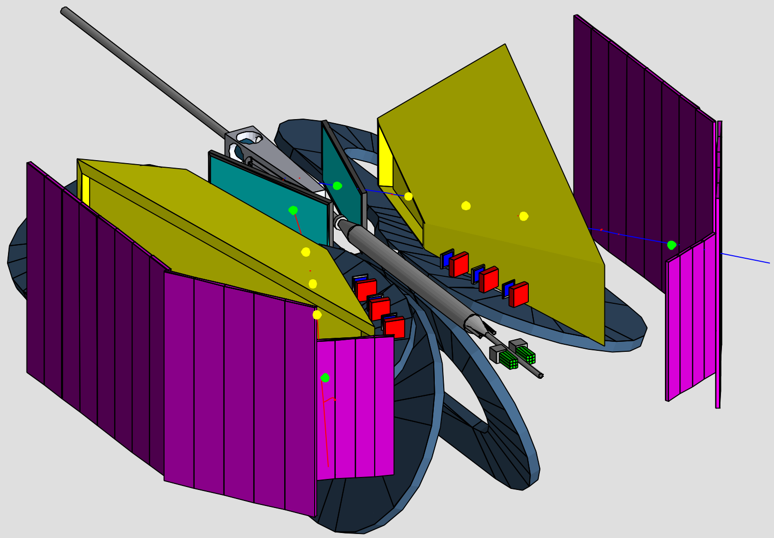
OLYMPUS Tracking



Axel Schmidt

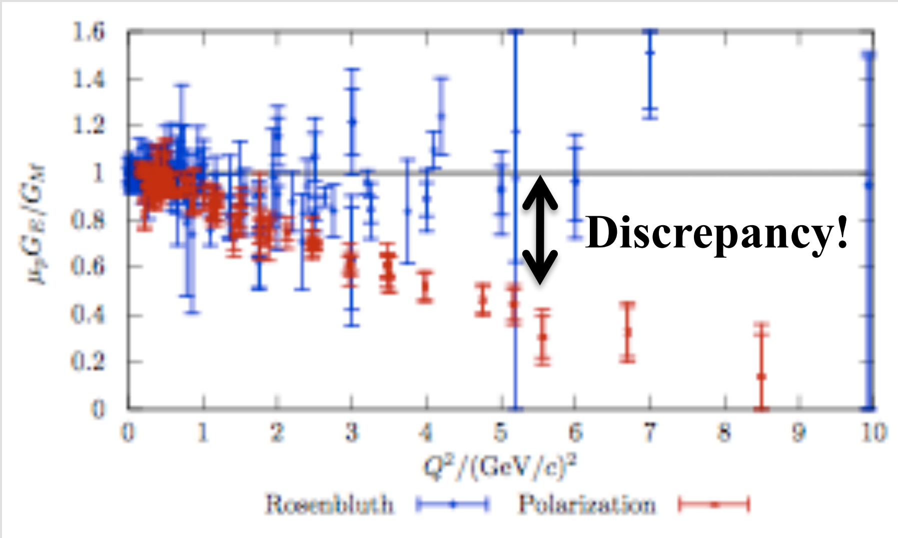
Massachusetts Institute of Technology

for the OLYMPUS Collaboration

The OLYMPUS Experiment

The Motivation:

Discrepancy in measurements of the proton's EM Form Factors



J. C. Bernauer, private communication

The Mission:

2-photon contribution

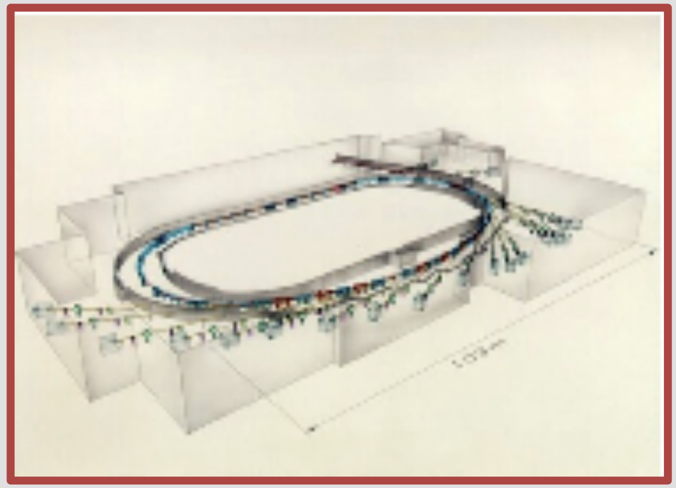
Ratio of elastic cross-sections:

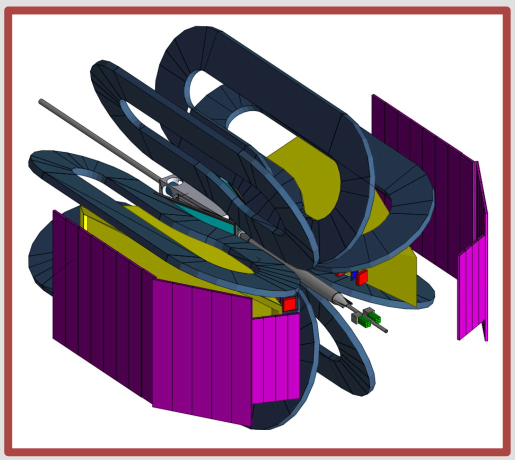
$$R \equiv \frac{\sigma^{(e^+p)}}{\sigma^{(e^-p)}} \approx 1 + 4\,\mathrm{Re}\{M_{1\gamma}{}^{\dagger} M_{2\gamma}\} / |M_{1\gamma}|^2$$

The OLYMPUS Experiment

The Machine:

- internal target experiment
- DORIS storage ring @ DESY
- reuse of the BLAST detector from MIT Bates
- heavily upgraded





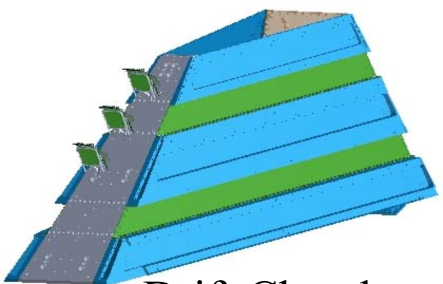
DORIS

Beam:	e^- or e^+
Energy:	2.0 – 4.5 GeV
Current:	up to 140 mA

Tracking

The Data Chain:

Detectors



Drift Chamber

→

Raw Signals
ADCs
TDCs

↓

Tracking
- Particle Species
- Momentum
- Scattering Angles
- Vertex

→

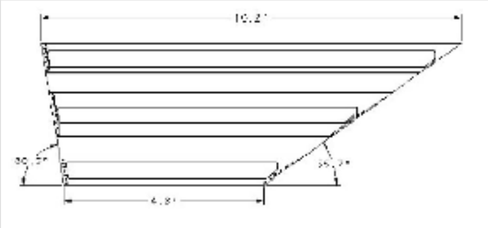
High-Level Analysis
- Elastic Event Selection
- Accounting for:
  - Acceptance
  - Luminosity
  - Radiative Effects

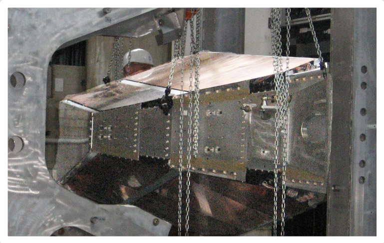
↓

Ratio

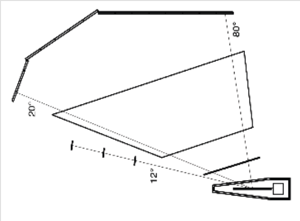
The important points

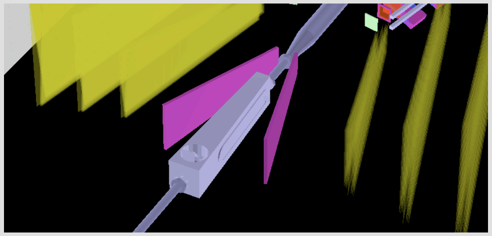
- Main tracking detectors: drift chambers



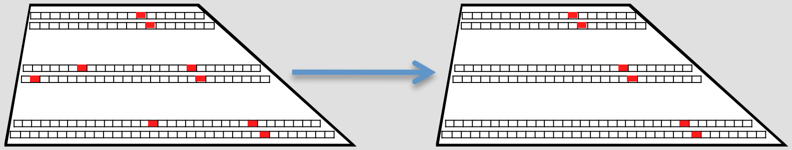


- Run II tracking upgrade: GEM planes

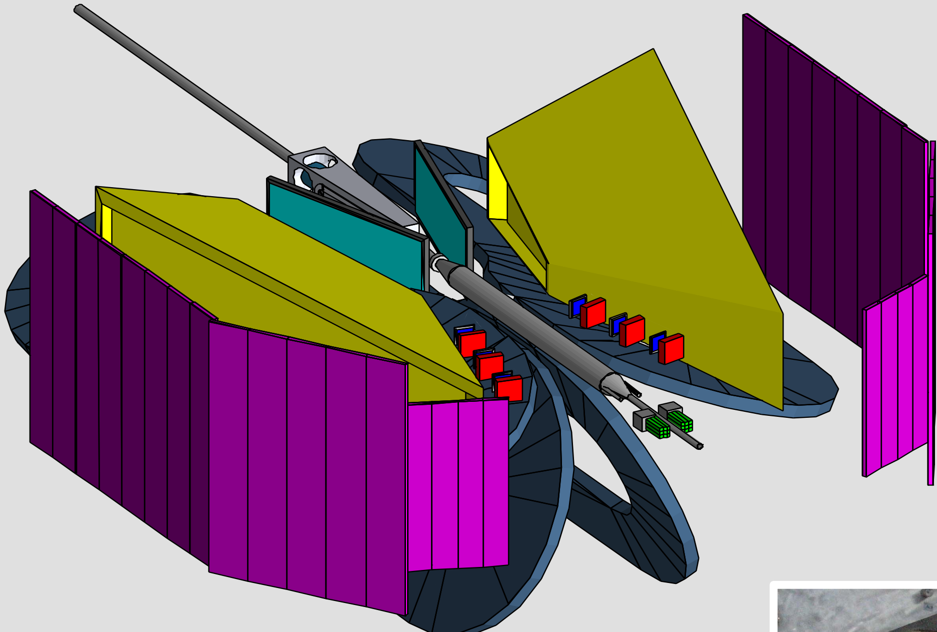


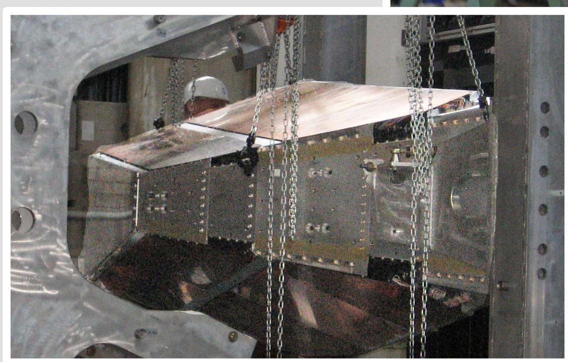


- Developing several tracking algorithms



Drift Chambers

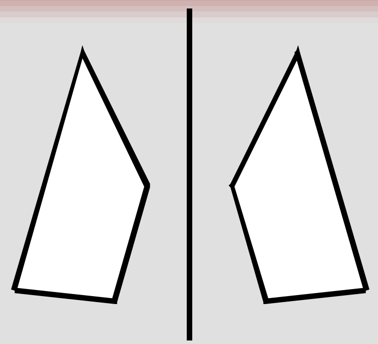




Acceptance:

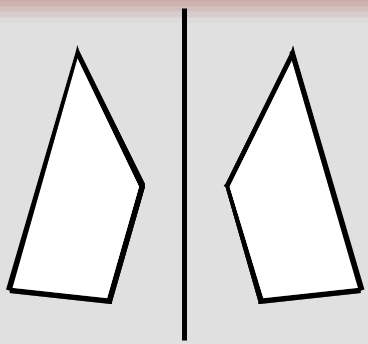
- 20° to 80° in polar angle
- ±15° in azimuth per sector

Drift Chamber - Schematic

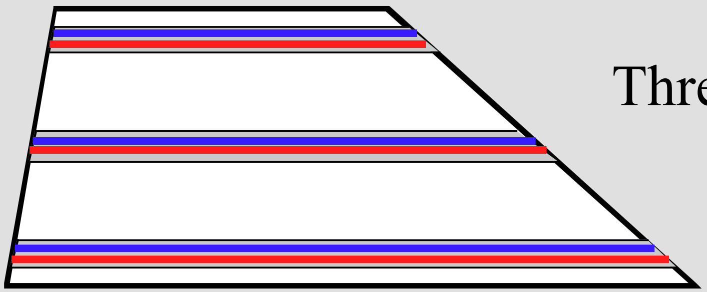


Two Sectors

Drift Chamber - Schematic

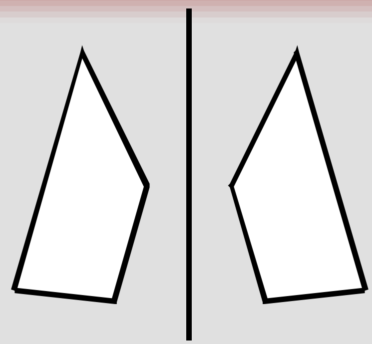


Two Sectors

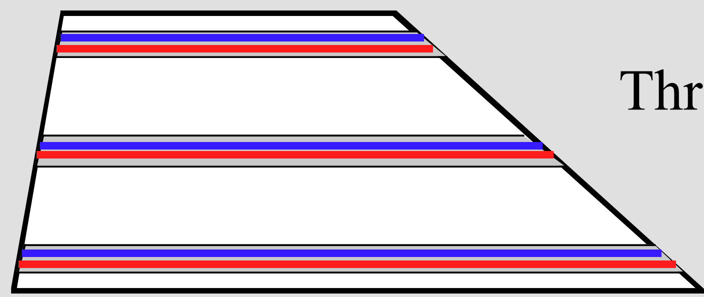


Three chambers
(single gas volume)

Drift Chamber - Schematic

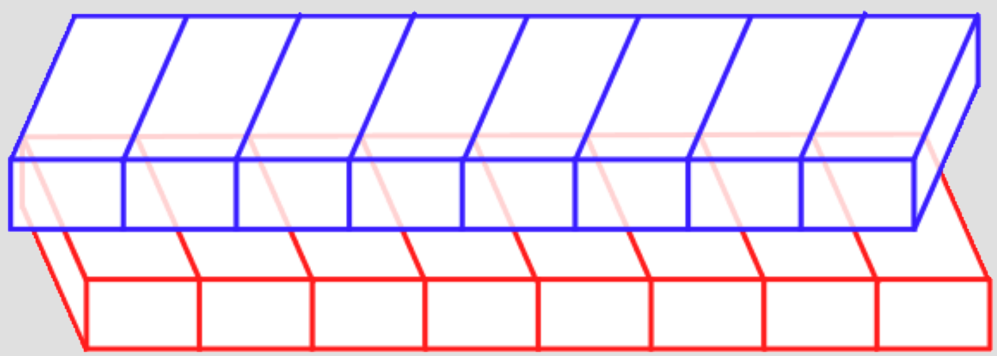


Two Sectors



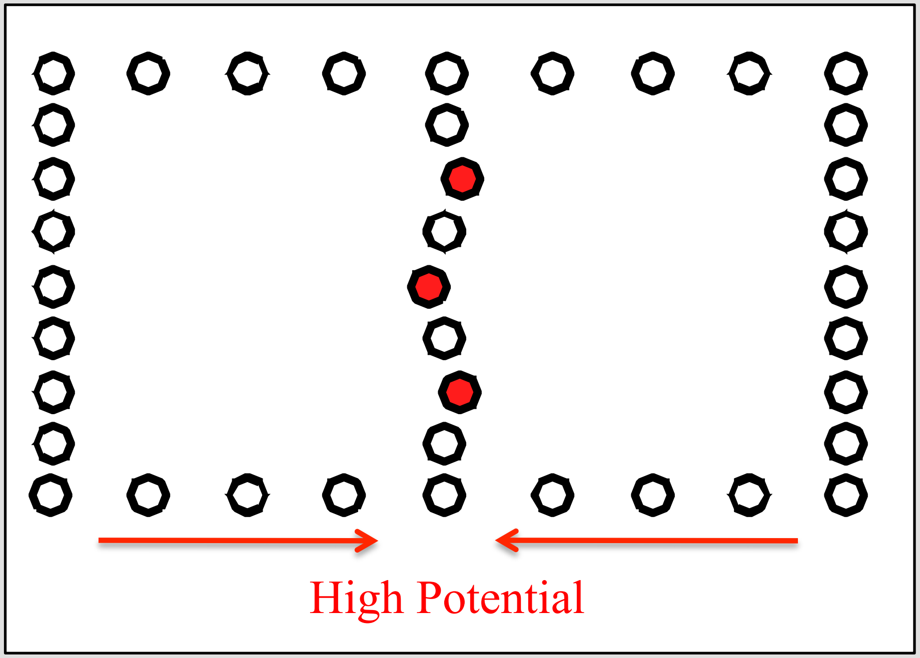
Three chambers
(single gas volume)

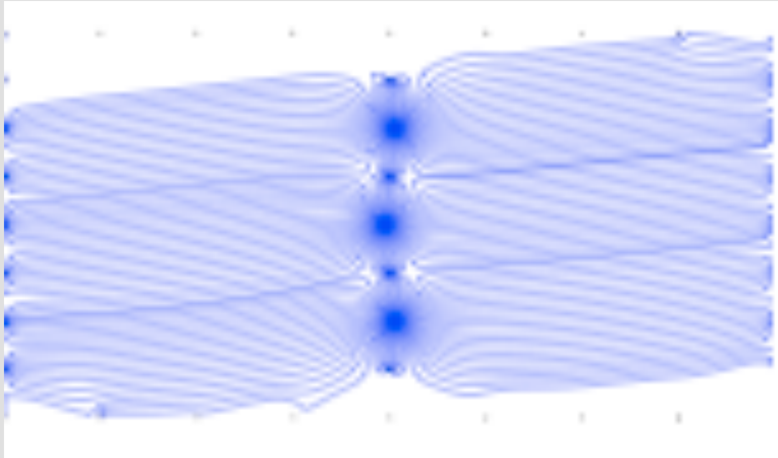
Individual Drift Chamber – Two superlayers made up of cells



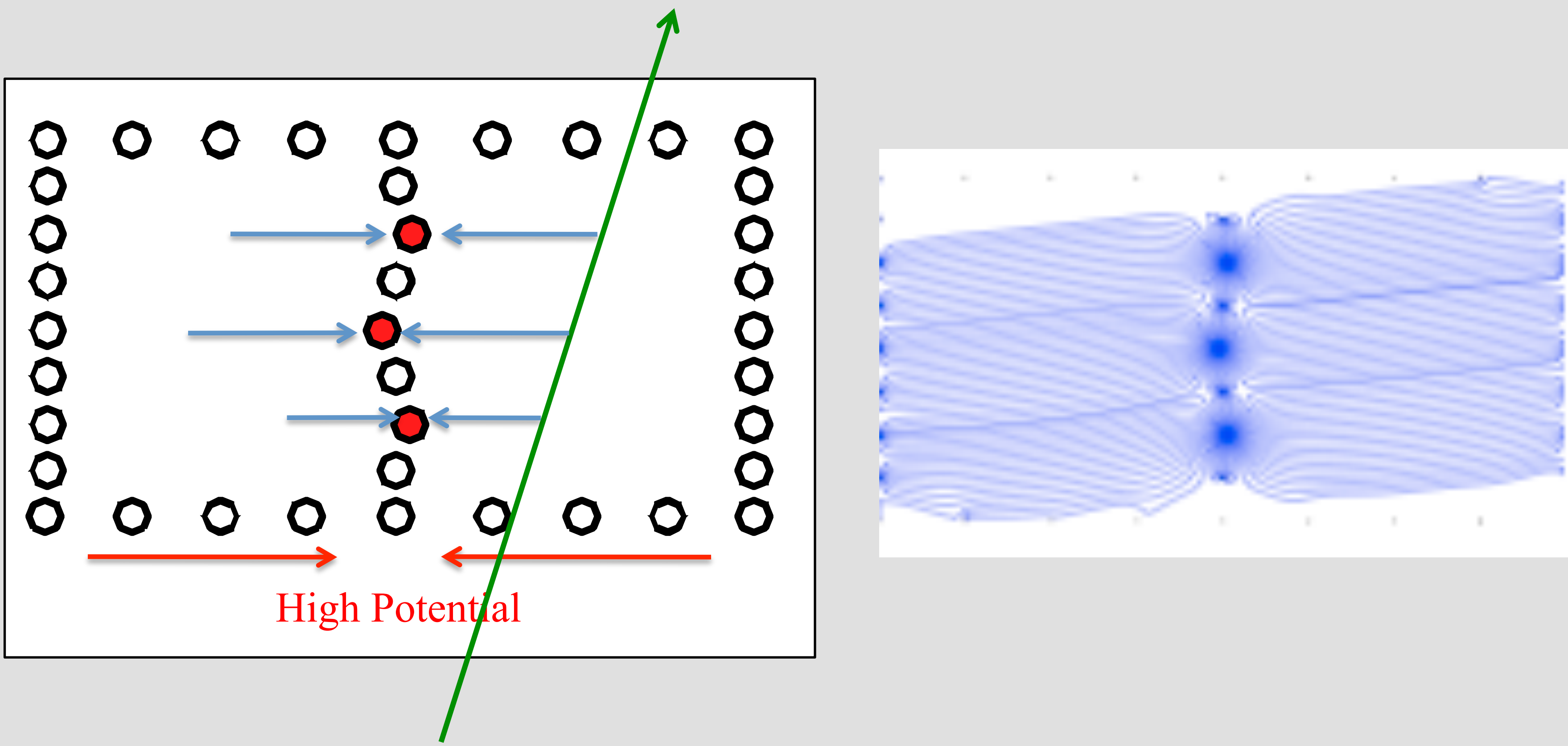
10˚ stereo angle

Drift Chamber Cell

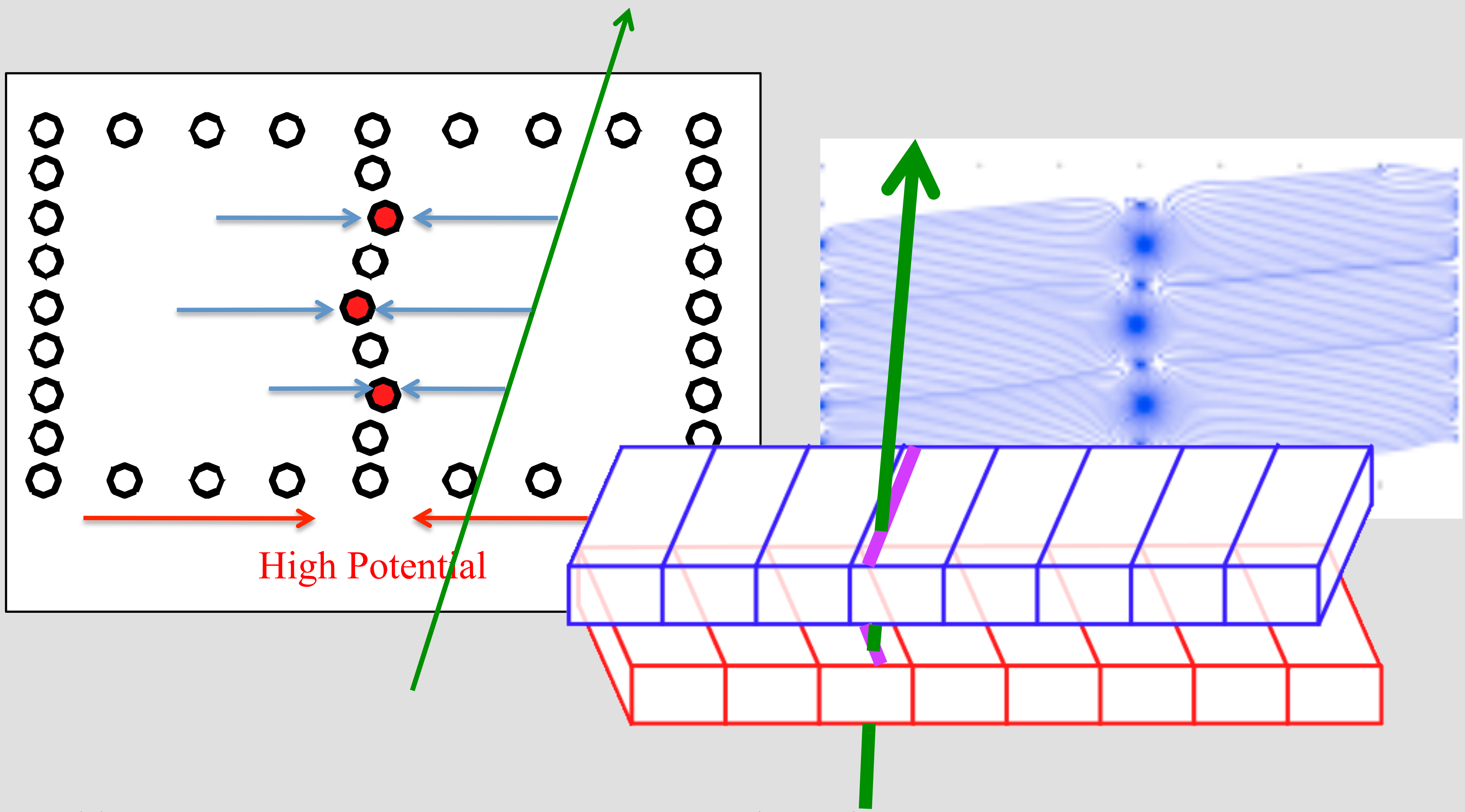




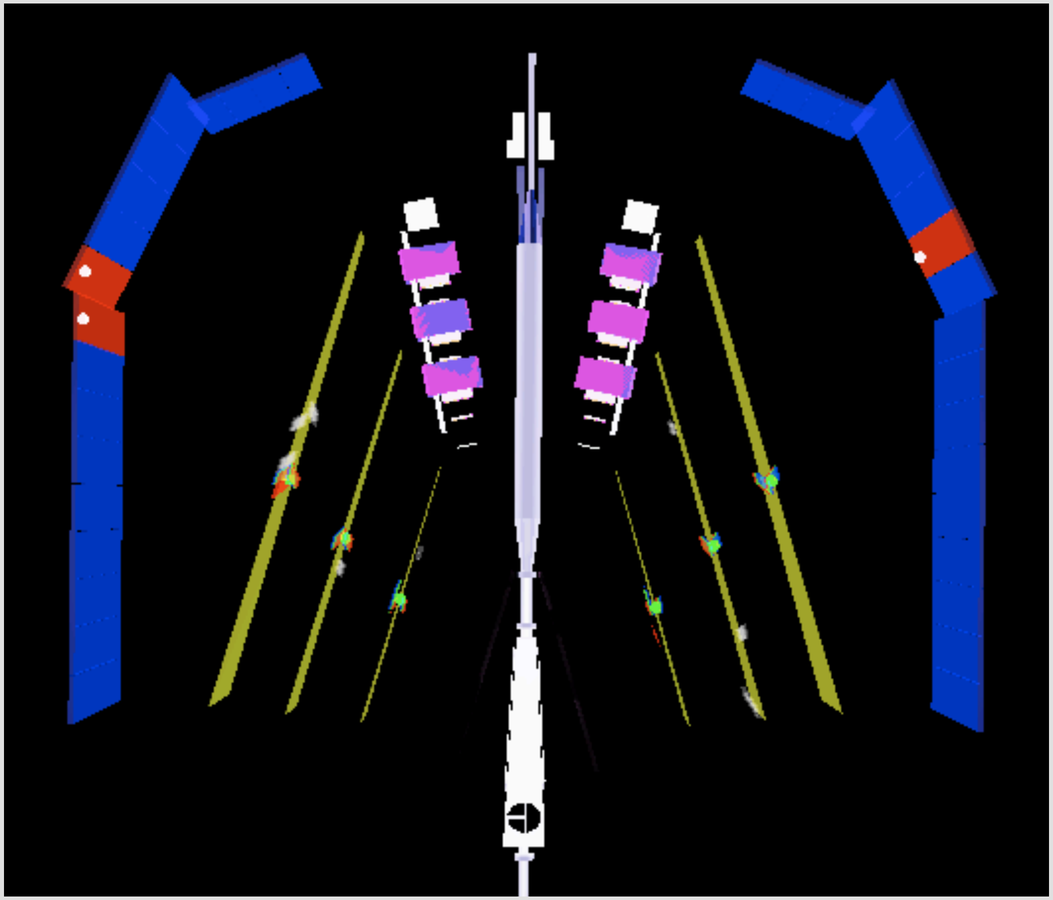
Drift Chamber Cell



Drift Chamber Cell

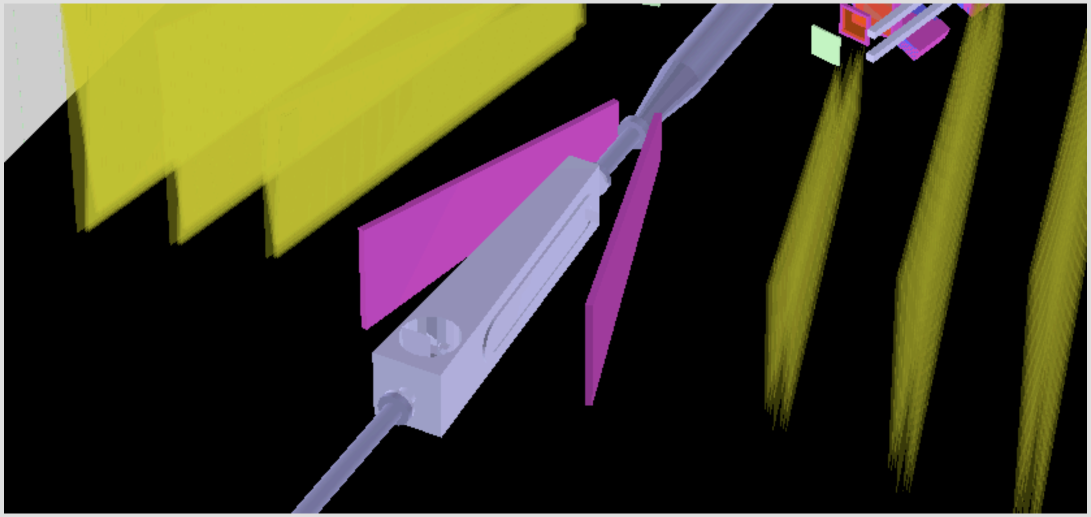


A Sample Event



Tracking Upgrade

- A pair of GEM detectors between the target and the drift chambers



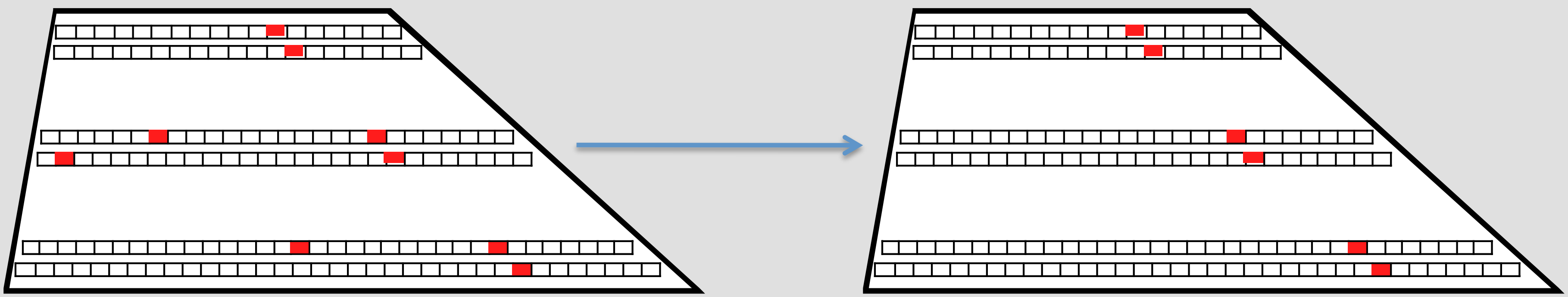
- Construction and testing ongoing @ MIT
- Installation this summer @ DESY

Tracking Software

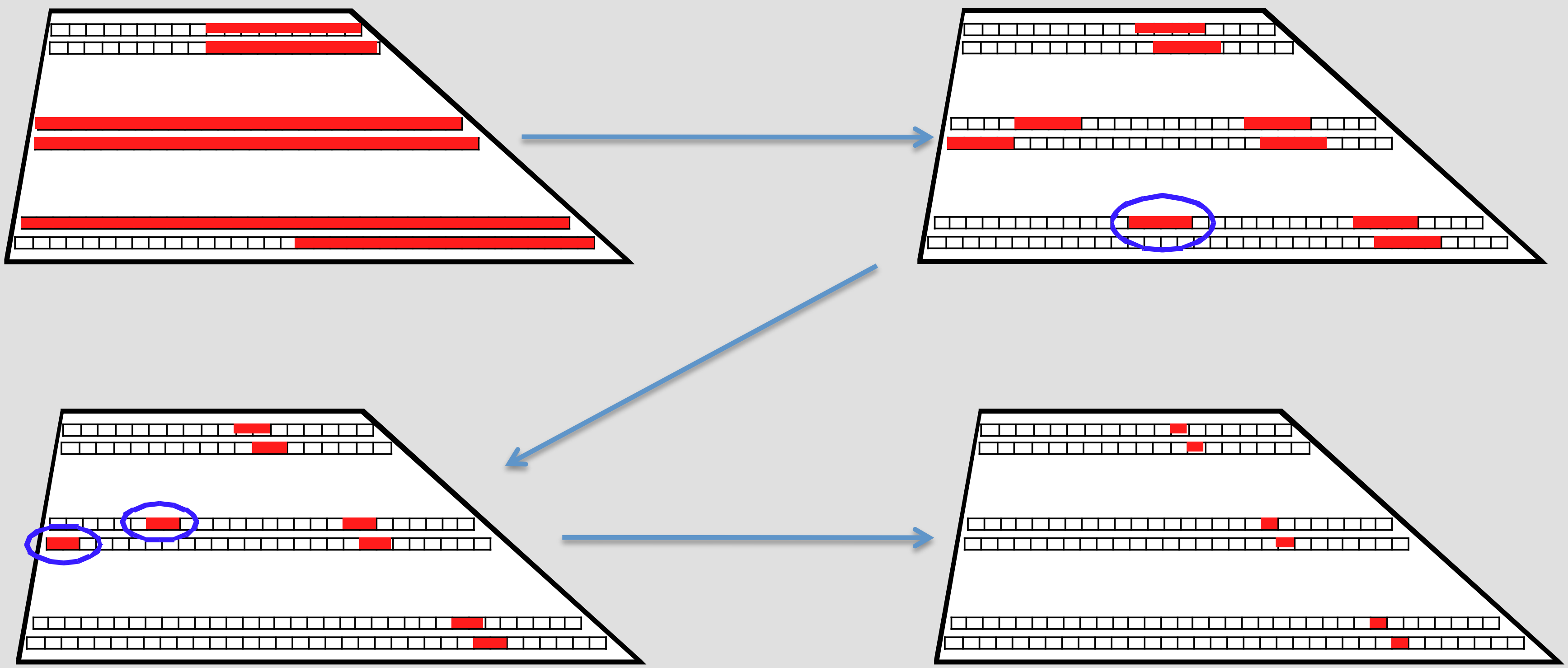
- Areas of Development
  - Feeding spatial “Hits” to a minimization program
  - Data clean-up using pattern-matching
    - Patterns from Monte Carlo
    - Tree-search
    - Remove noise
    - Reduce combinatorics
  - Track fitting at the TDC level

Benefits of Pattern-Matching

- Removes noise and spurious hits
- Tree search is fast
- Can give an estimate of initial parameters



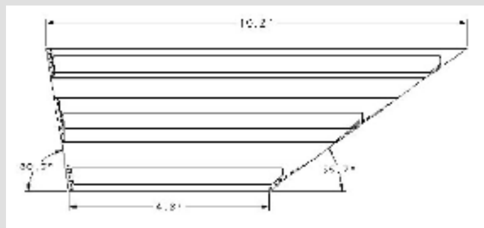
Tree Search

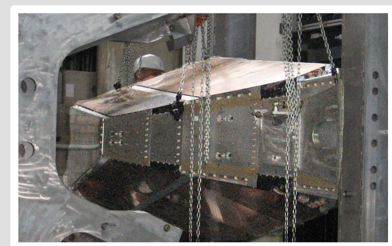


M. Dell'orso, L. Ristori, A Highly Parallel Algorithm for Track Finding,
Nucl. Inst. Meth. A **287**, (1990) 436-338

Summary

- Main tracking detectors: drift chambers





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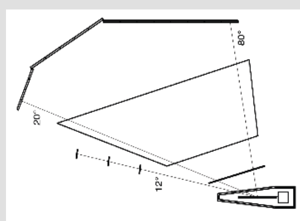

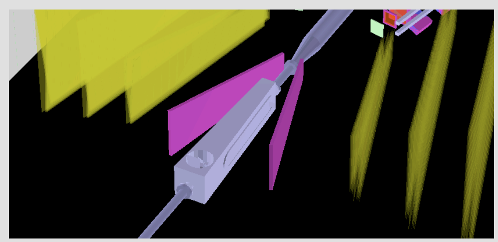

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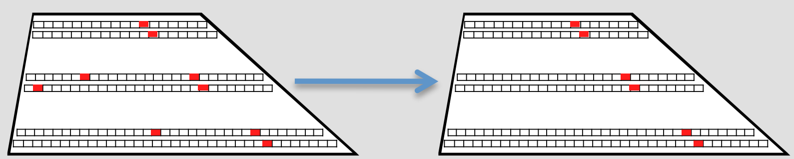


Acknowledgements

- OLYMPUS Collaboration

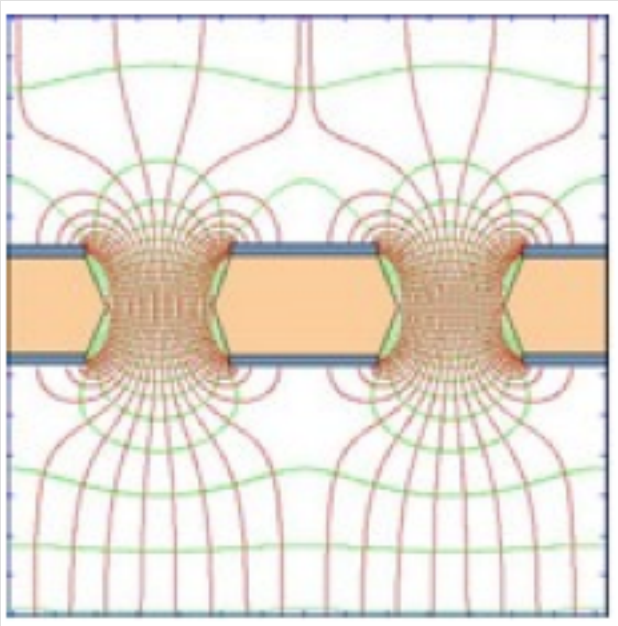
  Arizona State University
  DESY
  INFN Bari
  INFN Ferrara
  INFN Rome
  Hampton University
  MIT
  St. Petersburg Nuclear Physics Institute
  University of Bonn
  University of Glasgow
  University of Mainz
  University of New Hampshire
  Yerevan Physics Institute

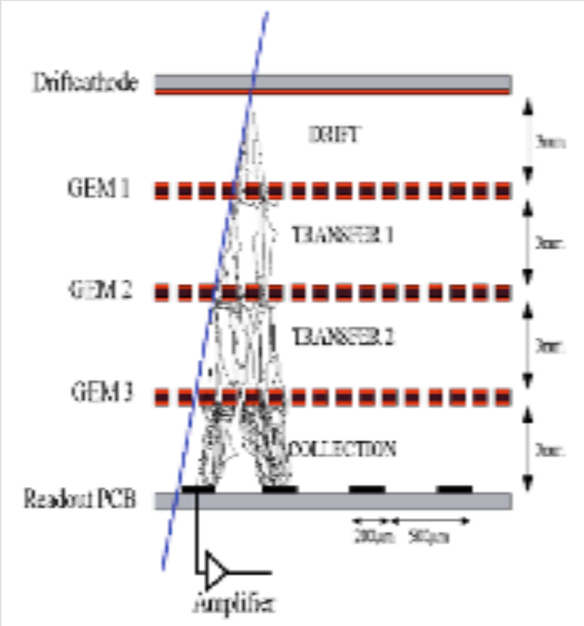
- DESY
- US DOE Office of Nuclear Physics
- National Science Foundation
- Deutsche Forschungsgemeinschaft

Bonus Slides

GEM Detectors

- Electric Field is concentrated within holes.
- Each GEM layer amplifies the number of ionization electrons.
- Collection on 2D readout plane.





Drift Chamber Wires