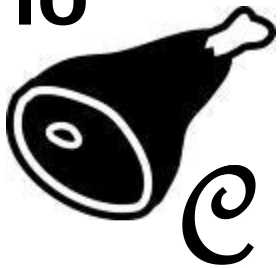
HAMC = Hall A Monte Carlo



Contributors: Dustin McNulty, Diancheng Wang

- **ROOT / C++ Design**
- **Somewhat like "SAMC" & "genercone"**
  A. Deur, V. Sulkosy — D. Lhuillier, K. Paschke, B. Moffit
- **For HRS only. Uses LeRose transfer functions.**
  or matrices, or "Guido" fcn.
- **Abstract classes: Experiment, Physics, Target**
- **Used by HAPPEX-3, PVDIS, and PREX.**

Applications of HAMC

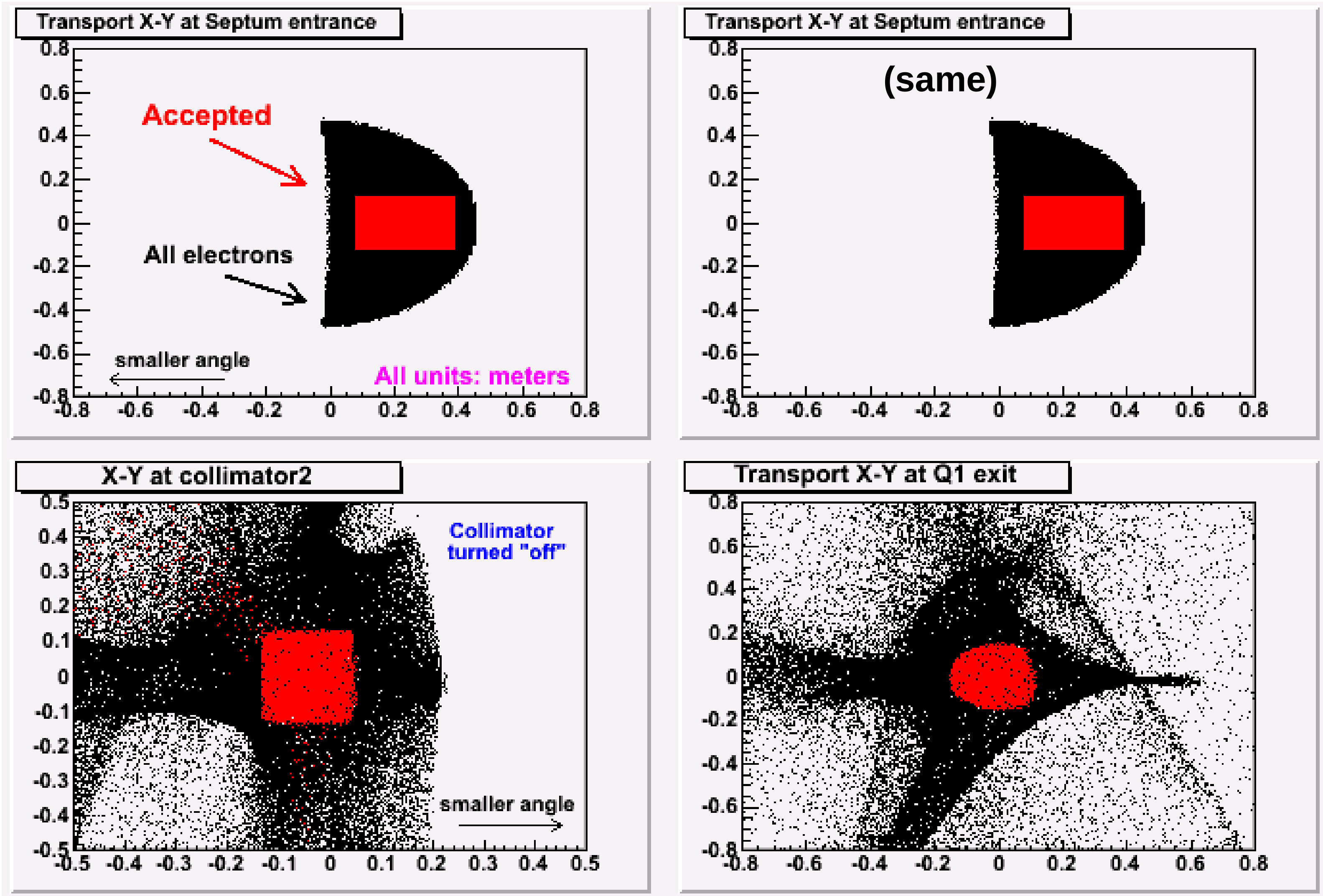
- Estimate Rates, Asymmetry, Sensitivity to Physics
- Design Collimator, Sieve, “A_T” detector.
- Design integrating detector & focus at detector
- Estimate sensitivities to beam parameters.
- Effects of radiative corrections, acceptance.

HAMC Events

Objects

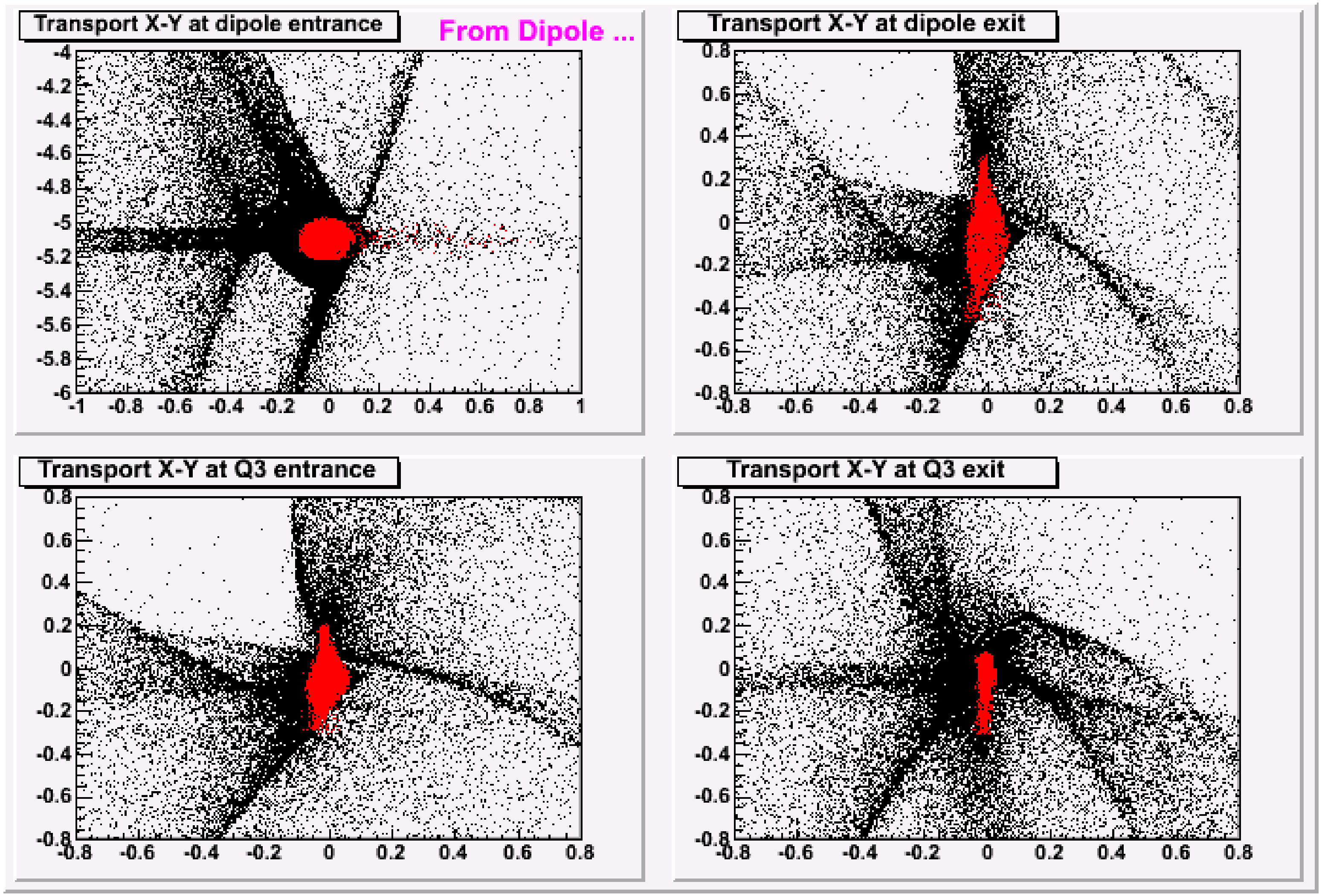
- Generate beam
- Target position uniformly sampled (raster option)
- Fill solid angle uniformly
- Cross-section computed for rates and weighting
- Asymmetry computed (for Parity Expts)
- Energy losses (Brehms and dE/dX) with MC methods
- Multiple Scattering
- Transport to various points in HRS and Septum
- Acceptance cuts applied at apertures
- Event Analysis on accepted events.

Transport Polynomials **from** John LeRose

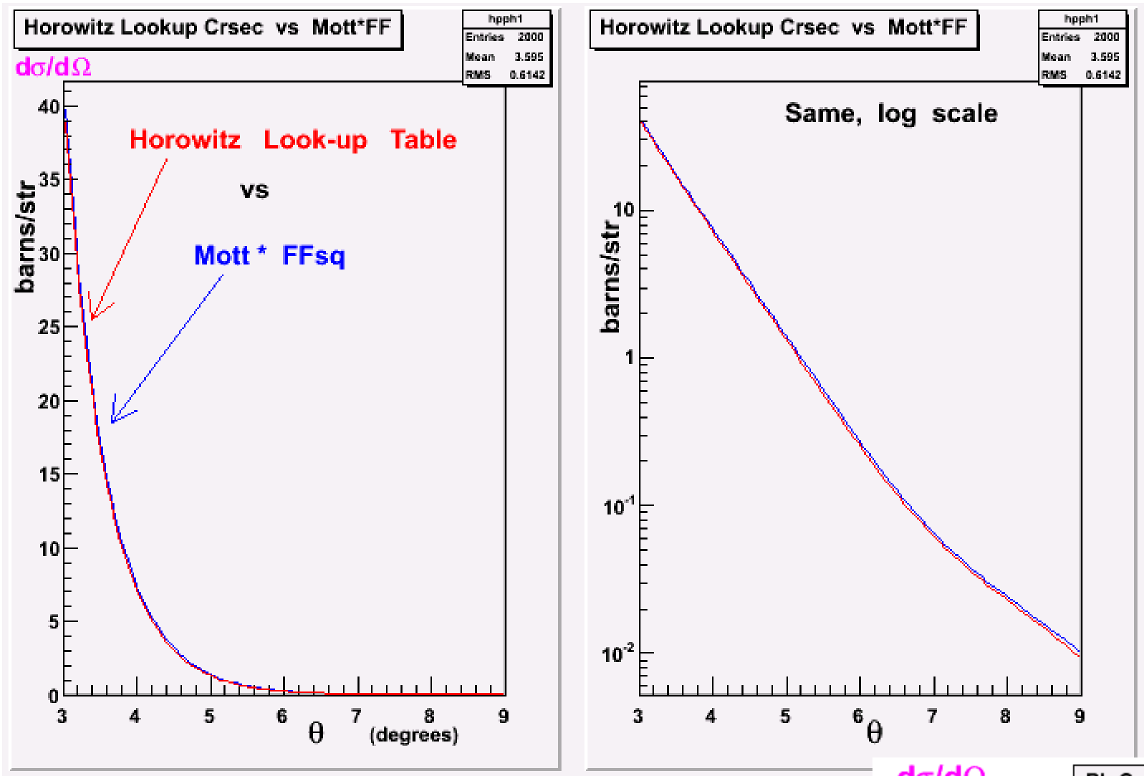


Transport Polynomials (part 2)

thanks, John LeRose

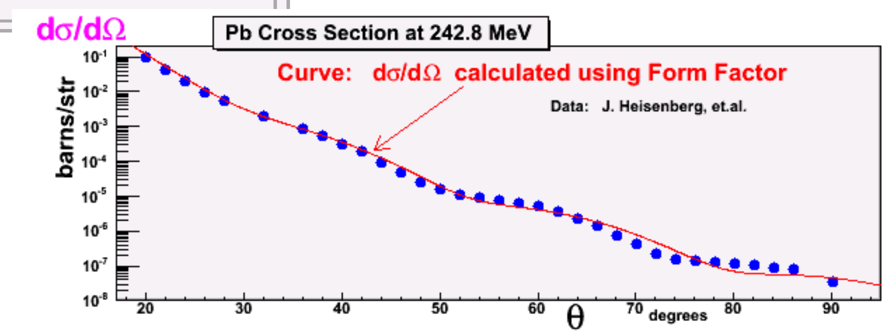


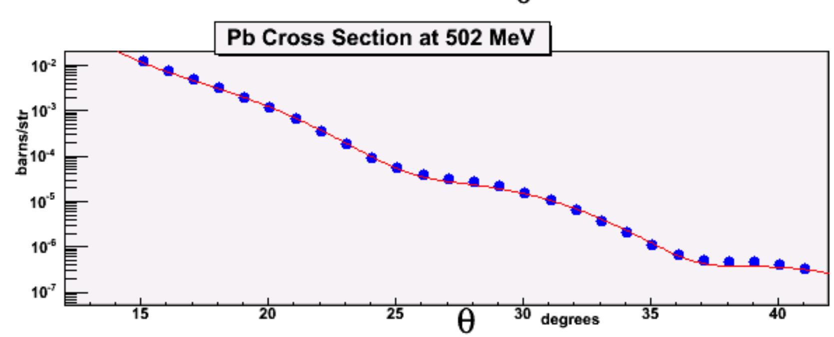
Was used to check where electrons scrape; e.g. not in iron of dipole ?



Cross Section Input

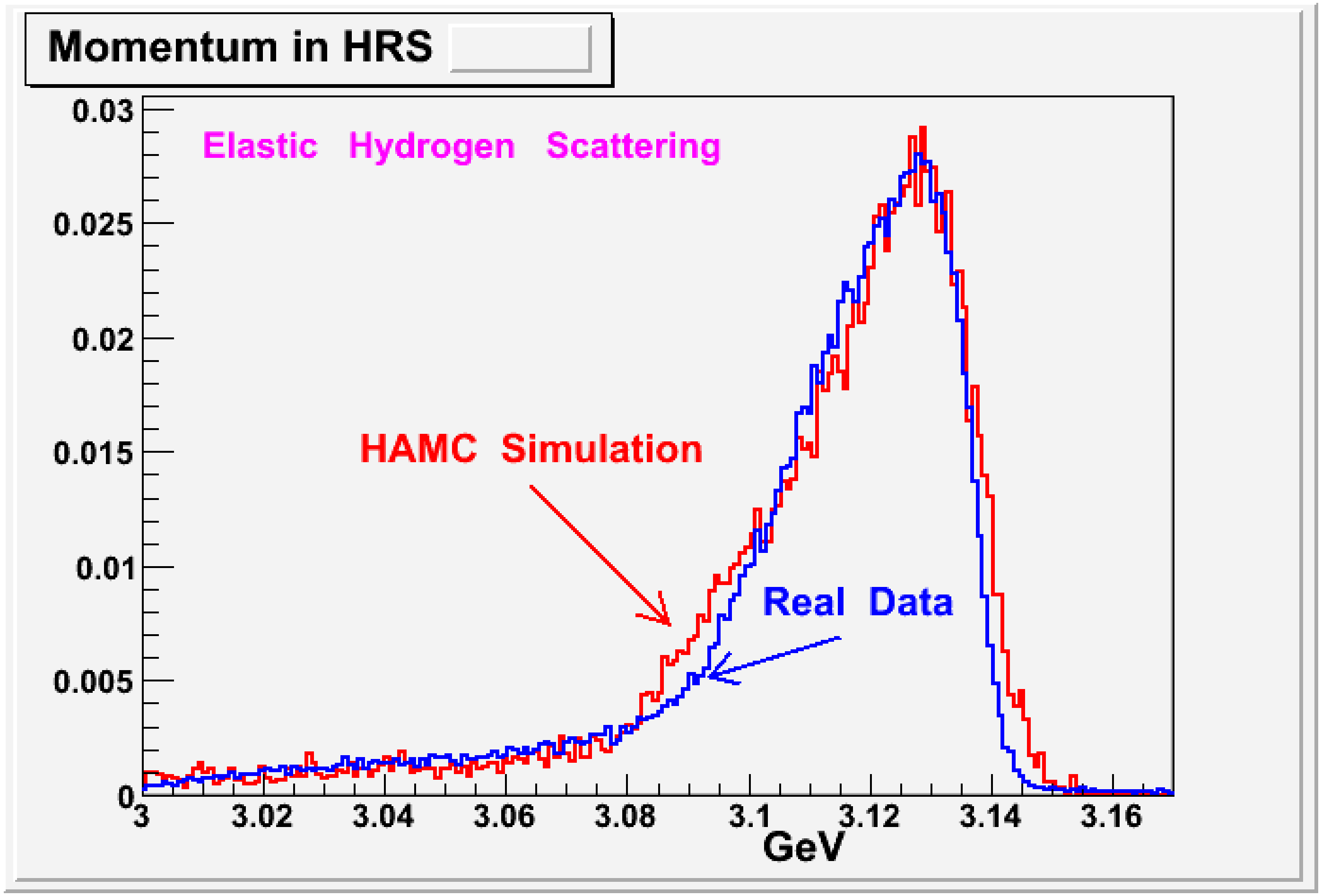
Shown here for Lead





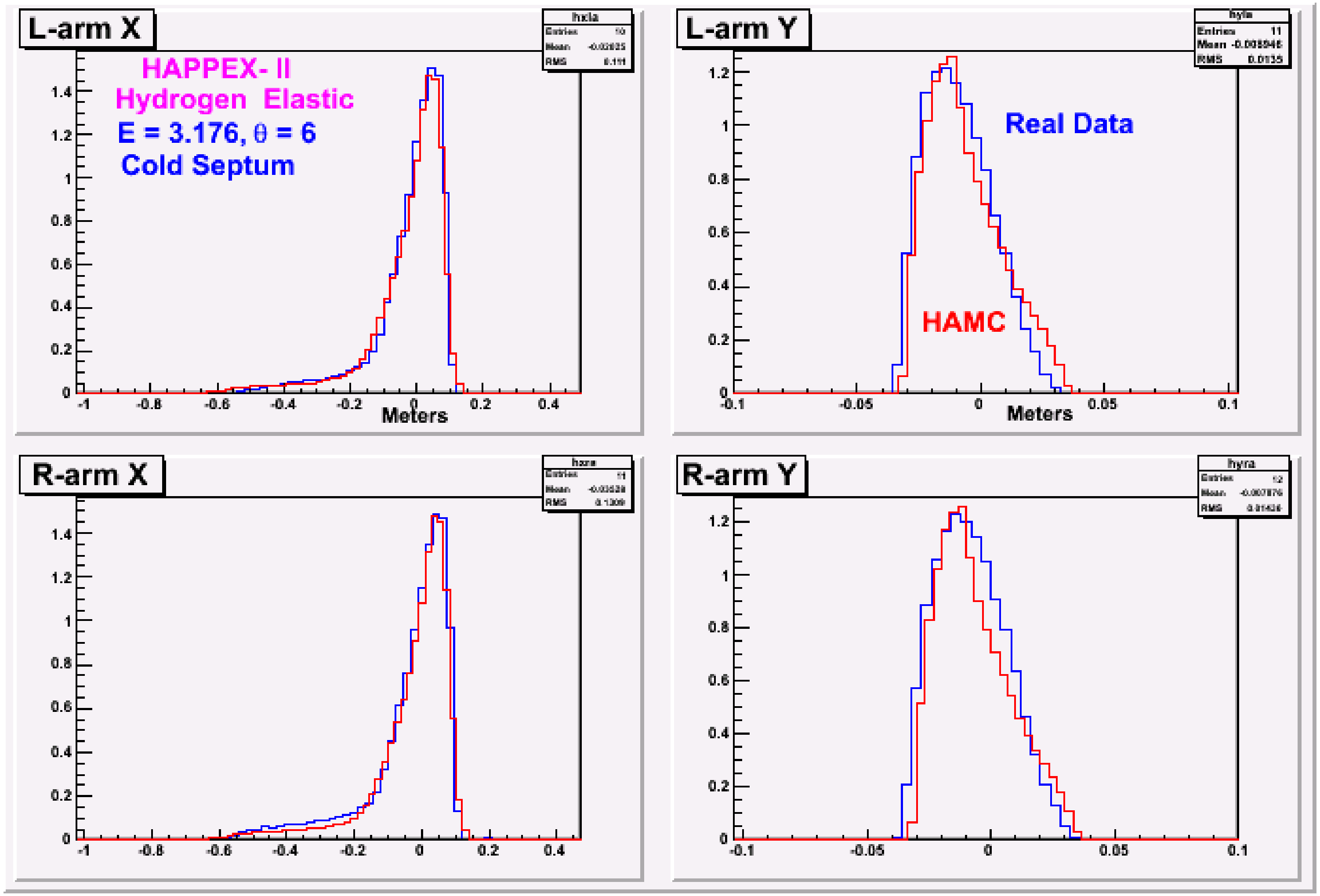
Does HAMC work ?

Yes, well enough for our goals.



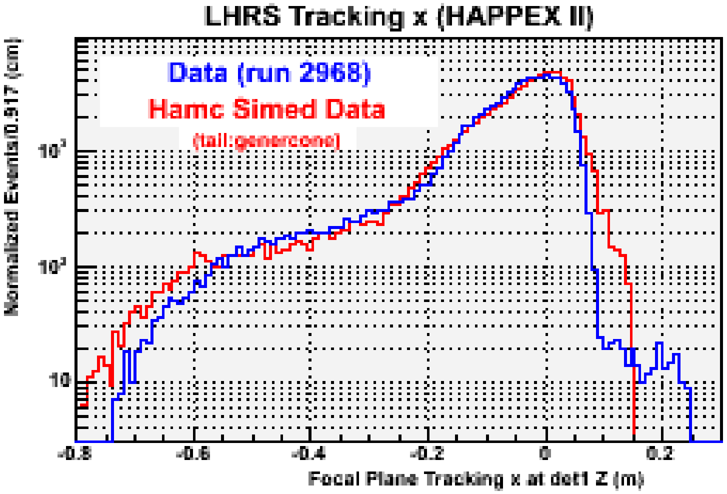
A problem: ***Radiative tail*** *out to high loss is underestimated.*
Use "effective target" size to adjust (reduce) predicted rates.

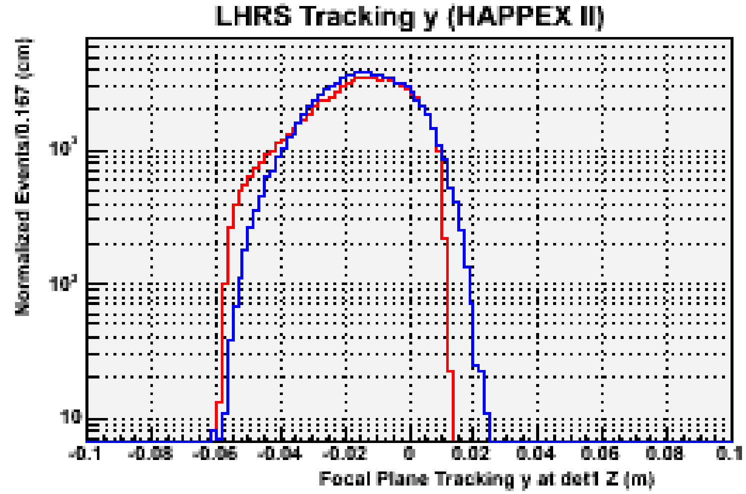
Comparing HAMC to Real Data

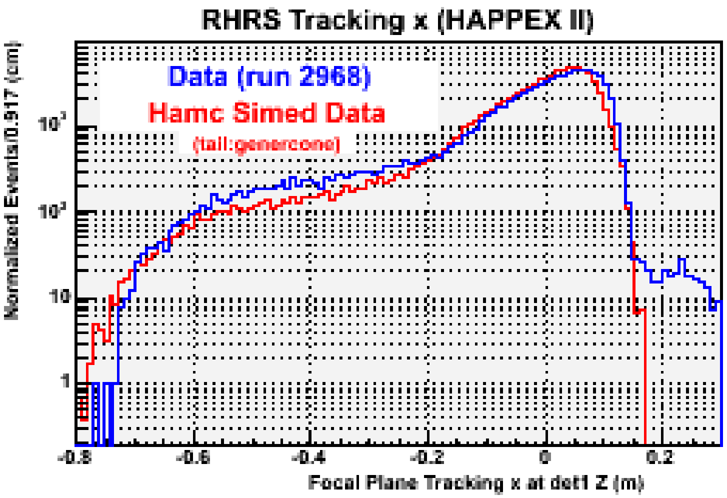


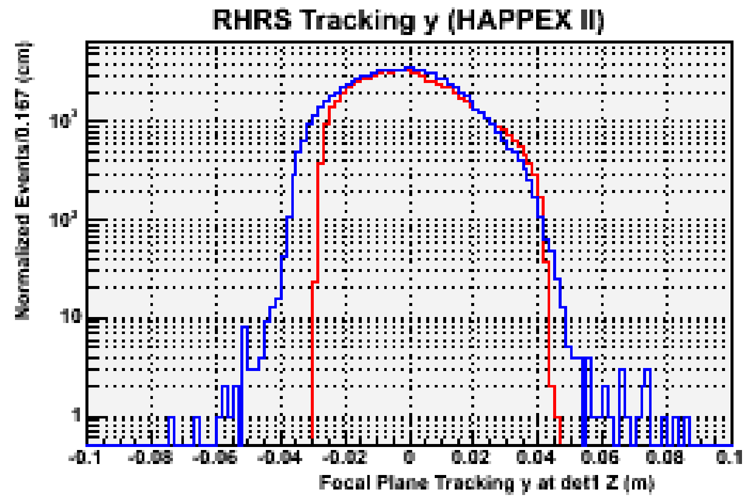
This was done for HAPPEX-1, HAPPEX-2, and a Lead test run

More Comparisons …



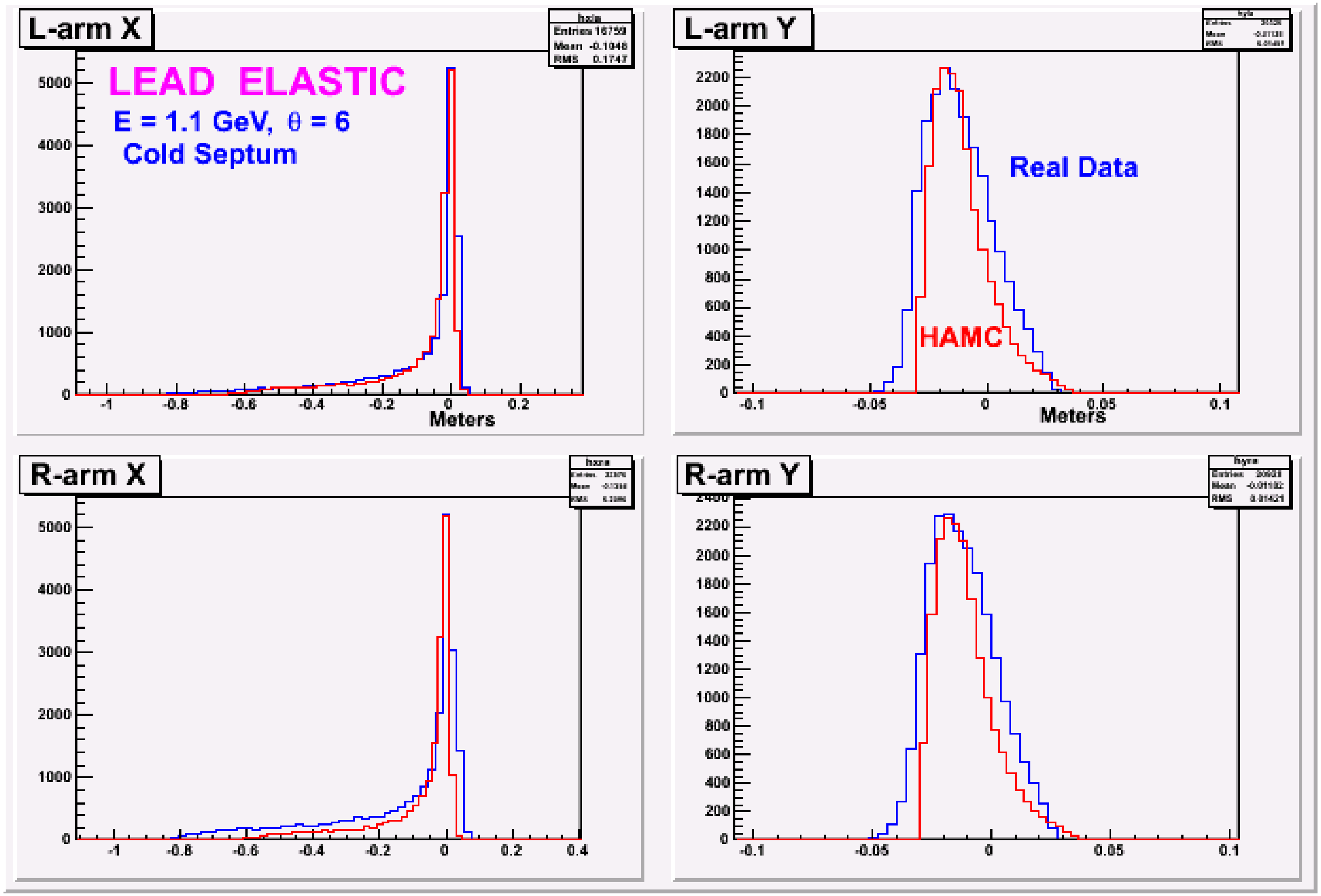




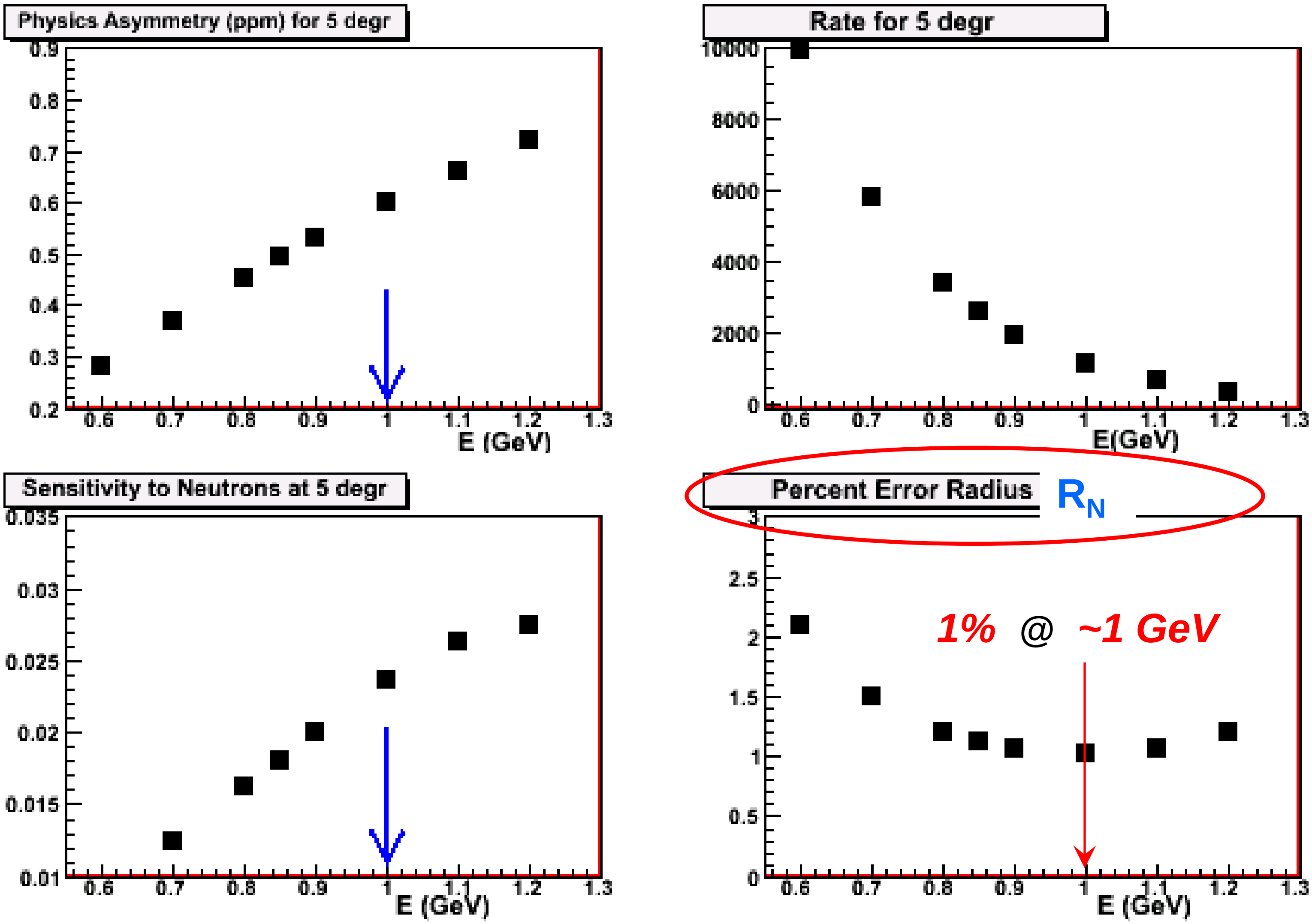


A Lead Test run in 2005

(using old septum magnet)



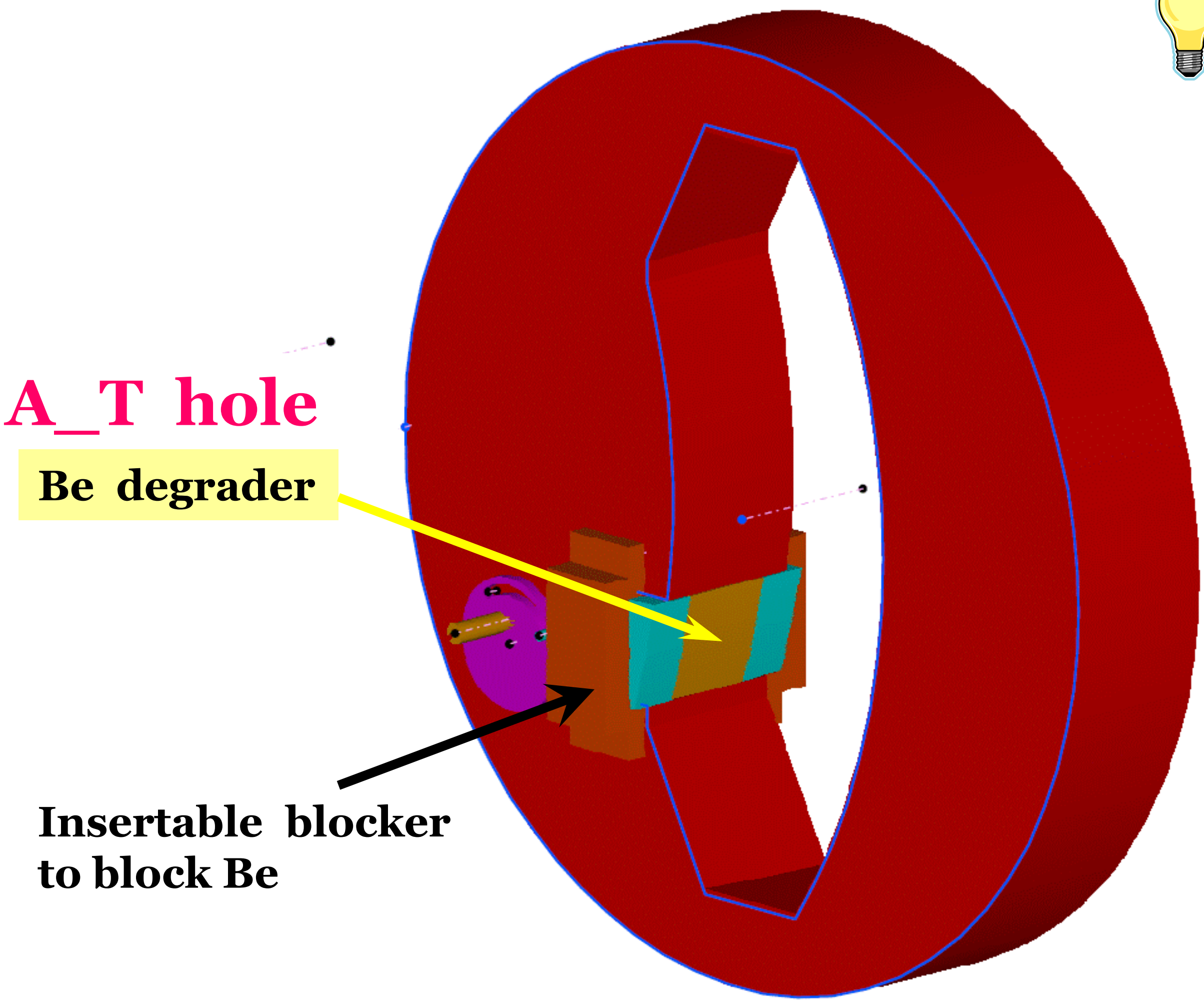
PREX Design : At 5^0 the Optimal FOM is at 1.05 GeV (+/- 0.05)



Collimator at entrance to spectrometer

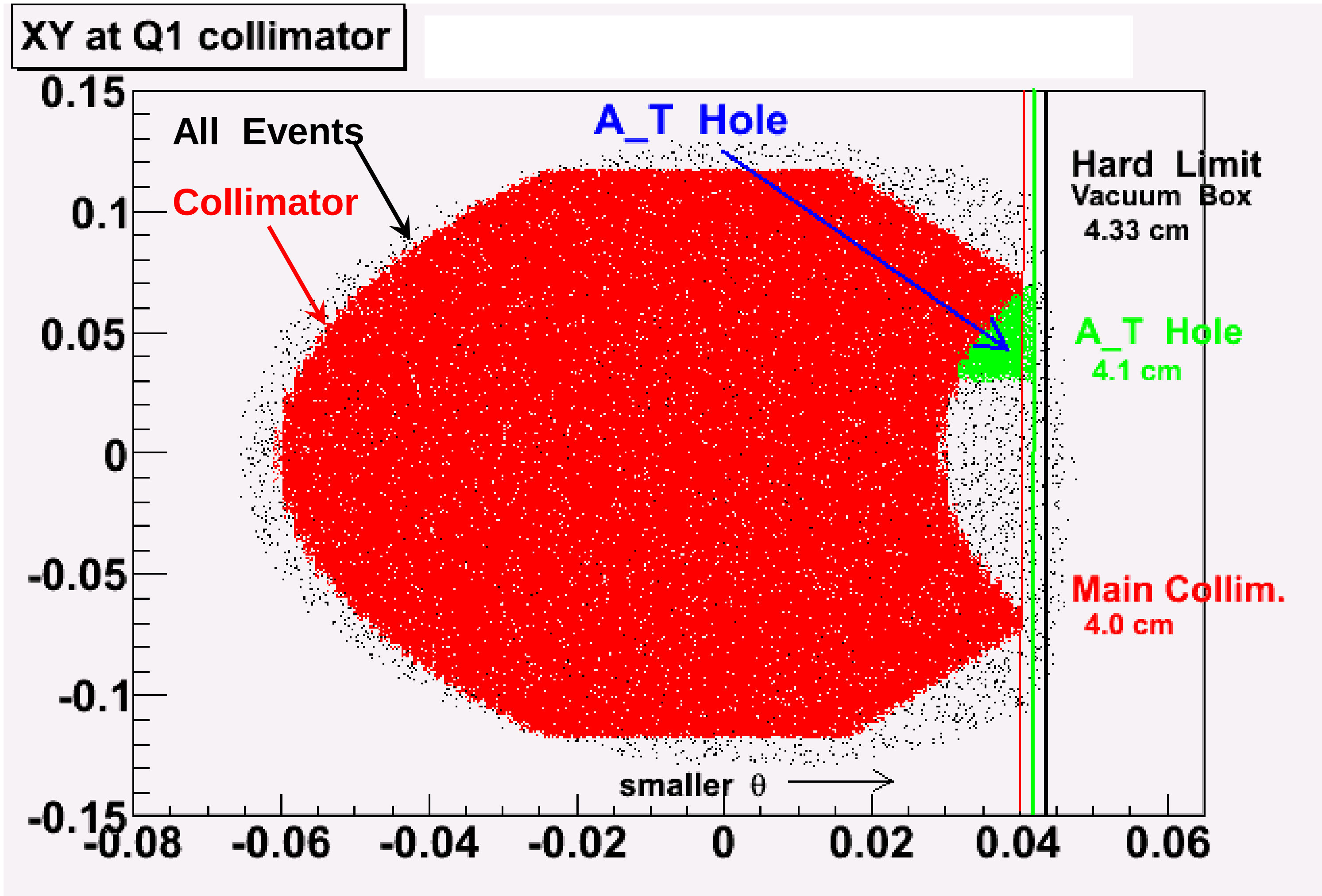
→ Suppressing A_T systematics

Paul Souder



Aligned in spectrometers to define identical Left / Right scattering angles as well as good up / down symmetry

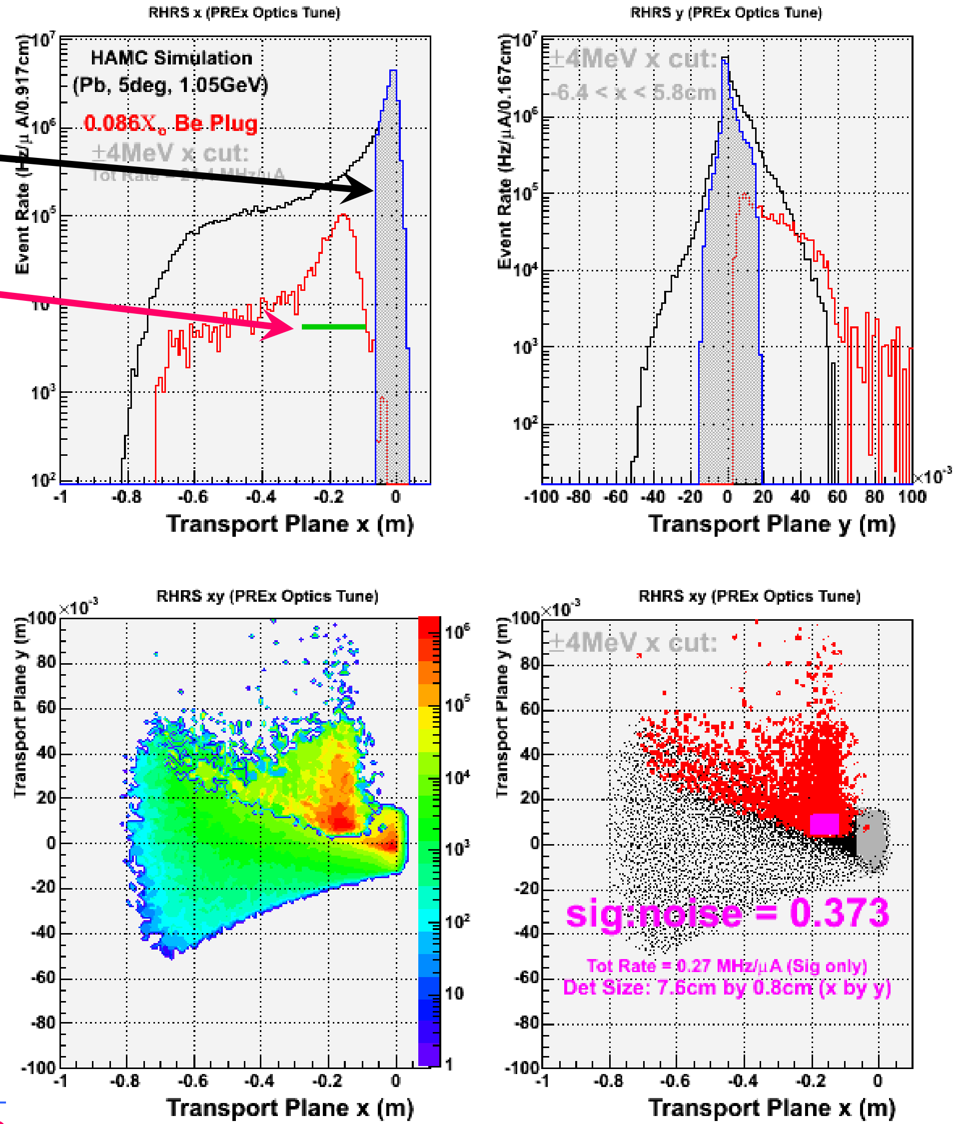
HAMC Design of Collimator



Events from A_T hole (Be plug)

Main detector

A_T detector



Measures horizontal A_T systematic.

(Vertical is measured from Left/Right spectrometers)

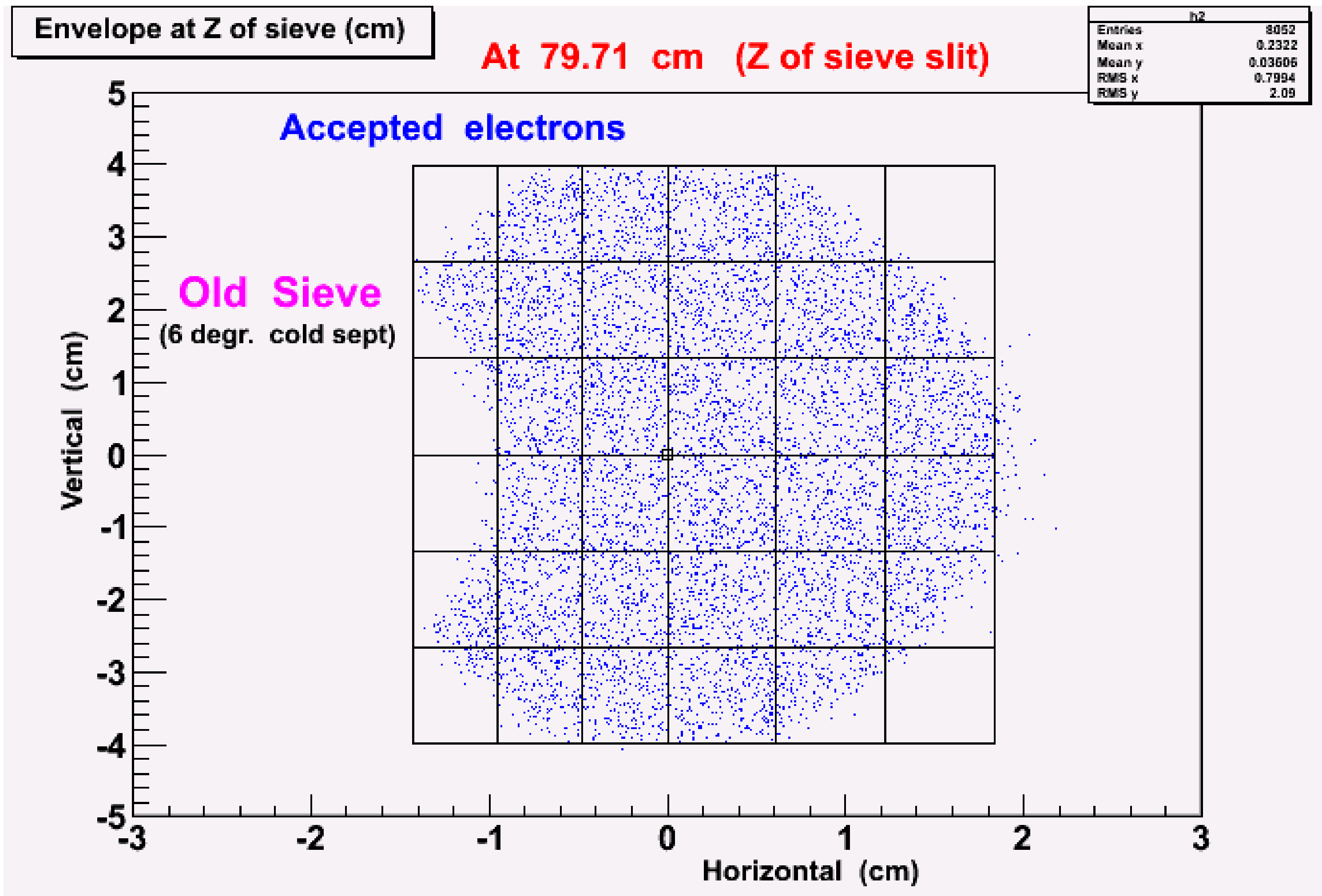
Thanks:

Dustin McNulty

Krishna Kumar

Paul Souder

Sieve Slit Design

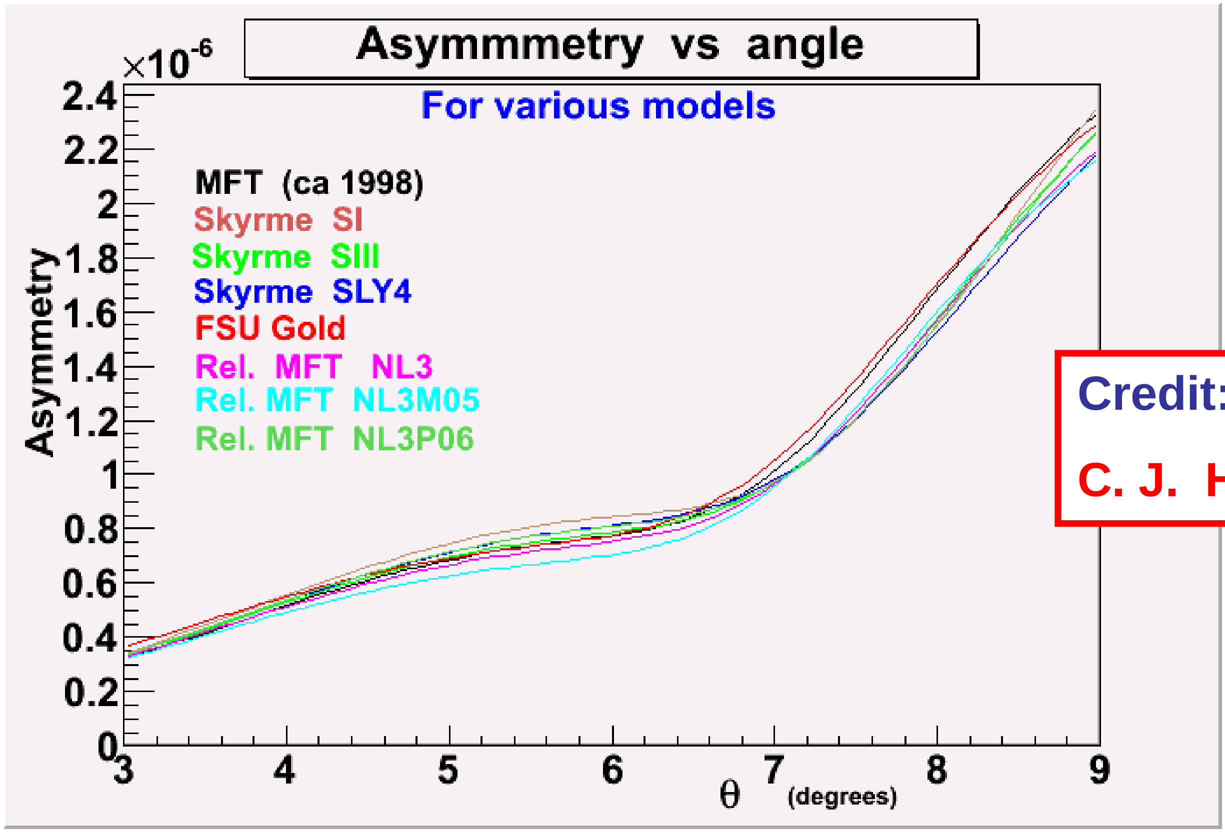


Few more holes drilled to improve coverage and accuracy.

Analysis for Workshops and Future Publication

$$< A >_{measured} = \frac{\int d\Omega \, \frac{d\sigma}{d\Omega} \, \varepsilon(\theta,\phi) \, A_{physics}}{\int d\Omega \, \frac{d\sigma}{d\Omega} \, \varepsilon(\theta,\phi)}$$

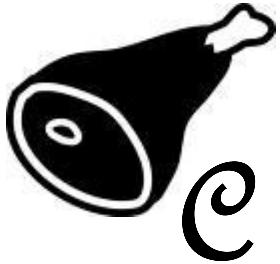
$\varepsilon(\theta,\phi) =$ **Acceptance Function**



Credit:

C. J. Horowitz

Conclusions re: HAMC



The GOOD

- Reproduces data -- well enough.
- Has aided in several estimates and design efforts.

The BAD

- Underestimates radiative losses -- maybe another MC better ?
- Restricted to HRS and single-arm at the moment.
- Might be easy to make a coincidence base class.