BNL efforts towards physics and detector simulations for the EIC

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Infrastructure "prospects" at BNL

- Currently …
  - ➡ My MacBook Pro plus 1 linux box in Thomas' office, BUT
- Negotiated (and agreed) with RACF:
  - ➡ 500 GB → 1 TB disk space
  - ➡ access to archival storage
  - ➡ need for about a dozen users
  - ➡ web-page hosting provision
  - ➡ access to the general batch queue
  - ➡ CVS/subversion capabilities
- Coming soon ...

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Repository not just for e+A, planned to be "EIC repository" and used for e+p as well

Where we stood @ MIT - Brian

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e-A Event Generator

Some profound thoughts

- Yes, we need one. (when?)
- No, nothing suitable currently exists.
- Yes, writing and maintaining one will require substantial effort.
- No, we can't ask theorist(s) to sacrifice their career simply to provide us one.
  - And even if we did ask they w(sh)ould say no.
- Writing/assembling an e-A event generator will require experimental/theory partnership.

Where we stood @ MIT - Brian

Summary

- We will need an event generator for e-A that includes the most important physics.
- Such a generator doesn't exist.
- Experience at RHIC indicates that we cannot count on spontaneous generation of one.
- So, we have to be proactive and make it happen.
  - It's too big a job for 1 or 2 people.
  - We need a joint effort of experimentalists & theorists
  - It should be well thought out and well organized
  - It should use modern computing tools, libraries.
- While the above is going on use DPMJET

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➡ Earlier versions may work but don't use due to bugs

Other e+A generators?

- HIJING

  ➡ not currently possible

  - could do with some work (V. Topor-Pop) but this is not likely to happen in the near future

- Leif Lönnblad model

  ➡ Mueller Dipoles

  - http://www-rnc.lbl.gov/ISMD/talks/Aug5/1200_Lonnblad.pdf
  - generator currently in its early stages but is easily modifiable for e+A collisions
  - easy access to shadowing? (vary size of dipoles)

Our method so far

- PYTHIA

  ➡ run e+p collisions in default mode then run with wrapper (HIJET - see last talk by Ron Longacre)

  - v6.4 - FORTRAN code (now considered old)

  - v8.1 - latest PYTHIA version, (C++), but it does not support e+p collisions and won't do so in the foreseeable future

  - run with all the default PDFs (CTEQ, GRV) and with 3 different energies

    ★ 3+100 ($\sqrt{s}$=34 GeV/c), 10+100($\sqrt{s}$=63) 20+100($\sqrt{s}$=89)

- RAPGAP

  ➡ set up to run in the same way as PYTHIA

Diagnostic Plots (10^5 events)

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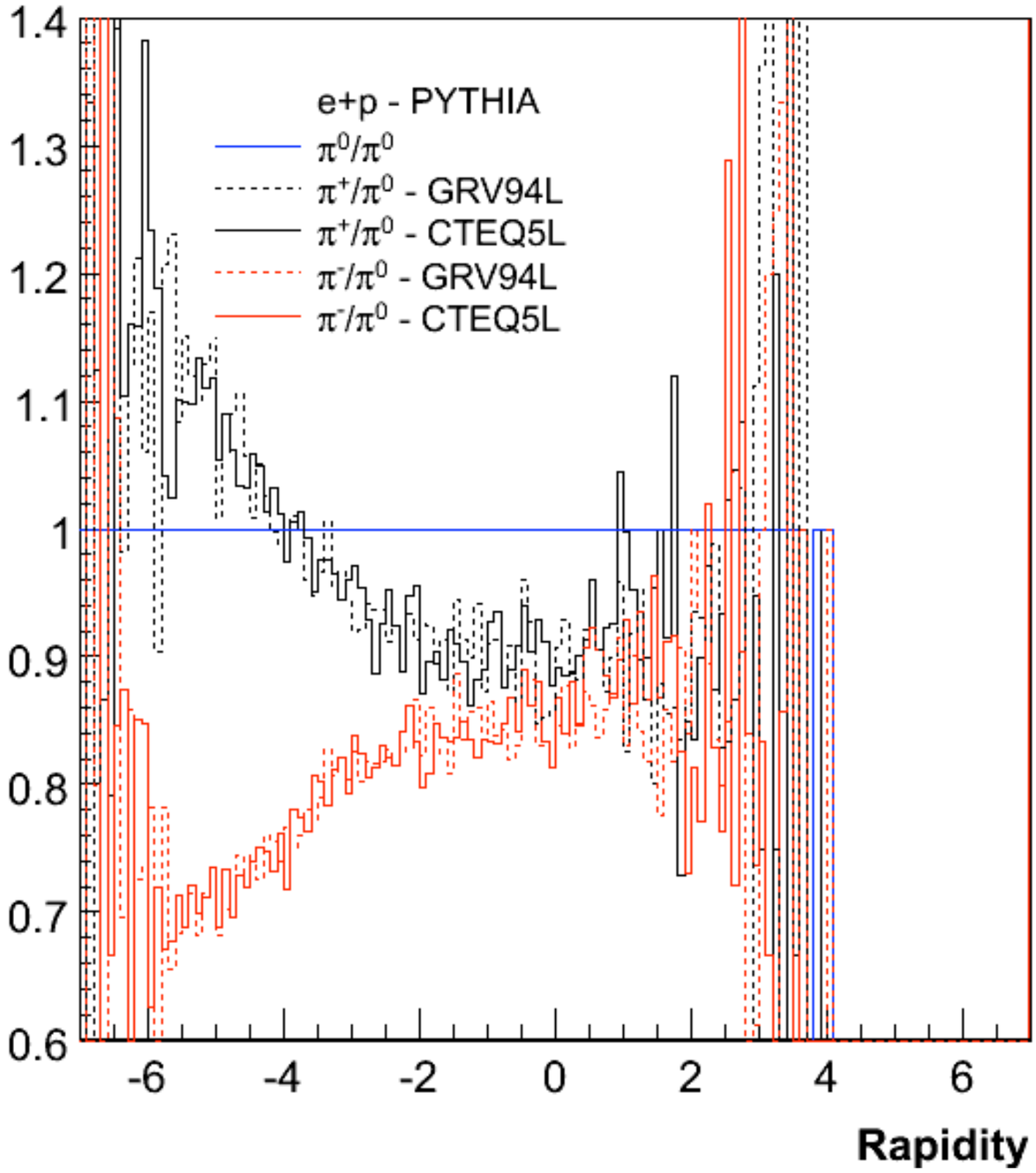
e(10)+p (100) GeV/c

also run e(3) and e(20) and see similar distributions



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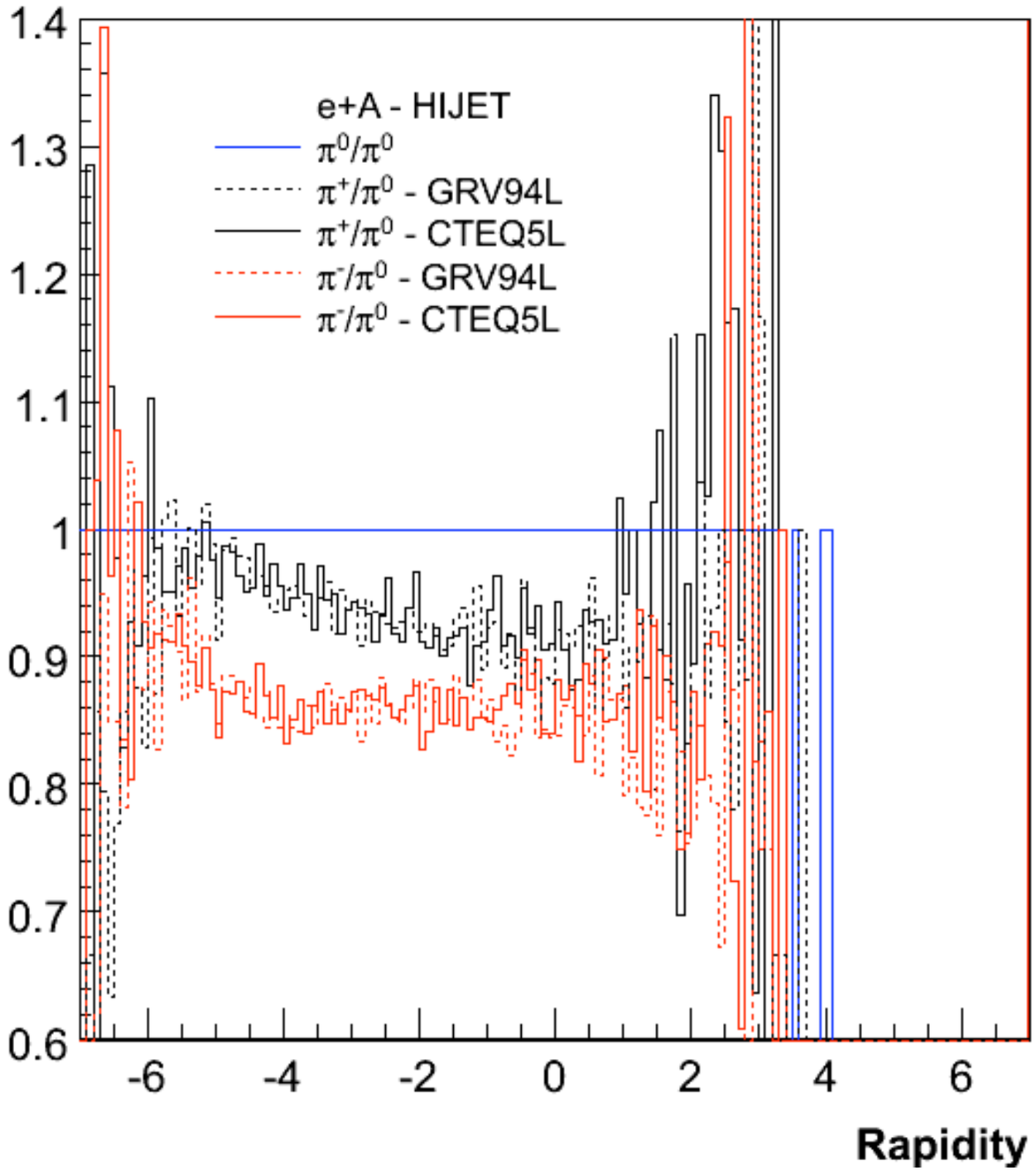


Diagnostic Plots (10^6 events)

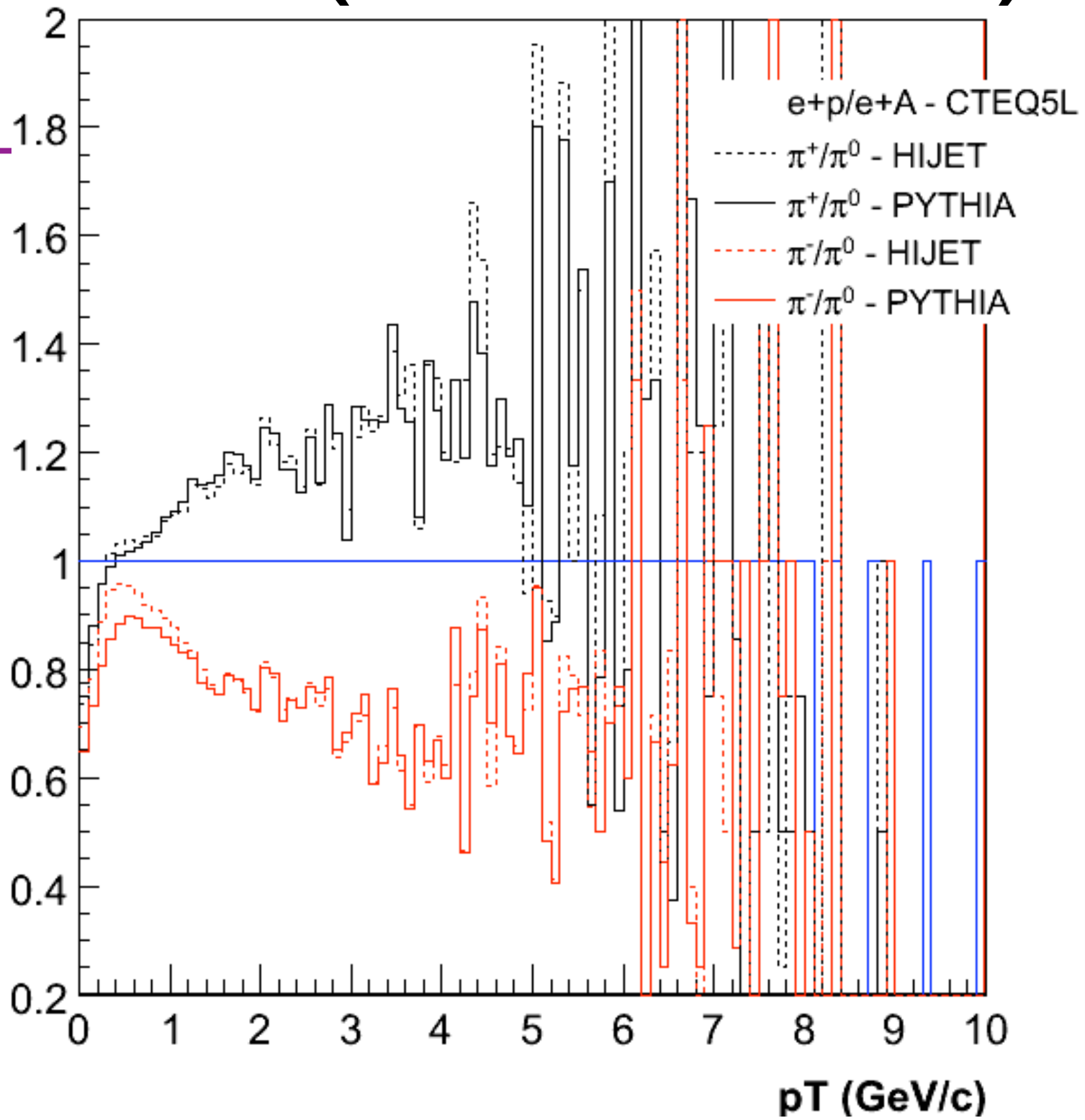
- Divide π^+,π^- by π^0 for both PYTHIA and HIJET

  ➡ Same actual events

  - no normalization needed

  ➡ Differences at low p_T - especially for π^-

  ➡ Expected as HIJET doesn't pretend to handle high p_T processes



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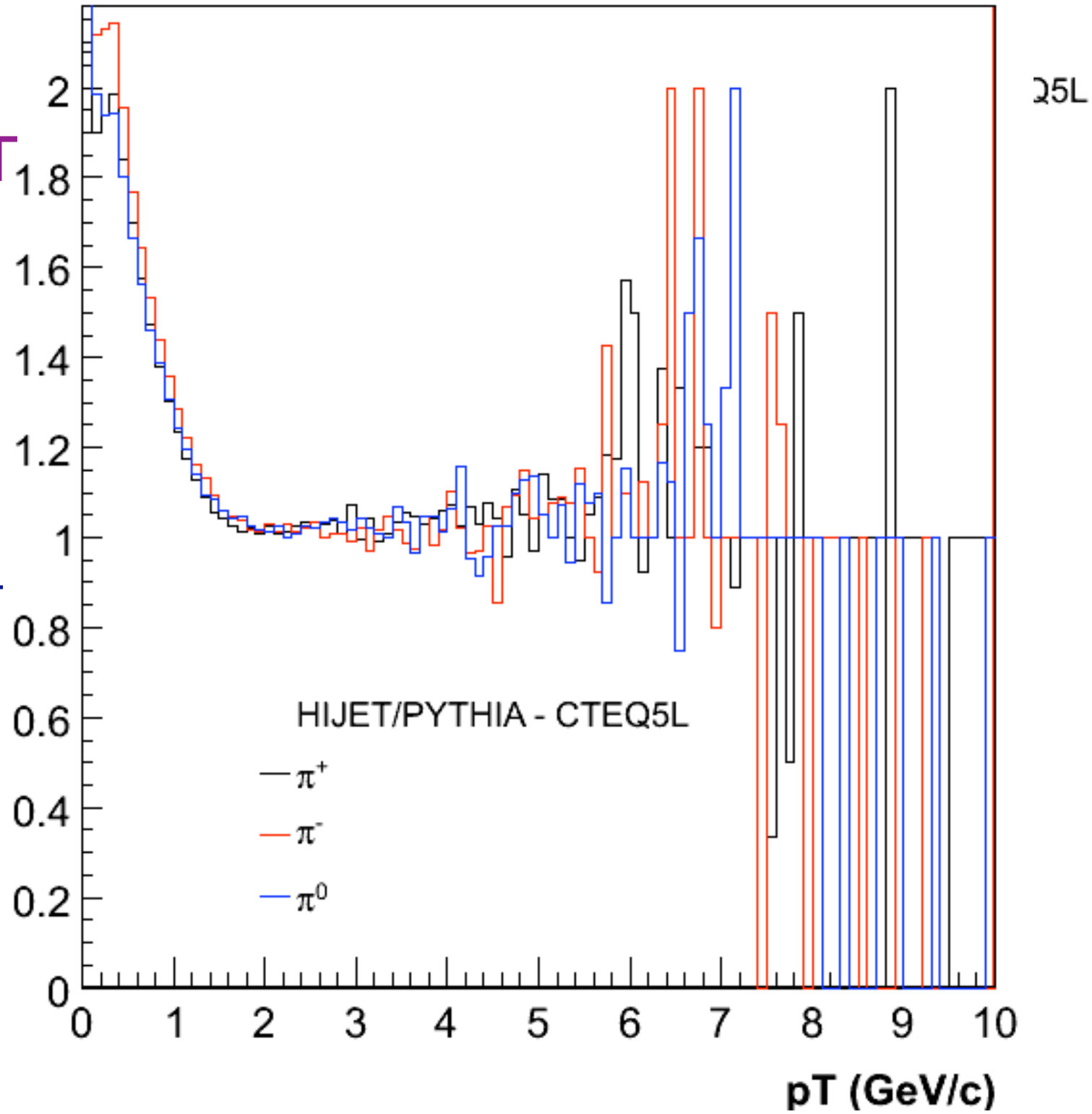

Plans: Generators

- Get a handle on the centrality of the e+A collisions

➡ run e+p with Pythia using different PDFs

- use external LHAPDF for PDFs with/without energy loss
- run PDF with energy loss in central e+A (with HIJET)
- run PDF without energy loss in peripheral e+A
- run a blind analysis to see if we can recover the centrality of the event

- Longer term - need a "real" e+A generator

Detector development

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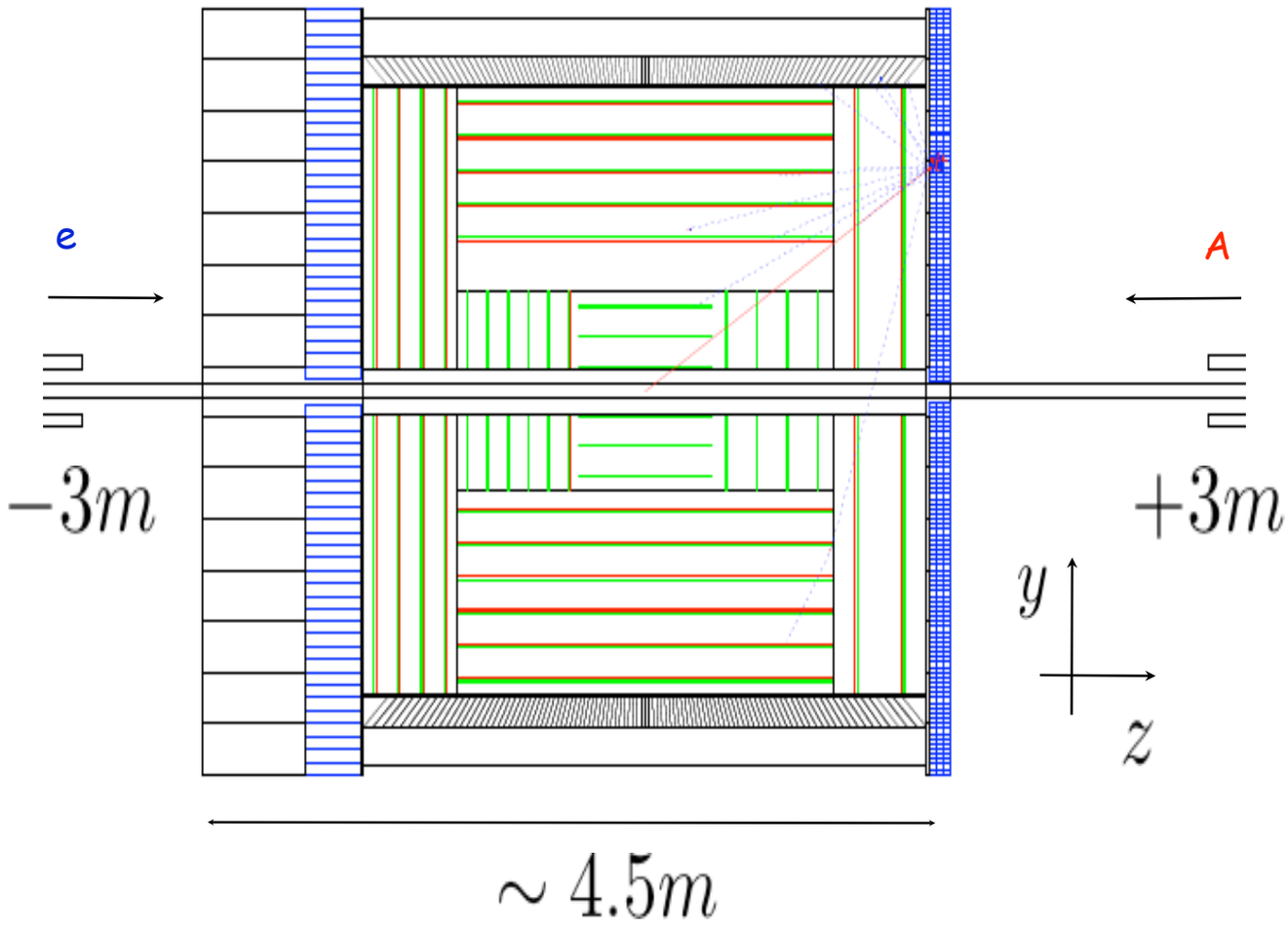
- Bernd's detector: ELECTRA



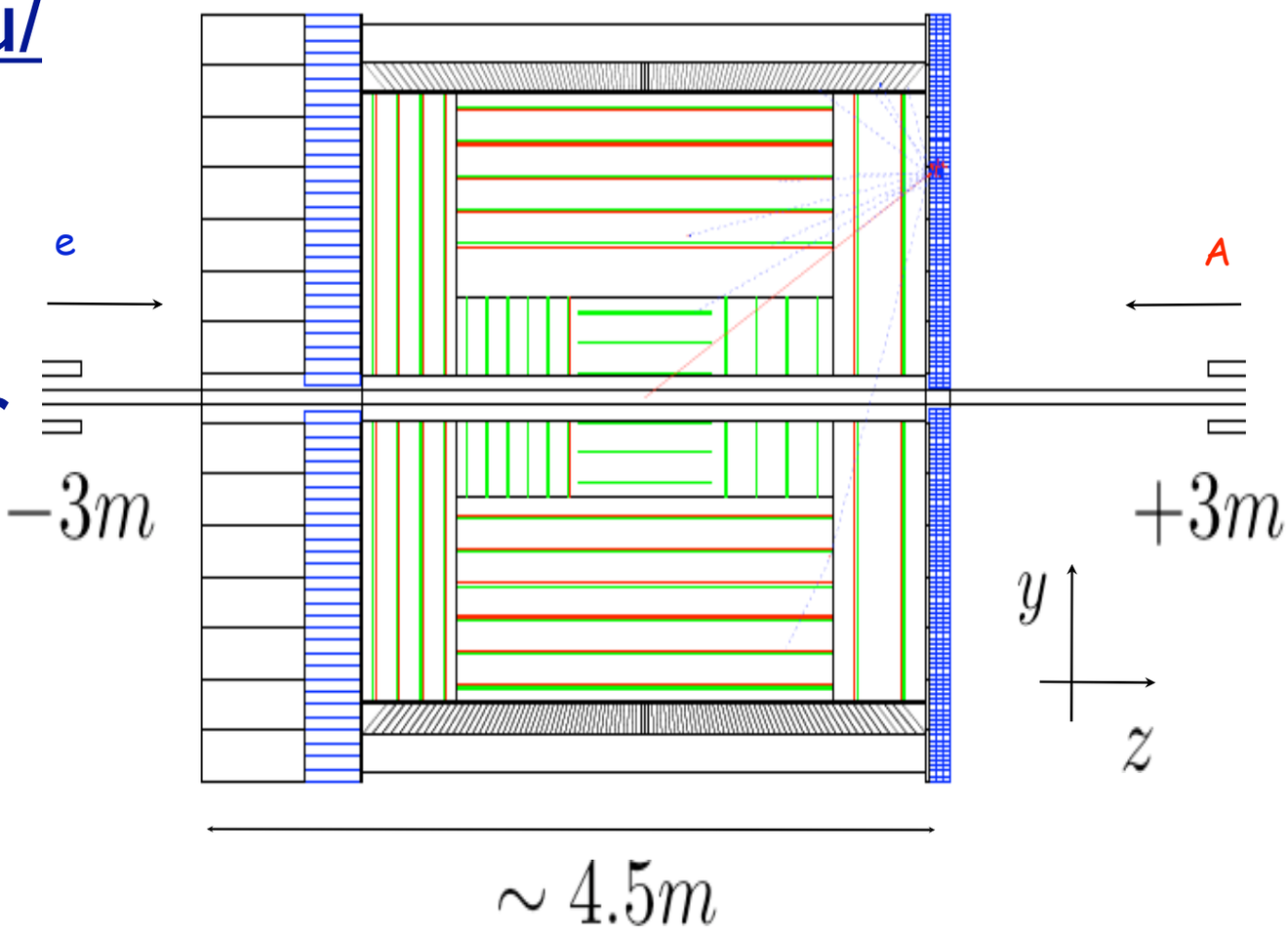
Detector development

- Bernd's detector: ELECTRA

  ➡ http://starmac.lns.mit.edu/~erhic/electra/

  ➡ easy to download and install using Bernd's User Guide

  ➡ installed on linux box at BNL, running PYTHIA/ HIJET data through the detector setup



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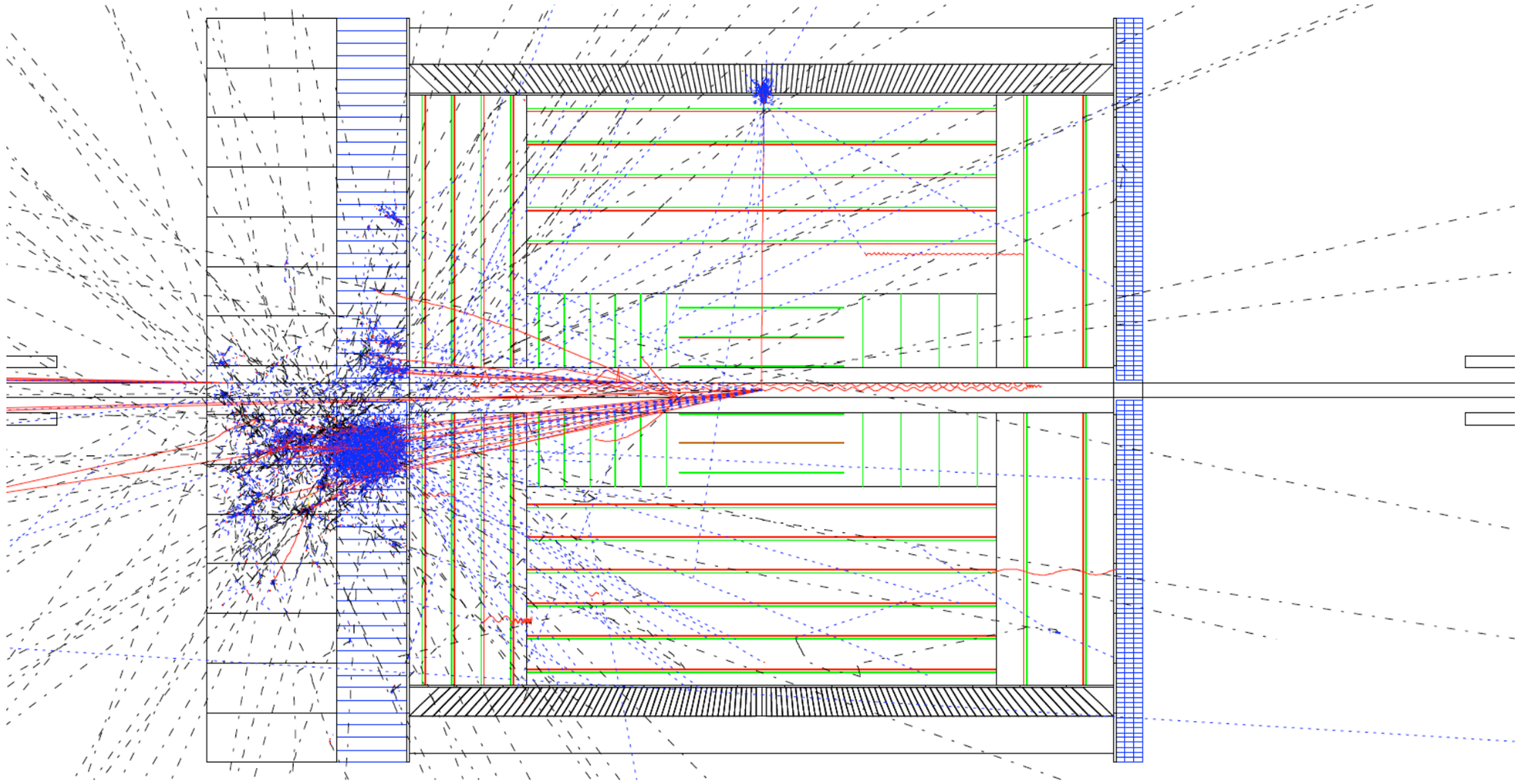
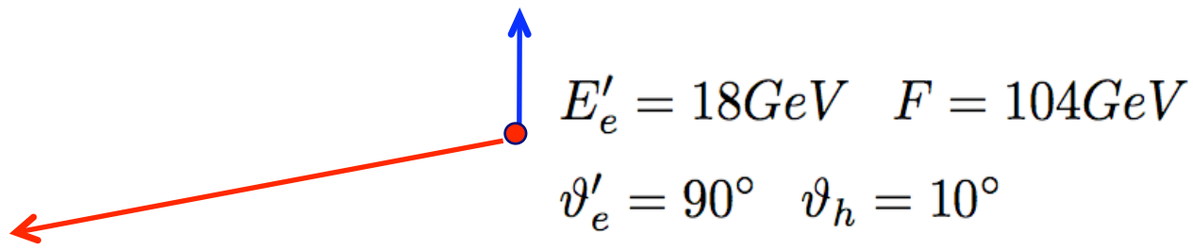


Side view

$$Q^2 = 361 GeV^2 \quad x = 0.45 \quad E_e = 18 GeV$$



$$E'_e = 18 GeV \quad F = 104 GeV$$

$$\vartheta'_e = 90^\circ \quad \vartheta_h = 10^\circ$$

Detector Development Plans

- GEANT3 isn't supported anymore
  - ➡ legacy FORTRAN code which means that there are less people who know it
  - ➡ Work with MIT/BNL to upgrade code to GEANT4 (C++) which has been the standard for some time and is well supported
- Use the PYTHIA/HIJET simulations to develop the detector needs further