Kinematic and Beam+Target Offsets

Dave Gaskell

XEM Collaboration Meeting

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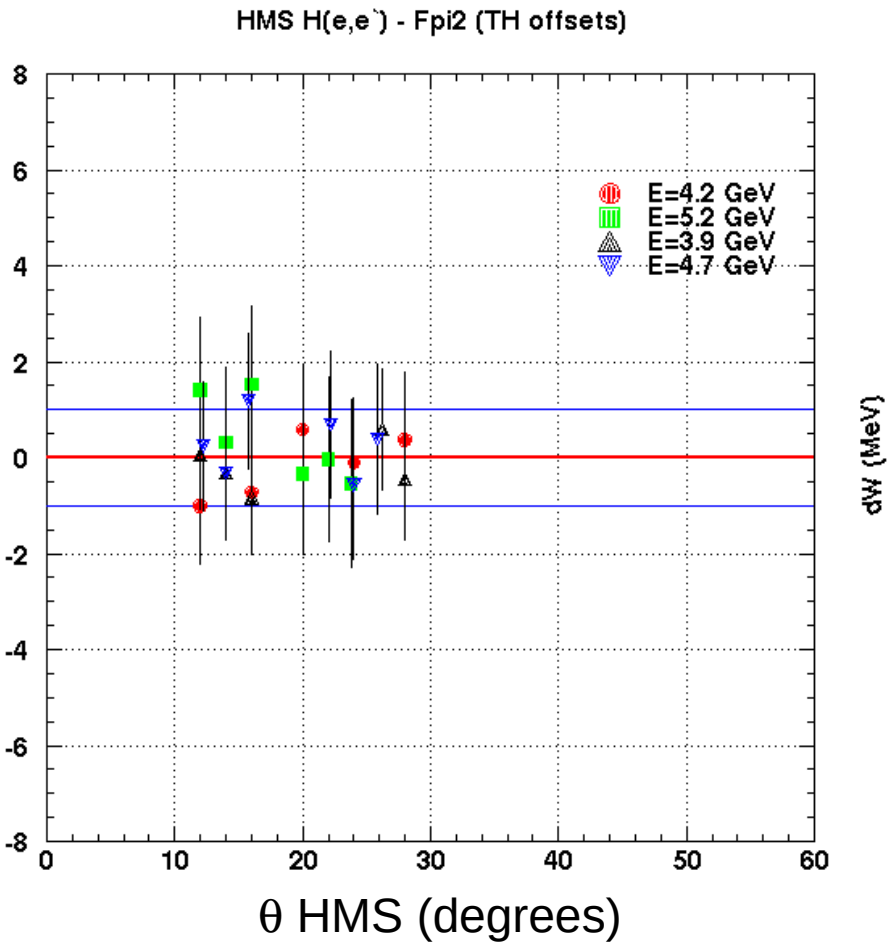
- Kinematic offsets
- Beam and target offsets

HMS Offsets from Elastic Singles

- Using a large body of elastic singles data, one can fit the angle and momentum offsets of the HMS
  - Assumes the beam energy is known
  - Can also allow the beam energy to float, but probably not needed these days (energy measurement good to a few x $10^{-4)}$
- Compare reconstructed W for elastic scattering to proton mass
- Things to look out for:
  - Optics effects – correlations in reconstructed of focal plane variables
  - Radiative effects
  - Energy loss
  - Vertical beam position -> mimic momentum offset

HMS offsets from Fpi-2

- Tanja Horn's analysis of HMS elastic singles from Fpi2
  - dP_{HMS} = -0.13%
  - $d\theta_{HMS}$=0 mrad
- Somewhat different from earlier analysis by Eric Christy
  - dP_{HMS} = -0.09%
  - $d\theta_{HMS}$=-0.6 mrad
- Eric's offsets gave strange results at very small HMS angles, but Eric's data sampled a much larger angular range at large energy



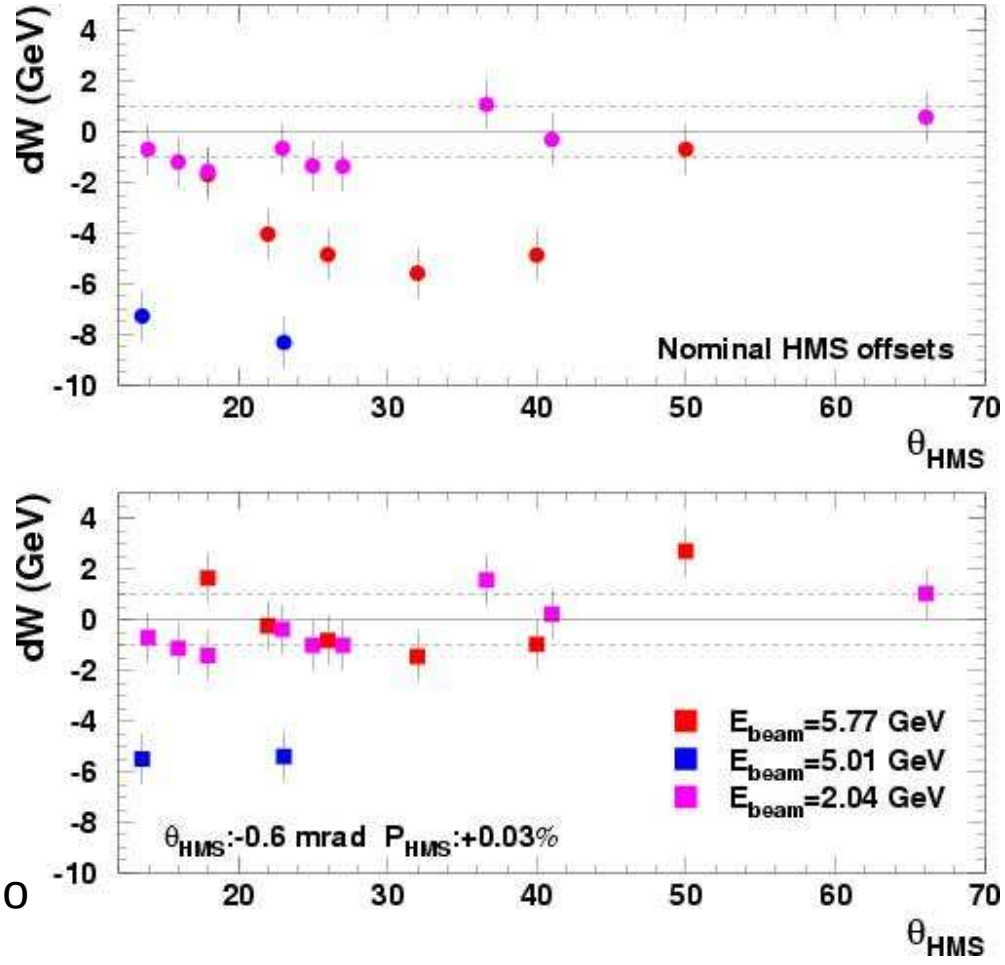
HMS offsets from XEM Data

• Fpi2 offsets work well for 2 GeV data, but not 5.77 GeV data

• Eric's offsets from '99 elastic analysis seem to work out better

•If I do a combined fit Of the 2 GeV and 5.77 GeV Data, I get ~-0.4 mrad

•Note the problem with the 5 GeV data. Logbook indicates dipole troubles – no angle written down.



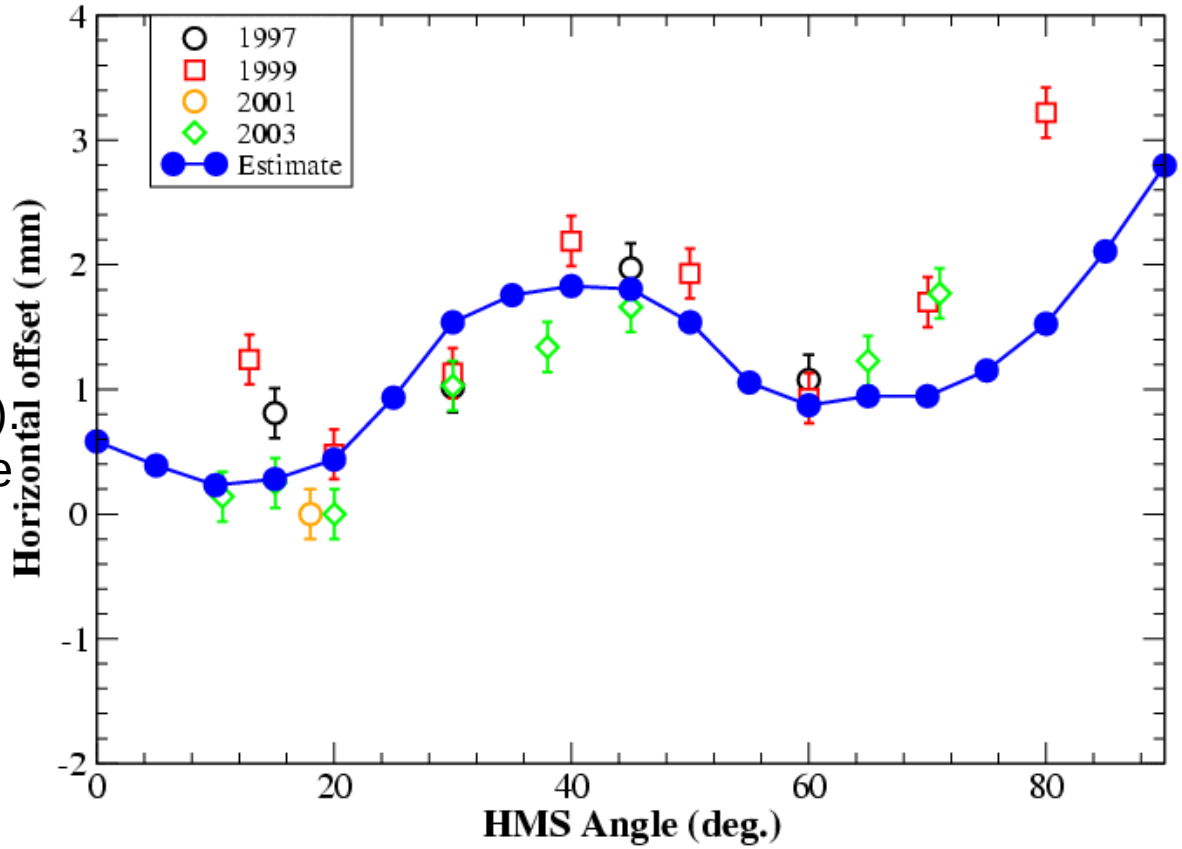
Beam and Target Positions

- Spectrometer ytar reconstruction can be used to figure out horizontal beam position and target z offset
- Ideally, would use simultaneous HMS/SOS data and project back to target and find intersection
- Most of our runs with data in the HMS and SOS at the same time have rather low SOS statistics
- Alternatively, if HMS spans large angular range, can use a family of projections to find position

Spectrometer Mispointing

•Need to correct extracted ytar for spectrometer mispointing

• The HMS points a little bit downstream (as you face the target). This results in a positive offset in hsytar

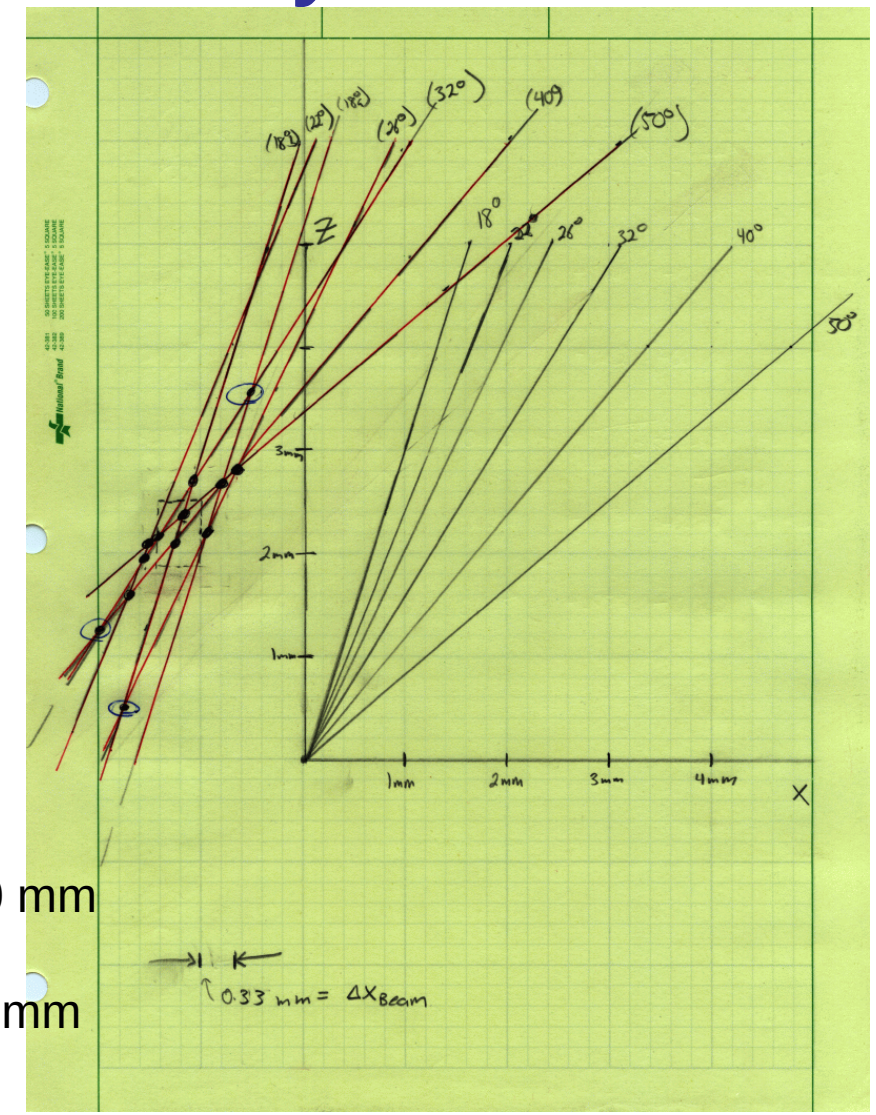


Beam and Target Position - the Fun Way

- Fit ytar position for z=0 “point” target
- Apply pointing offset
- Draw line parallel to spectrometer angle, offset by ytar
- Find where points intersect
- Note: did not correct for horizontal beam position (max dx = 0.33 mm)

dx = -1.20 mm

dz = 2.26 mm



Beam and Target Position – the Less Fun Way

- Use:

ytar = -x cos(θ) + z sin(θ)

ytar/cos(θ) = -x + z tan(θ)

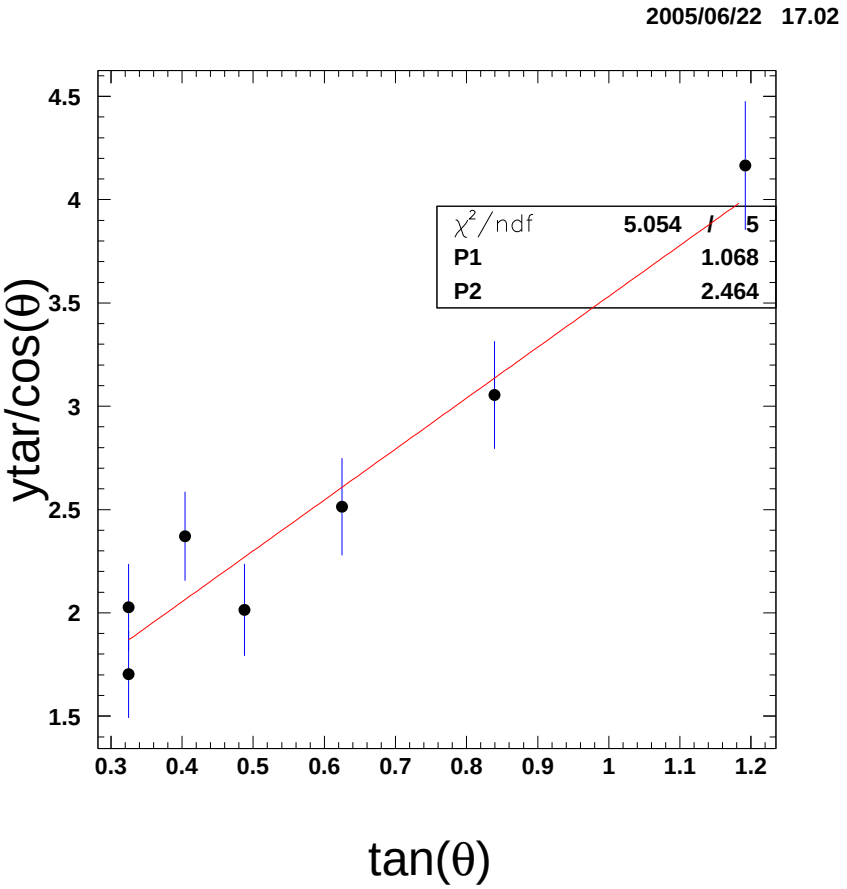
- Fitted offsets:

dx = -1.1 mm

-> this is relative to -0.18 mm using BPMs

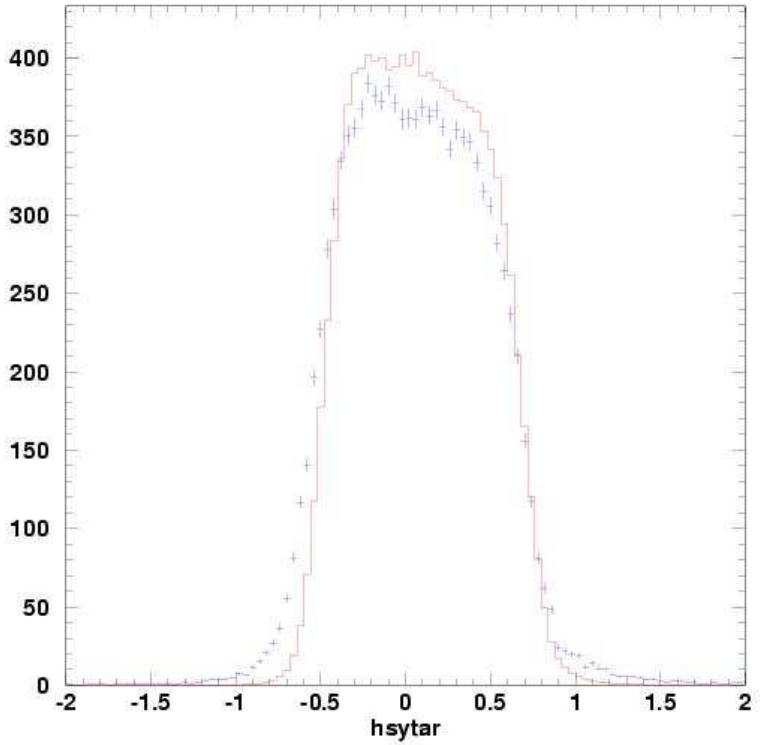
dz = 2.5 mm

- Data from H/D running consistent with data from He3/He4 running



Beam+Target Positions Compared to MC

- Ideally, after all that work, I should be able to put best fit beam and target positions in Monte Carlo and have perfect agreement
- Unfortunately – doesn't quite work
- BUT – cryotarget may not be centered at same z as solid target. Survey only gives position of upstream face of solid target holder – need more info from Meekins



Elastic data at 18 degrees

Vertical Beam Position

- Vertical beam position offset can, at first order, result in a momentum offset (0.077%/mm)
- To determine the correct vertical beam position, we use the HMS sieve slit
- Assuming the sieve slit central hole is centered on the HMS optical axis, xptar offset for trajectory through central hole is proportional to vertical offset

  xtar = xptar/(-1.73 mrad/mm)
- From run 50130 hsxptar=-0.2 mrad -> beam position = -0.12 mm (low in the lab)
- For this run, the BPMs read -0.43 mm, so BPM positions should by corrected by +0.31 mm to give correct vertical beam position

Summary

- Best values for HMS offsets:
  - dP=+0.03% (relative to -0.13% in ENGINE)
  - -0.4 mrad
- Beam and target offsets:
  - dx = -1.1 mm (relative to -0.18 mm on BPM)
  - dz = 2.5 mm
  - dy = 0 when BPM = -0.31 mm