Status of Focal Plane Polarimeter

E04-108 (GEp-III) & E04-019

Frank R. Wesselmann

Norfolk State University

Status of Focal Plane Polarimeter

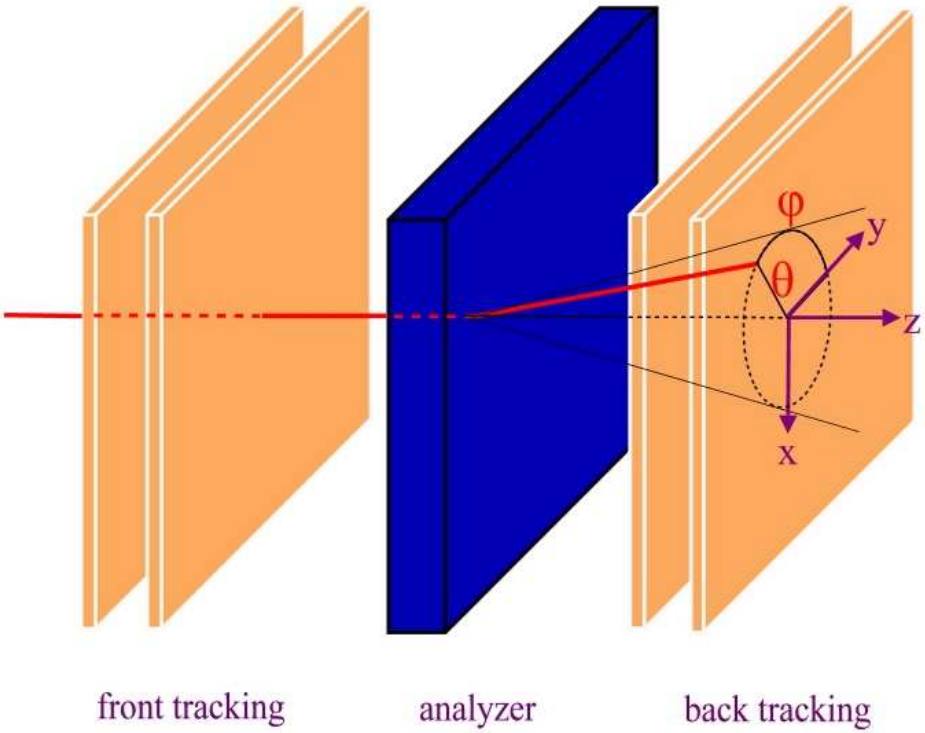
Outline:

- Overview & Introduction
- Hardware
  - *Assembly & Testing*
  - *Calibration & Studies*
- Software
  - *Custom Tracking*
  - *Integration into HMS Replay*
- Plans
  - *Installation*
- Summary

Overview

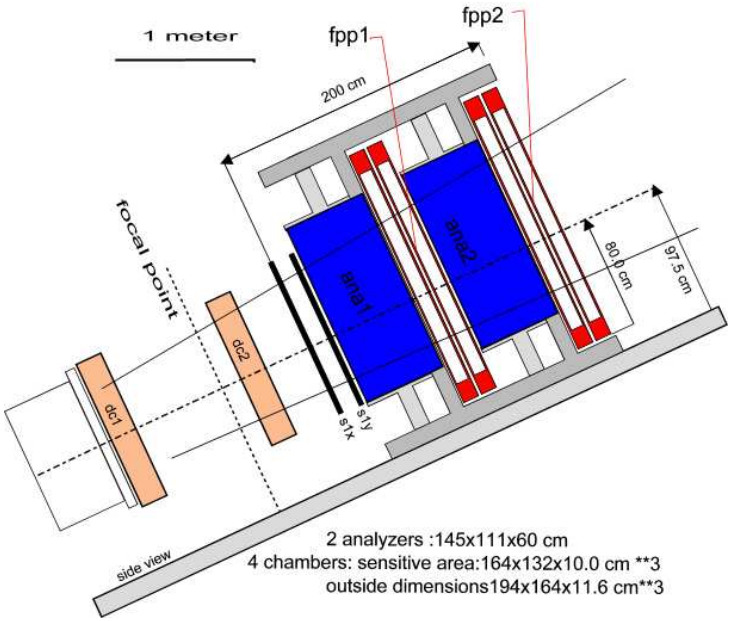
Focal Plane Polarimeter:

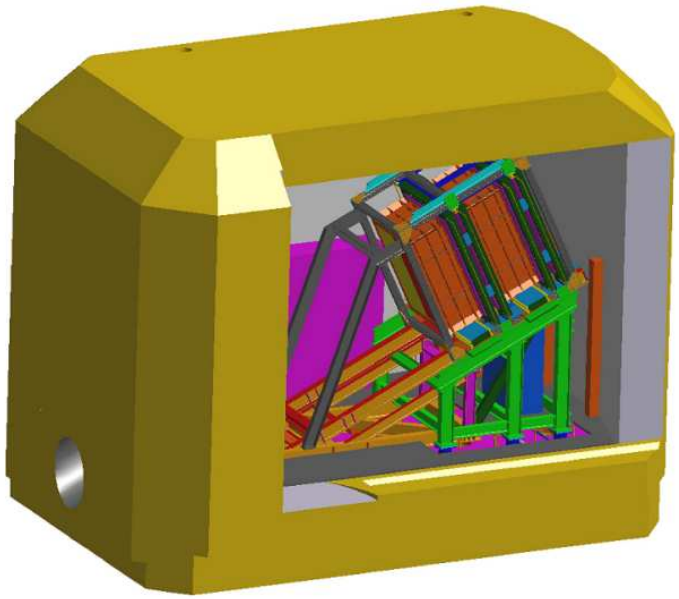
- Installed in HMS, Instead of Cerenkov
- Measures Proton Polarization



- Coincidence with Electrons in BigCal

HMS FPP – Overview



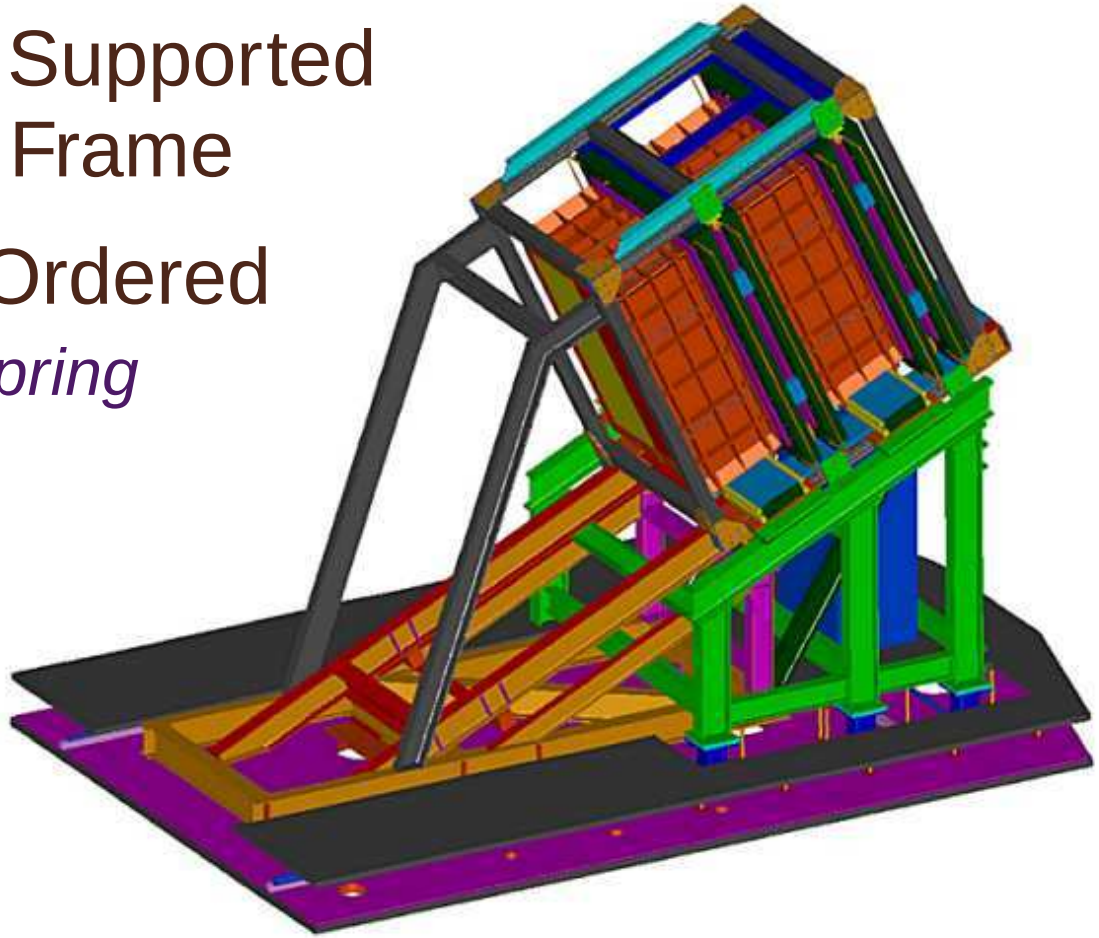


- Active Area: 166 cm (V) $\times$ 132 cm (H)
- Two Successive Polarimeters:
  CH_2 Analyzer & two 3-Layer Drift Chambers *Each*
  - *maximizes analyzing & detection efficiency*
- Requires 3x Distinct Tracking
  - *1x per polarimeter + standard HMS tracking*

HMS FPP – Hardware

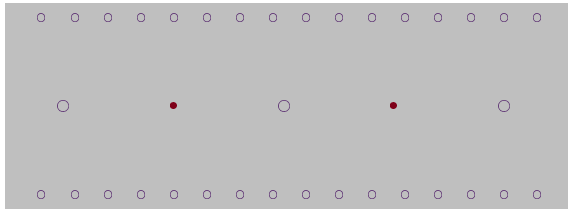
Analyzers:

- 55 cm Thick, Layered, Split L/R
  - *opens like collimator for straight-through tracking*
- Independently Supported on Interleaved Frame
- CH_2 & Frame Ordered
  - *expected this spring*



HMS FPP – Hardware

Drift Chambers

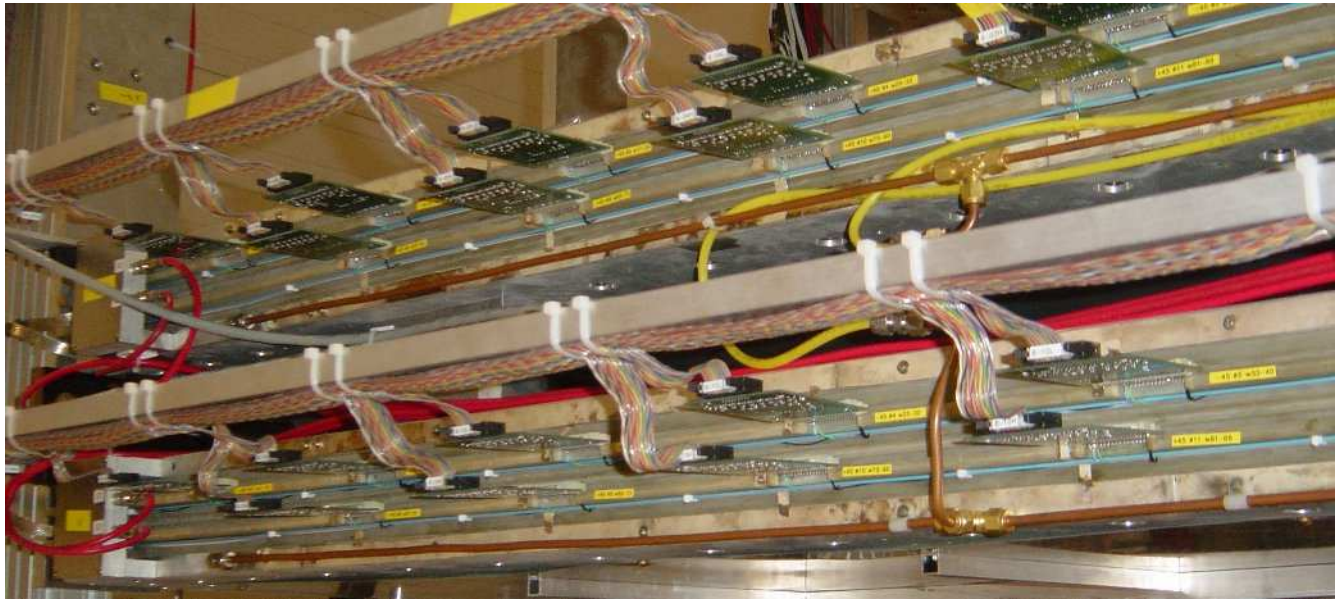


- Measure Coords u, x, v
- Drift Cells: 2 cm (in-plane) $\times$ 1.6 cm (out-of-plane)
- Target Resolution: $< 200\,\mu\mathrm{m}$ (~ 1 mr)
- Chamber Gas: 50/50 Mix of Argon/Ethane
- 4 + 1 Chambers Built by Dubna
- Chambers On Site, Tested
  - *4 of 1164 wires bad, one chamber inverted stacking order*
- Support Frame On Site,
  Special Installation Pieces Ordered

HMS FPP – Hardware

Drift Chambers (continued)

- Chambers Assembled & Installed in Frame



- Resolution & HV Studies in Final Phase

  $\longrightarrow$ software section

HMS FPP – Hardware

Custom Trigger Hardware

- Cannot Use HMS S2 Scintillators for Trigger
  - *after polarimeter*
- Need Custom S0 Scintillators
  - *S1 single rate too high*
- Installed Next to HMS DC1
  - *maximum available distance from S1*
- Scintillator Assembly Constructed by Eliezer Piasetzky (Tel Aviv U.)
  - *60 cm (H) $\times$ 30 cm (V)*
  - *2 paddles, tube on both ends*
- Expected On-Site This Month

HMS FPP – Software

Need Tracking for FPP DCs Integrated Into:

- HMS Part of Hall C Replay Engine
- Simple Replay for Hardware Testing

Tracking Requirements for FPP DCs:

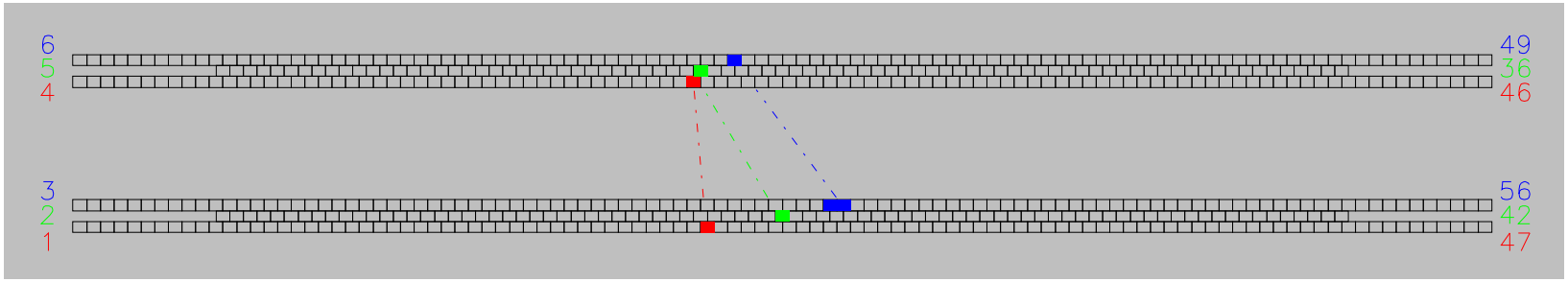
- 2x Independent Tracking
  - *polarization info from comparison to HMS track*
- FPP DCs Few Layers, Closely Spaced
  - *No inherent restriction on possible hit wire combos*

$\longrightarrow$ Potential to Re-Use HMS Tracking Code?

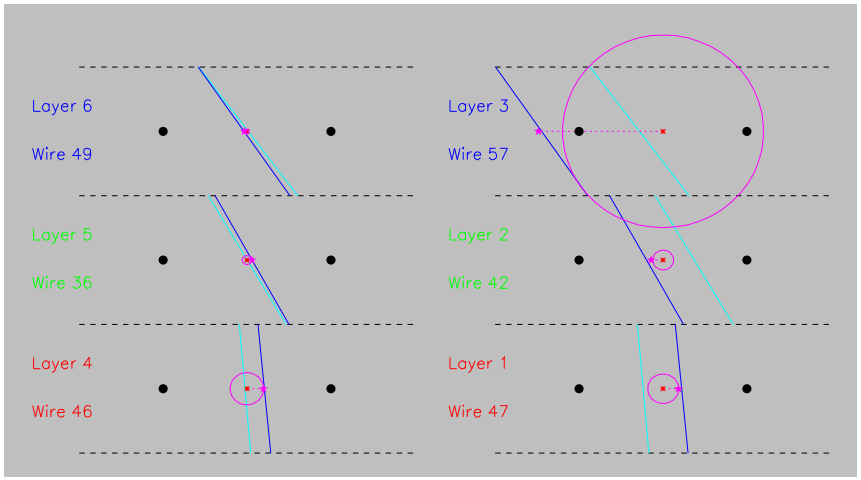
HMS FPP – Software

Custom Tracking for FPP DCs Using 2-Step Algorithm:

- Use Wire Positions *Only* to Select Hits
  - *test all possible hit combinations, pick best* $\chi^2/\mathrm{d.f.}$



- Consider Drift for Selected Hits for Final Track
  - *corrections to drift time based on simple track*



Software Status

Status of FPP Analysis Software:

- Custom Tracking Code Written & Tested
- Implemented Trigger & Drift Time Corrections, Drift Map
  - *signal propagation delays, geometry corrections*
- Current Results:
  - *resolution* $200 - 300\,\mu\mathrm{m}$
  - *efficiency* $> 99\%$ *(*~ 30 *Hz soft cosmics)*
- Early Version Integrated into Hall C Replay Engine

Software Status

Remaining Tasks for FPP Analysis Software:

- Improve Timing Parameters
  - *maximum resolution*
- Better Abstraction of Drift Map
  - *currently: look-up table* per wire
- Investigate Suitability of HMS Tracking
  - *established, less code to maintain*
- Update HMS-ported Custom Tracking in Engine
  - *switch to latest engine version*

Plans

Winter/Spring 2006:

- Support from Chamber Builders in Dubna:
  - *Repair Chamber with 3 Bad Wires*
  - *Re-Stack Inverted Chamber*
- Finalize Drift Map and Corrections
- Find Best HV Values
- Switch DAQ from FastBus to VME

Spring/Summer 2006:

- Install Complete FPP into HMS
- Continue Testing after Installation
  - *requires HV, DAQ — new gas handling system?*

Summary

Focal Plane Polarimeter

- New HMS Detector
  - *reusable*
- Good Resolution, Efficiency
  - *as designed*
- Ready this Year
  - *Where's the Beam?*