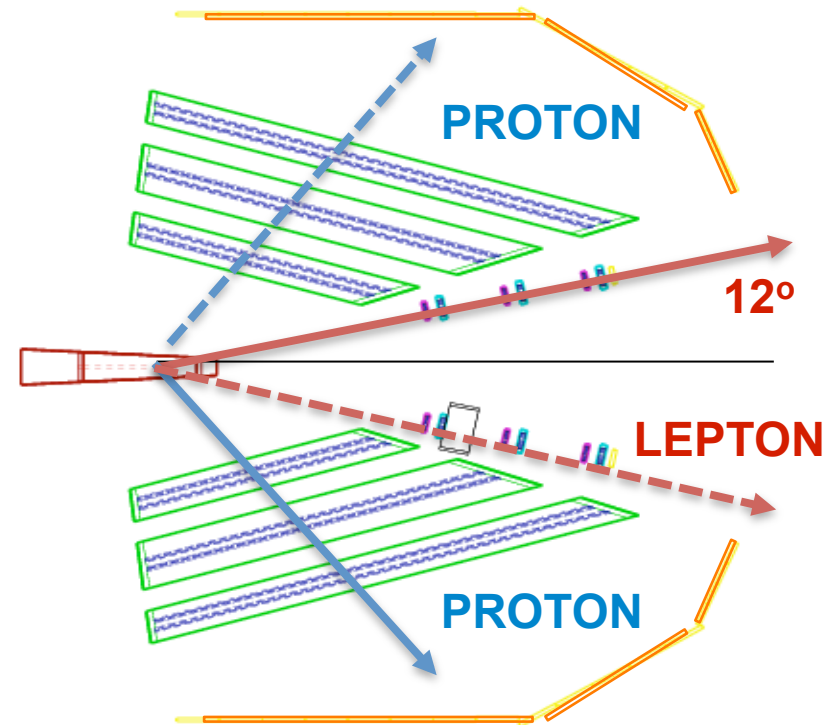
Repeat cycle many times for L_{ij} , N_{ij} , A_{ij}

$$\frac{\sigma_{e^+}}{\sigma_{e^-}} = \left[\underbrace{\frac{N_{e^{++}} N_{e^{+-}}}{N_{e^{-+}} N_{e^{--}}}}_{\text{Ratio of counts}} / \left(\underbrace{\frac{L_{e^{++}} L_{e^{+-}}}{L_{e^{-+}} L_{e^{--}}}}_{\text{Ratio of luminosities}} \cdot \underbrace{\frac{A_{e^{++}} A_{e^{+-}}}{A_{e^{-+}} A_{e^{--}}}}_{\text{Ratio of acceptances (phase space integrals)}} \right) \right]^{\frac{1}{2}}$$

- Forward-angle (high-epsilon, low-Q) elastic scattering ($\sigma_{e^+} = \sigma_{e^-}$) means there is no two-photon exchange
- Separately determine three super ratios
- Left-right symmetry = Redundancy

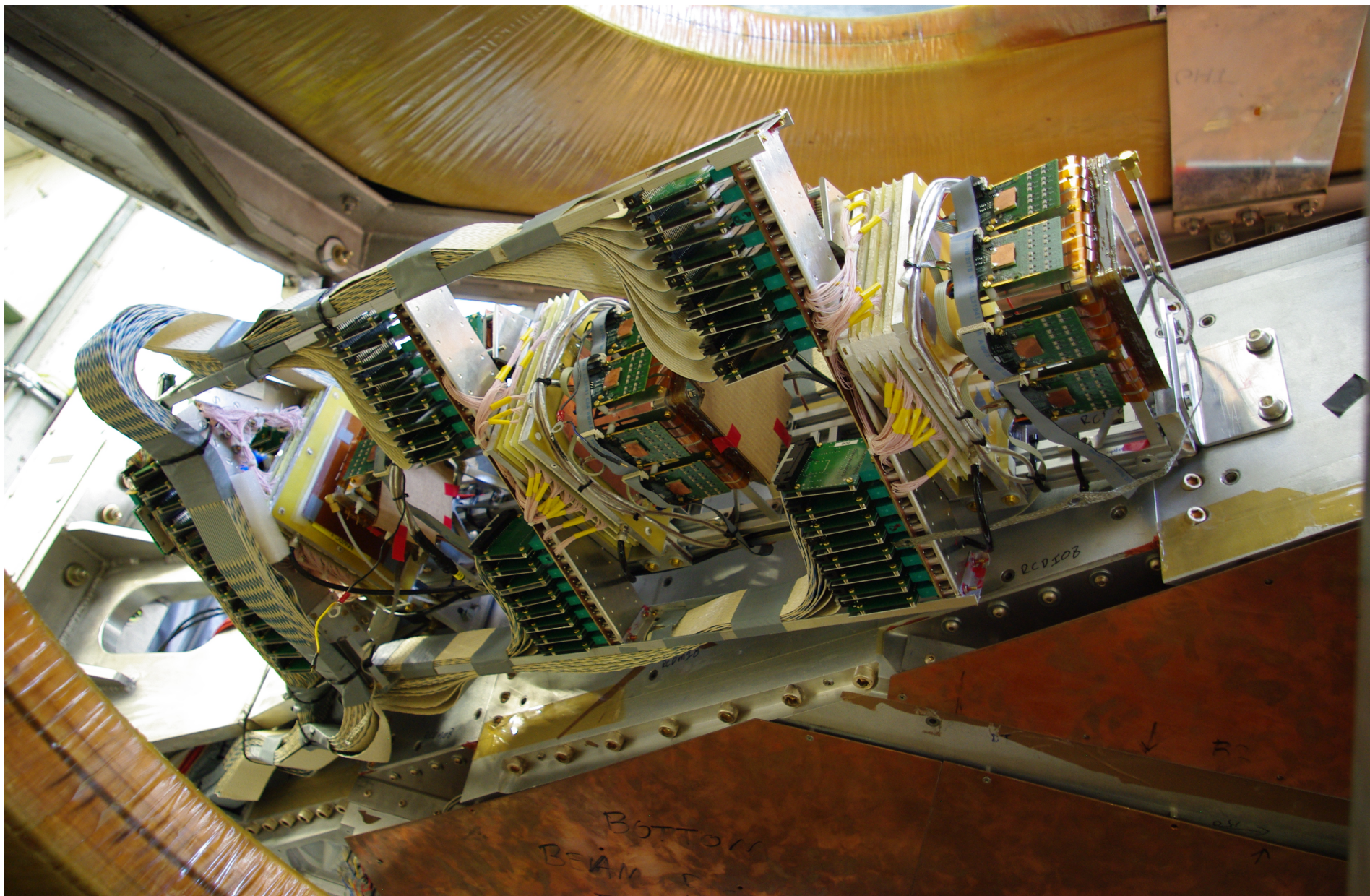
12° Luminosity Monitors: GEM + MWPC

- Forward elastic scattering of lepton **at 12°** in coincidence with proton in main detector
- Two **GEM + MWPC** telescopes with interleaved elements operated independently
- Scintillator for triggering and timing
- **Sub-percent (relative)** luminosity measurement **at 2.0 GeV**
- High redundancy – alignment, efficiency
Two independent groups (**Hampton, PNPI**)

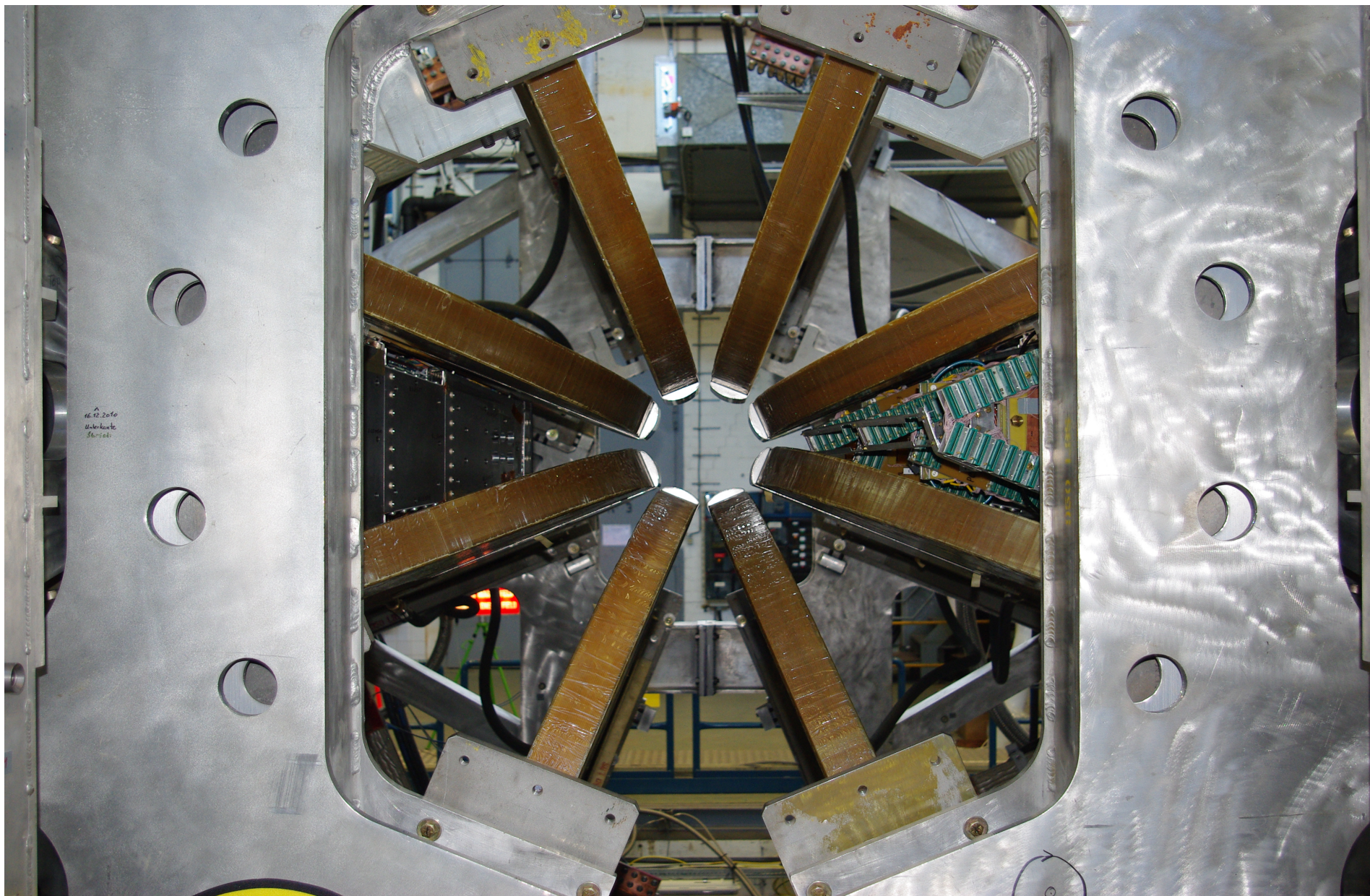


Designed to fit into forward cone





After Installation (July 18, 2011) in DORIS



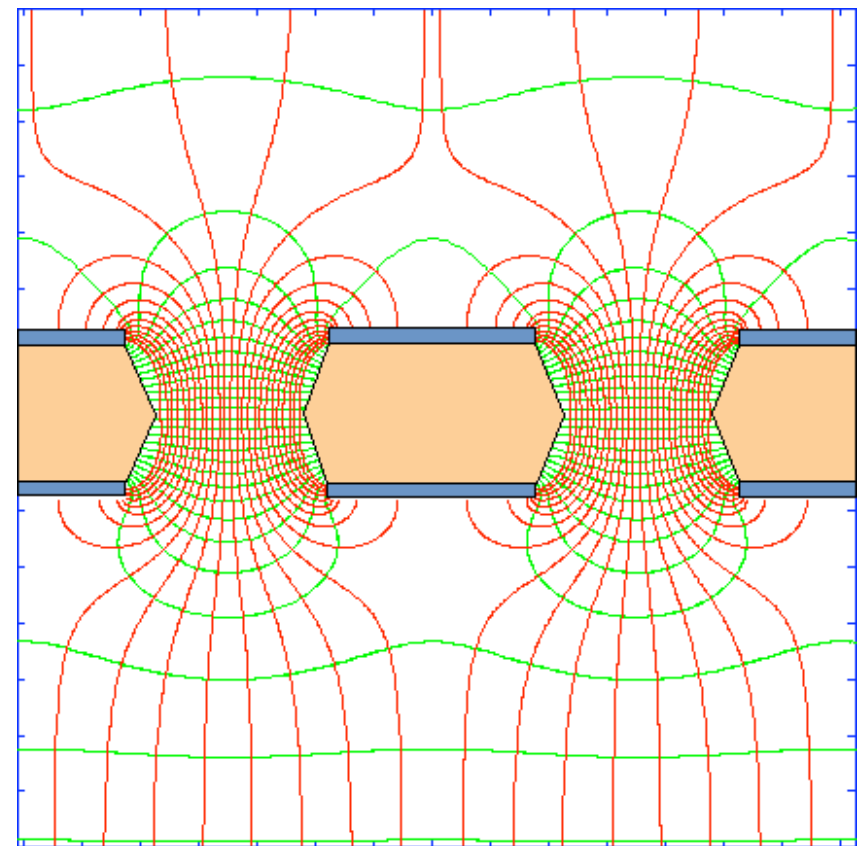
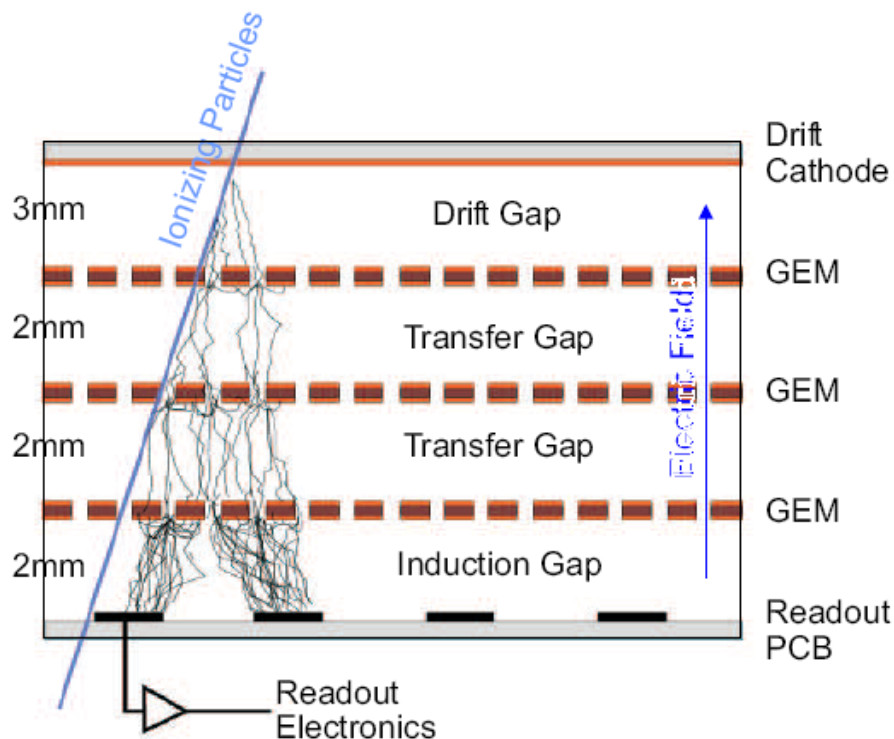
Left arm installed (July 5, 2011)

How does a GEM Detector work?

- GEM = Gas Electron Multiplier

introduced by F. Sauli in mid 90's, [F. Sauli et al., NIMA 386 \(1997\) 531](#)

- High Rate Capability
- Good Spatial Resolution



Manufacturing The GEMs at HU-GEM LAB

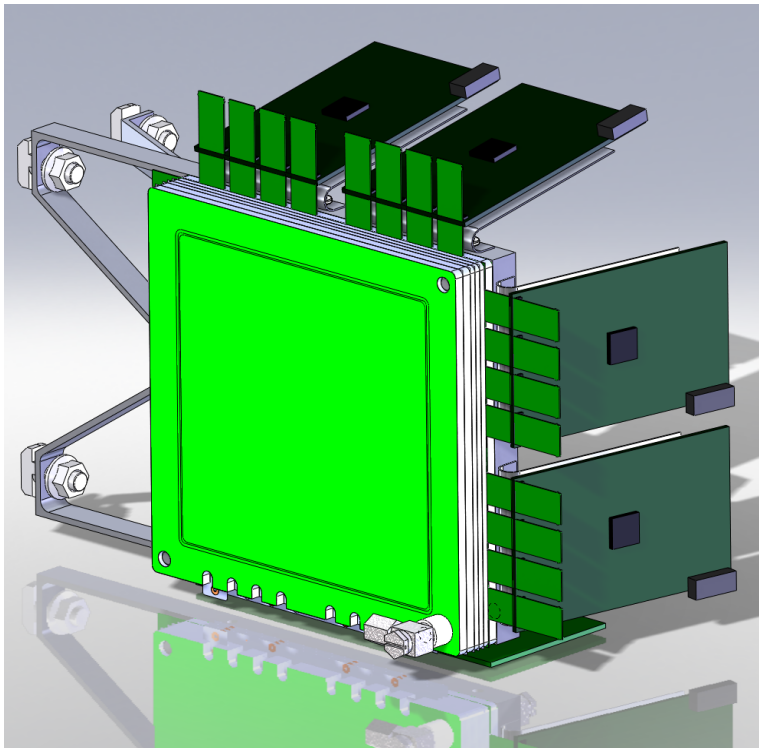
Test each GEM Foil (Optically + by HV) individually at MIT and HU

Glue the GEMs, PV, HV Foils into their frames at HU

Test the triple GEMs in GEM2D Box at HV with $\text{ArCO}_2(70:30)$ at HU

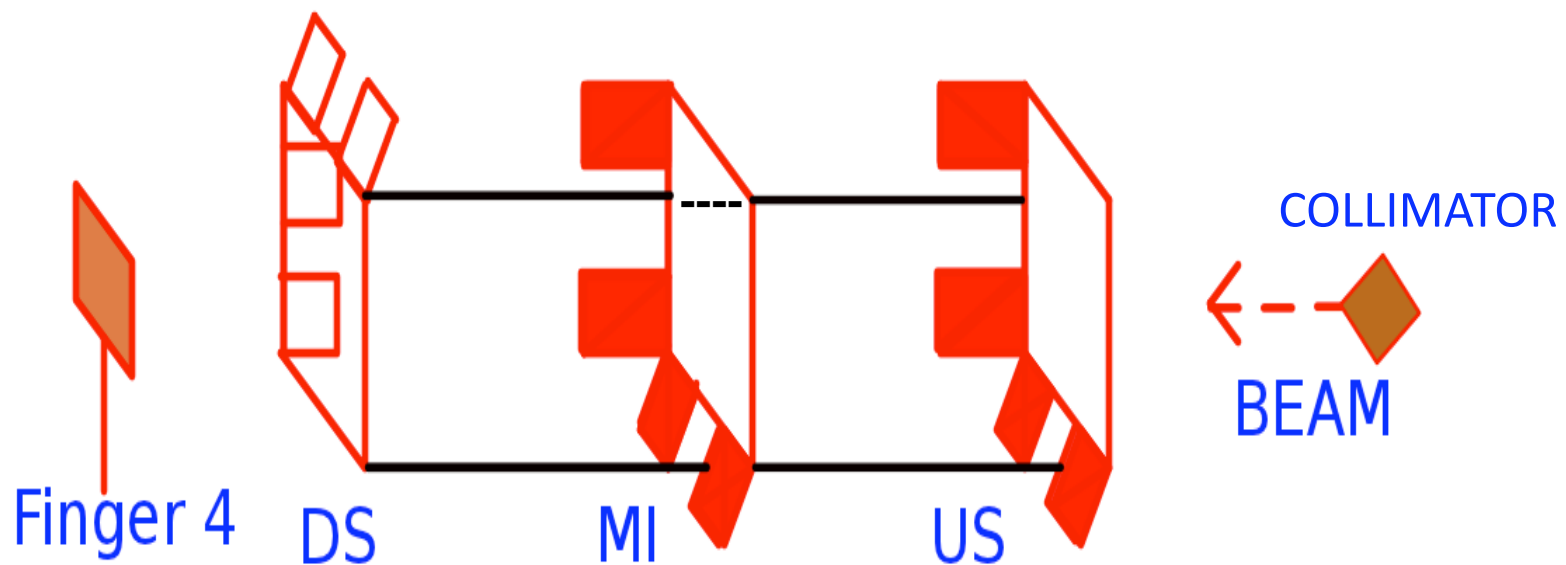
Glue 9 stacks of tGEMs with their Readout Boards at HU

Again test those GEM stacks at Cosmic Ray Test Stand and Ship them to DESY



GEMs tested at Test Beam@22 at DESY

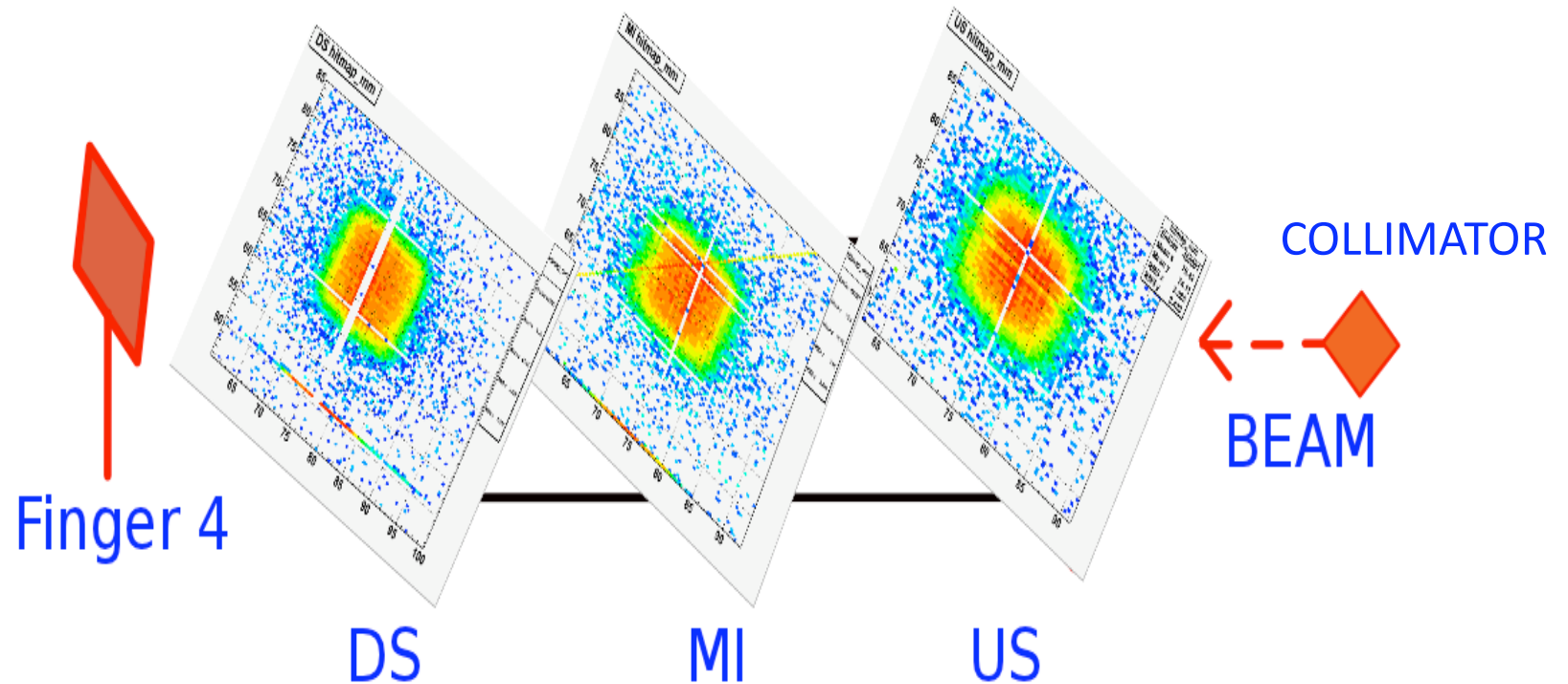
GEM telescope with APV readout



BEAMSPOTS: 2 GeV Electrons, Triggered Plastic Scint. Finger 4

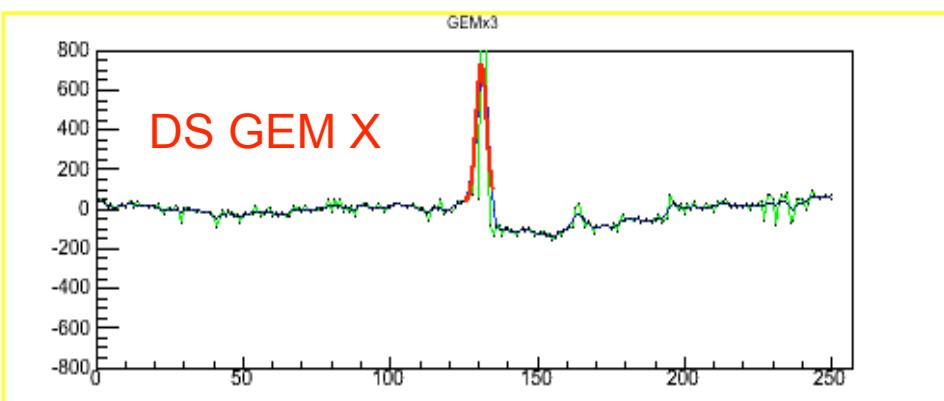
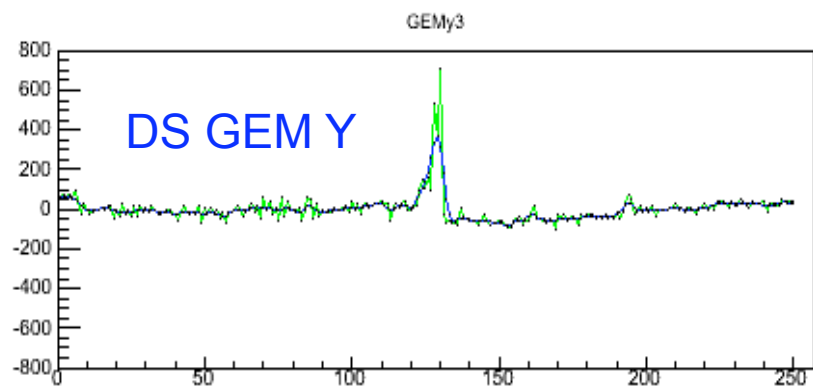
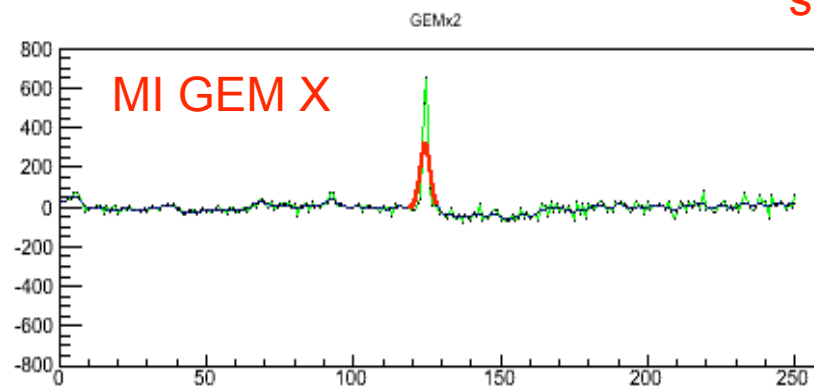
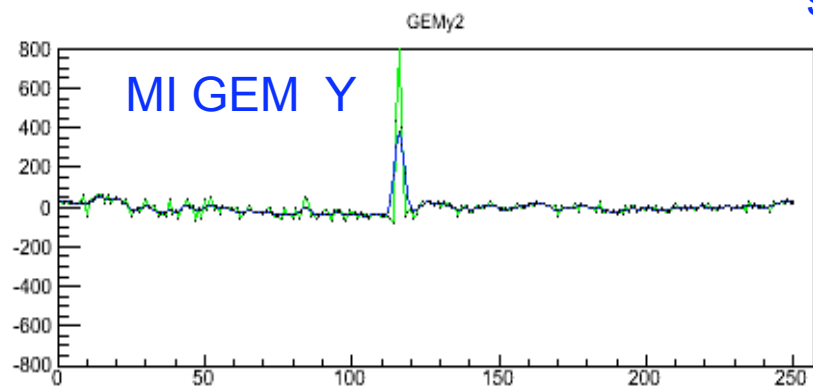
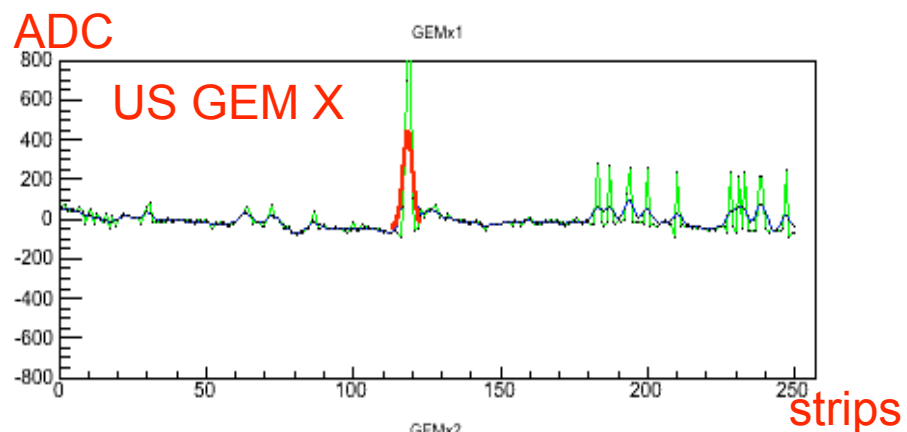
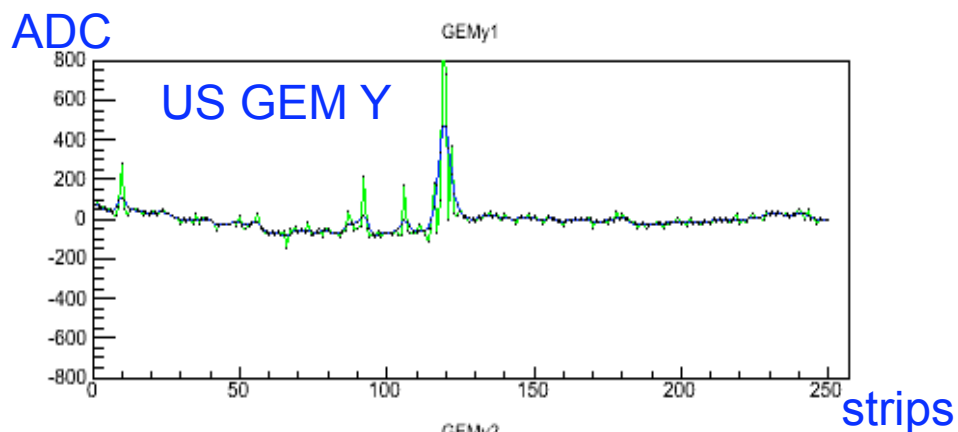
GEMs tested at Test Beam@22 at DESY

GEM telescope with APV readout



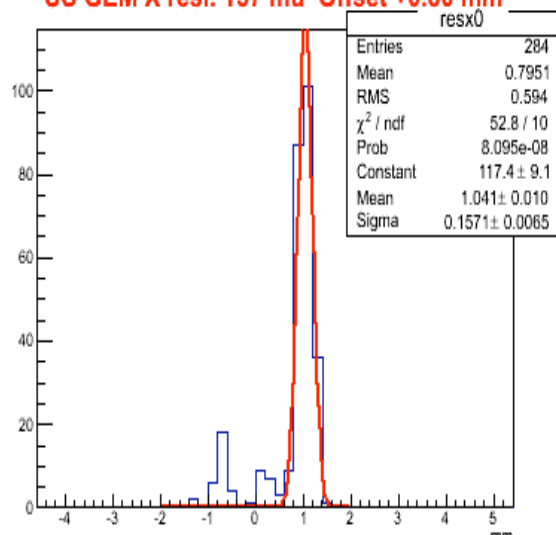
BEAMSPOTS: 2 GeV Electrons, Triggered Plastic Scint. Finger 4

Test Beam@22 Raw Data: Hit Candidates from GEM Elements

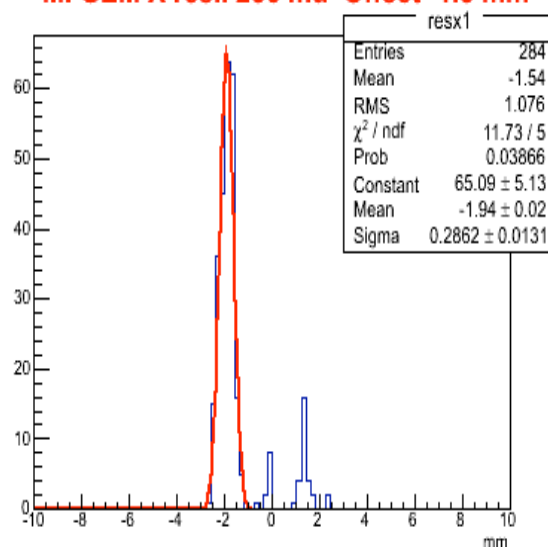


Measured Data@DORIS: RESIDUE at GEM Planes +5000A Magnet Current, 1sccm flow, Positrons

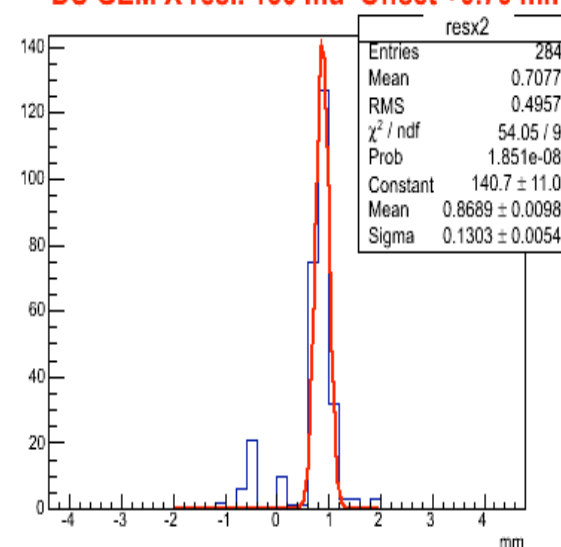
US GEM X resi. 157 mu Offset +0.80 mm



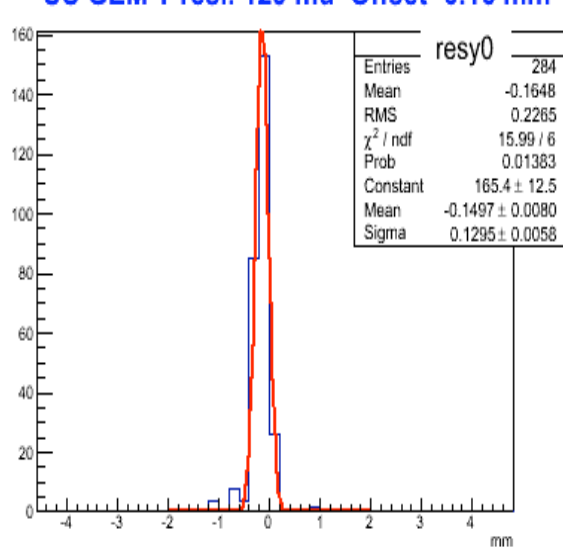
MI GEM X resi. 286 mu Offset -1.5 mm



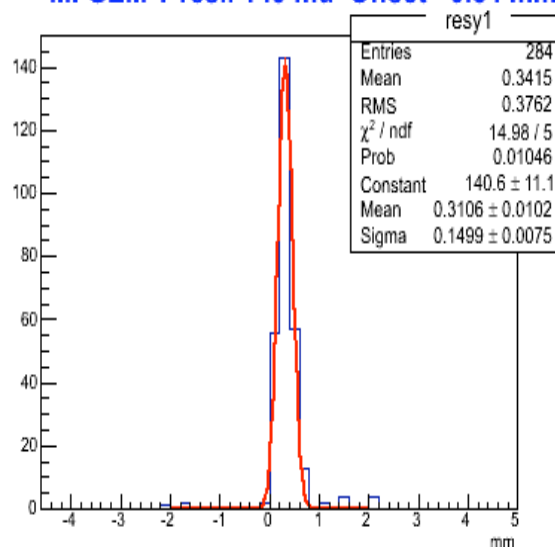
DS GEM X resi. 130 mu Offset +0.70 mm



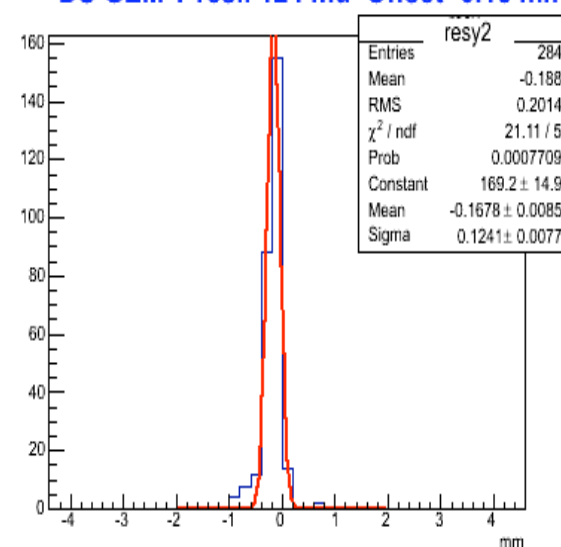
US GEM Y resi. 129 mu Offset -0.16 mm



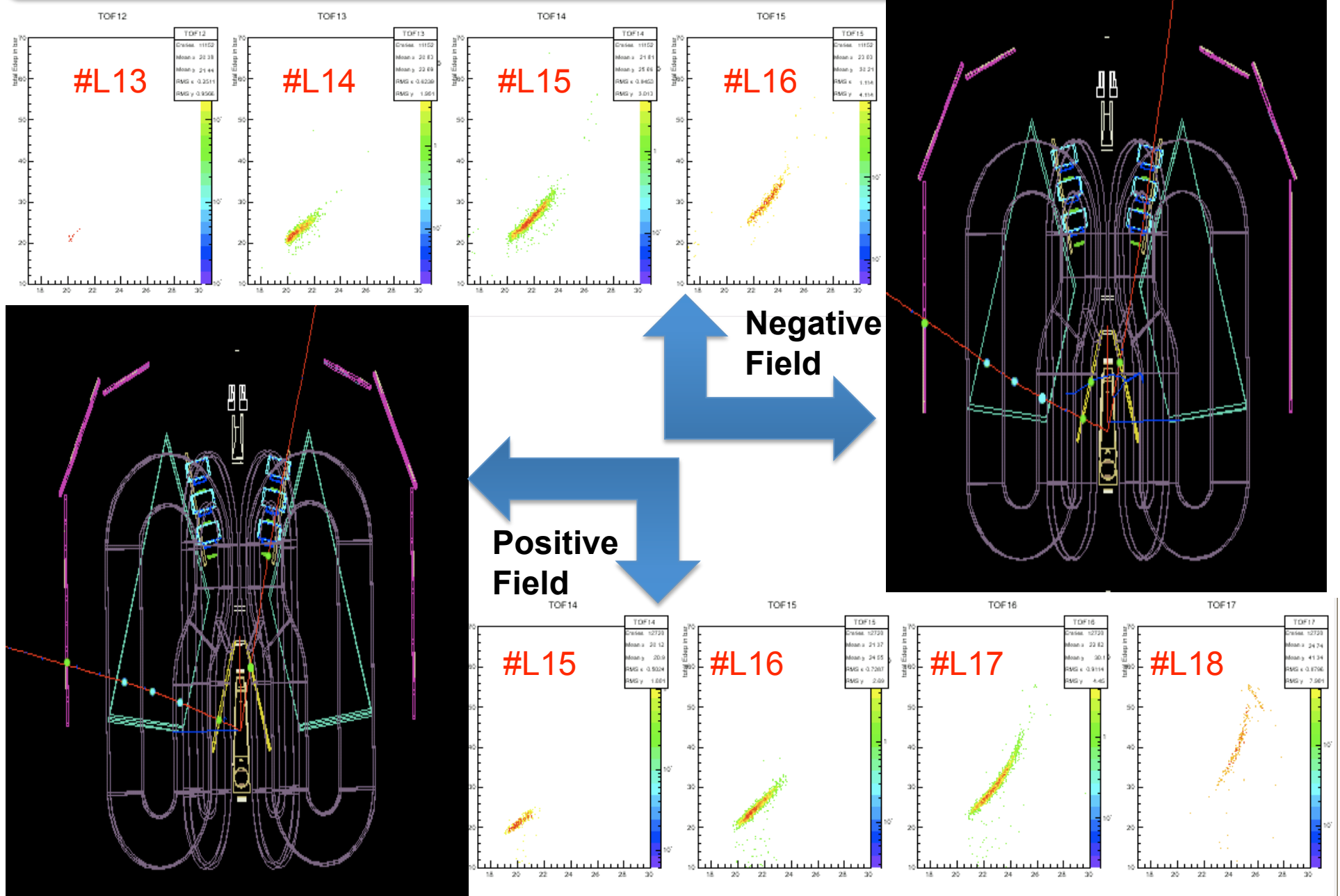
MI GEM Y resi. 149 mu Offset +0.34 mm



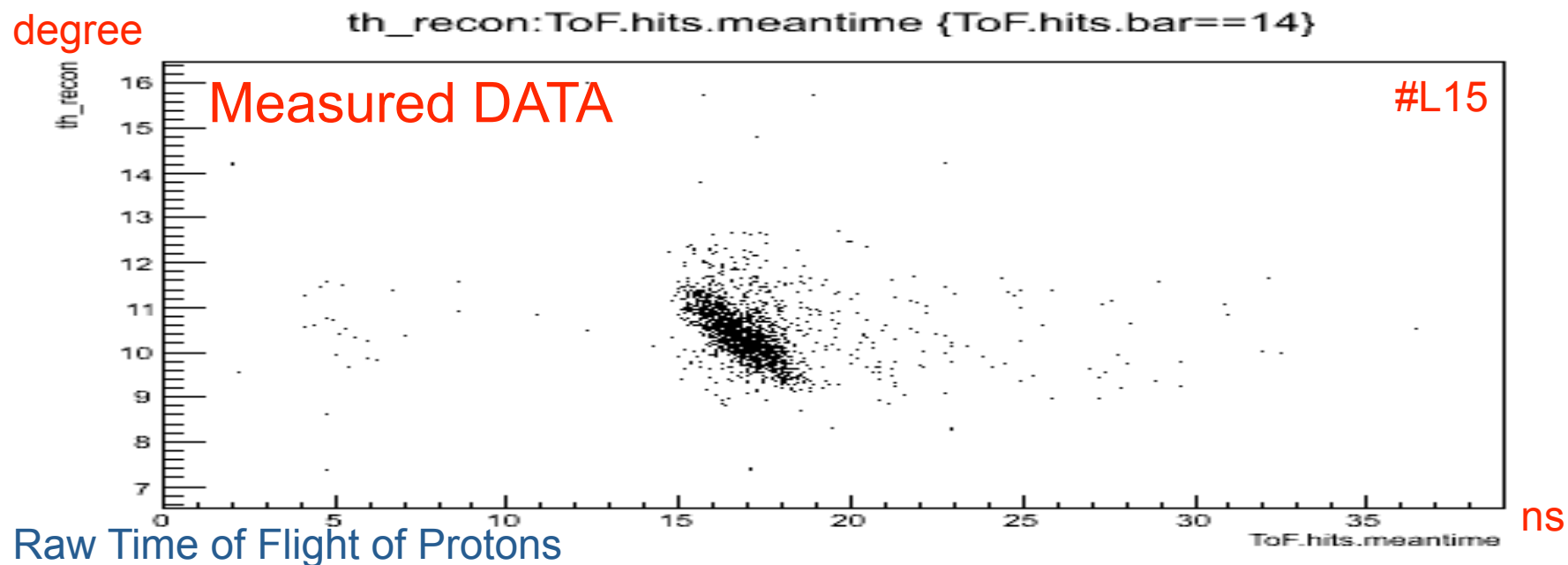
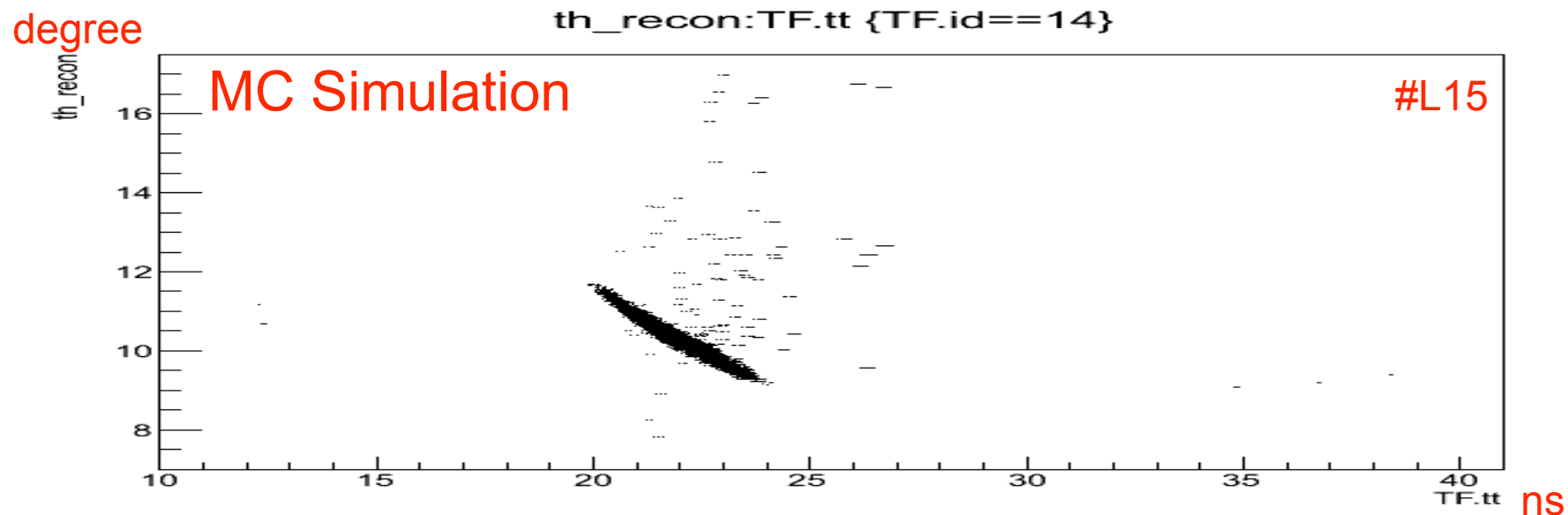
DS GEM Y resi. 124 mu Offset -0.18 mm



MC Simulation (Edep vs Meantime), Recon. Positrons, $-/+5000A$



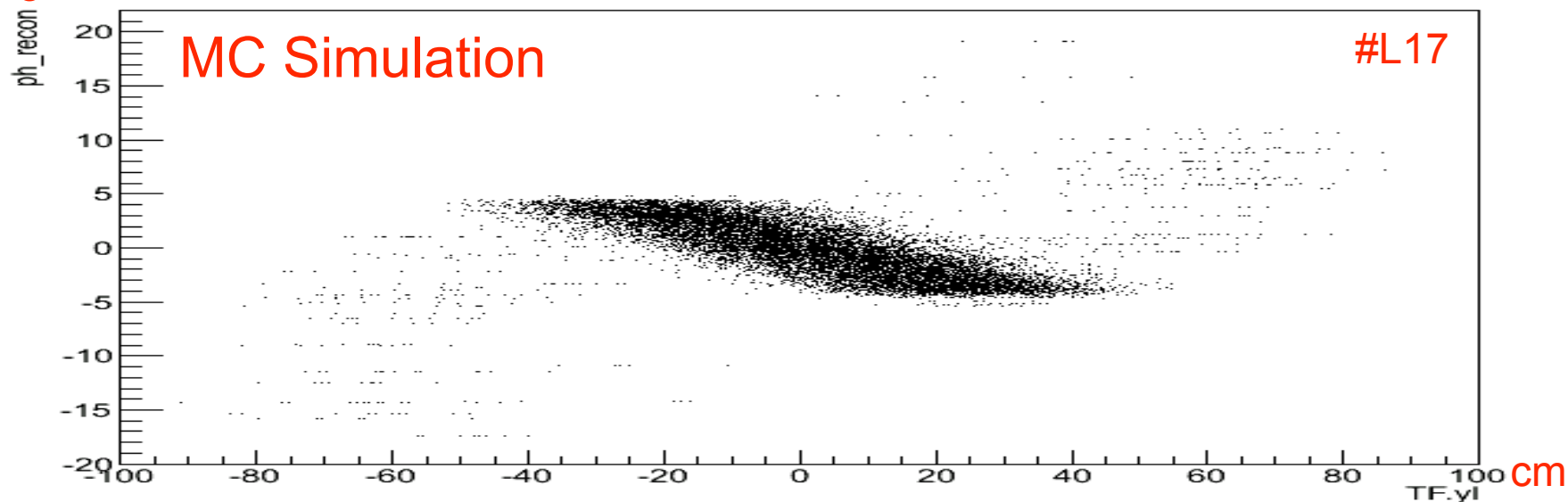
Lepton Scattering Angle vs Proton Meantime, Positrons, -5000A



Lepton Azimuthal Angle vs Proton HitPos, Positrons, +5000A

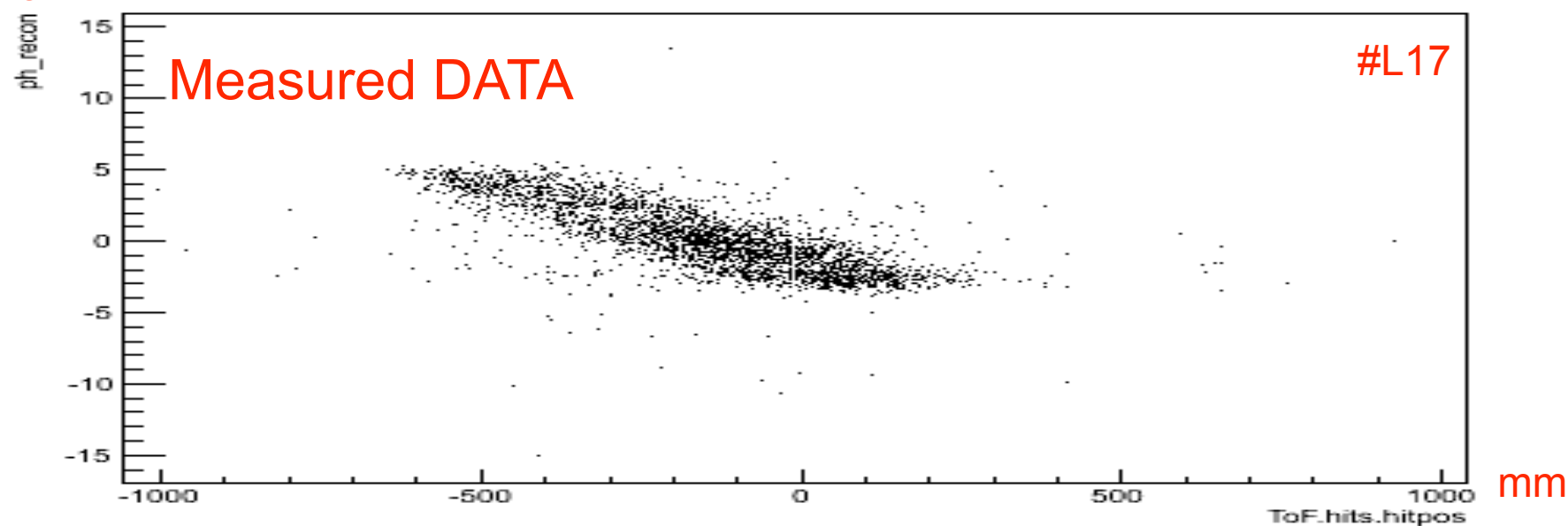
degree

ph_recon:TF.yl {TF.id==16}

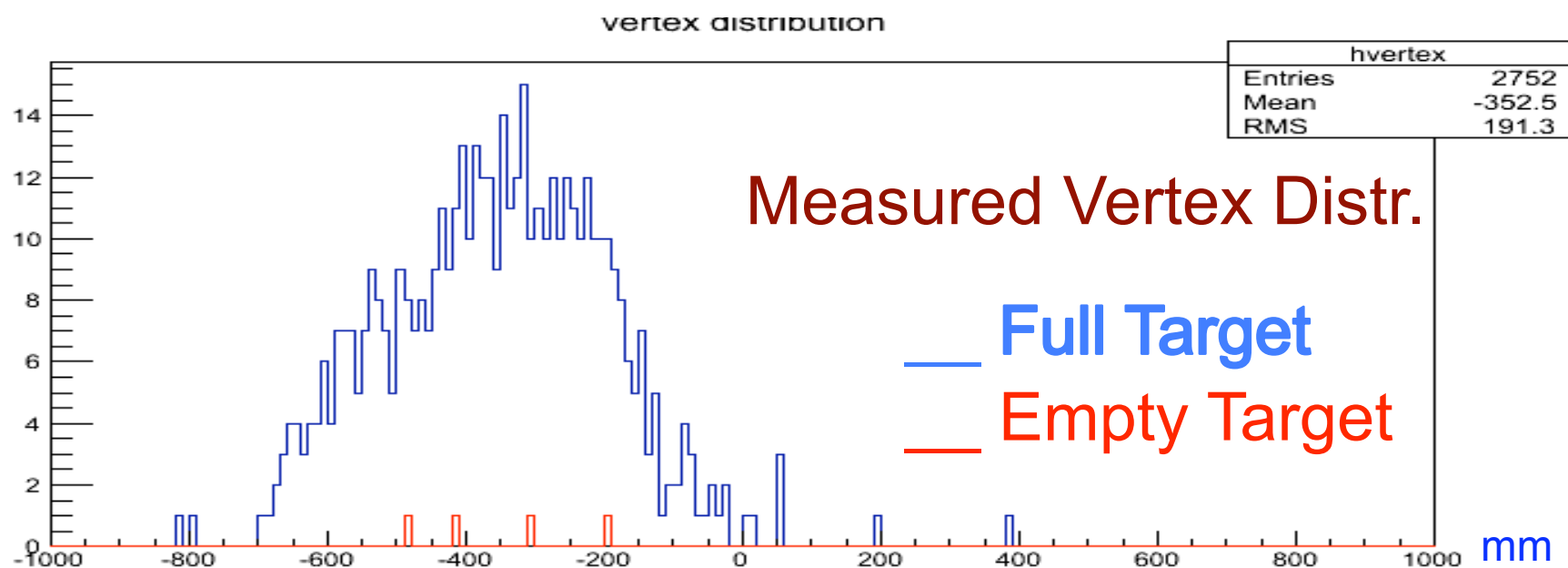
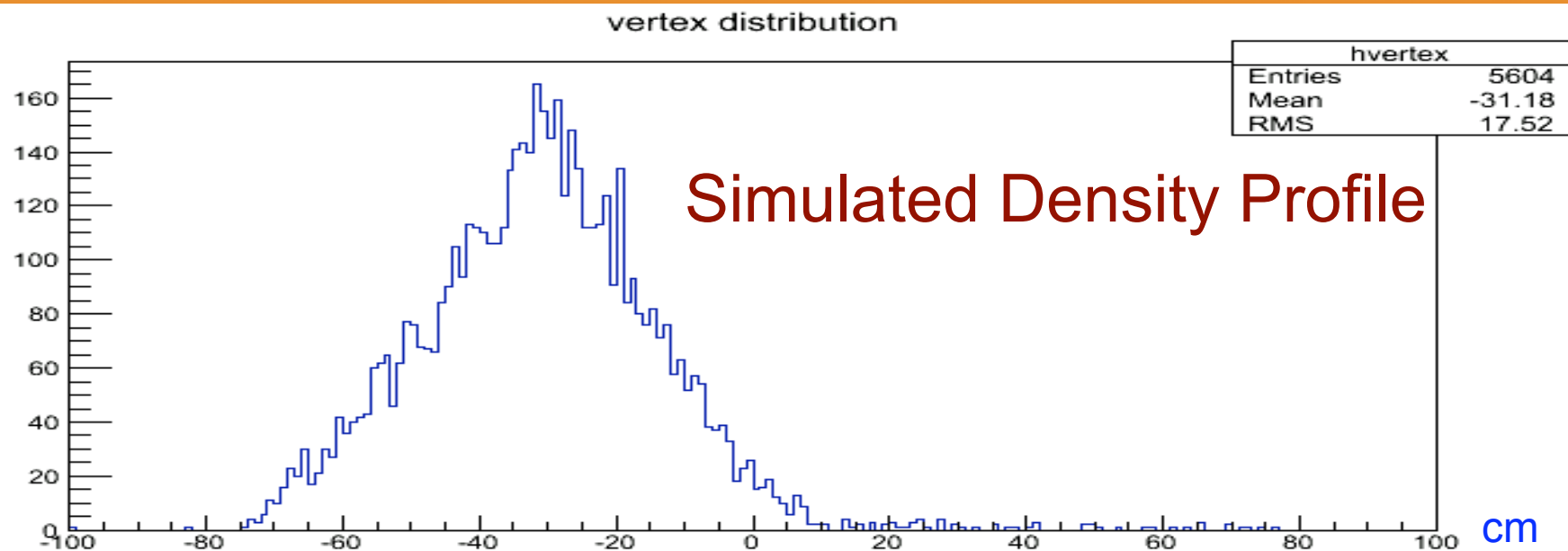


degree

ph_recon:ToF.hits.hitpos {ToF.hits.bar==16}

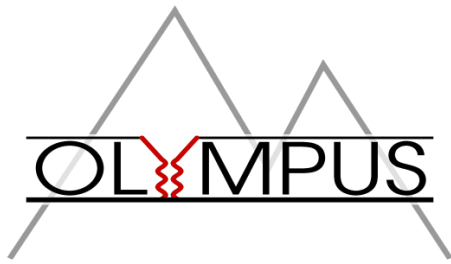


Target Density Profile, (Vertex Distribution), Positrons, -5000A



SUMMARY

- ✓ 9 GEM detectors were built at Hampton University
- ✓ All 9 GEM elements were tested at DESY test beam
- ✓ Two detector telescopes with 3 GEM detectors each were installed
- ✓ First data taking period was successful!
- ✓ Combined tracking with GEM and MWPC has started
- ✓ Olympus aims to determine Two Photon contribution to ep elastic scattering with approx. 1% precision.



THANKS.