EIC meson structure

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Pion and Kaon Structure White Paper

- In EPJA...
  - Geometric acceptance - standard Pythia and accept forward particles
  - Can now do real detection
- But need to find how to distinguish decay products? (e.g. lambda)

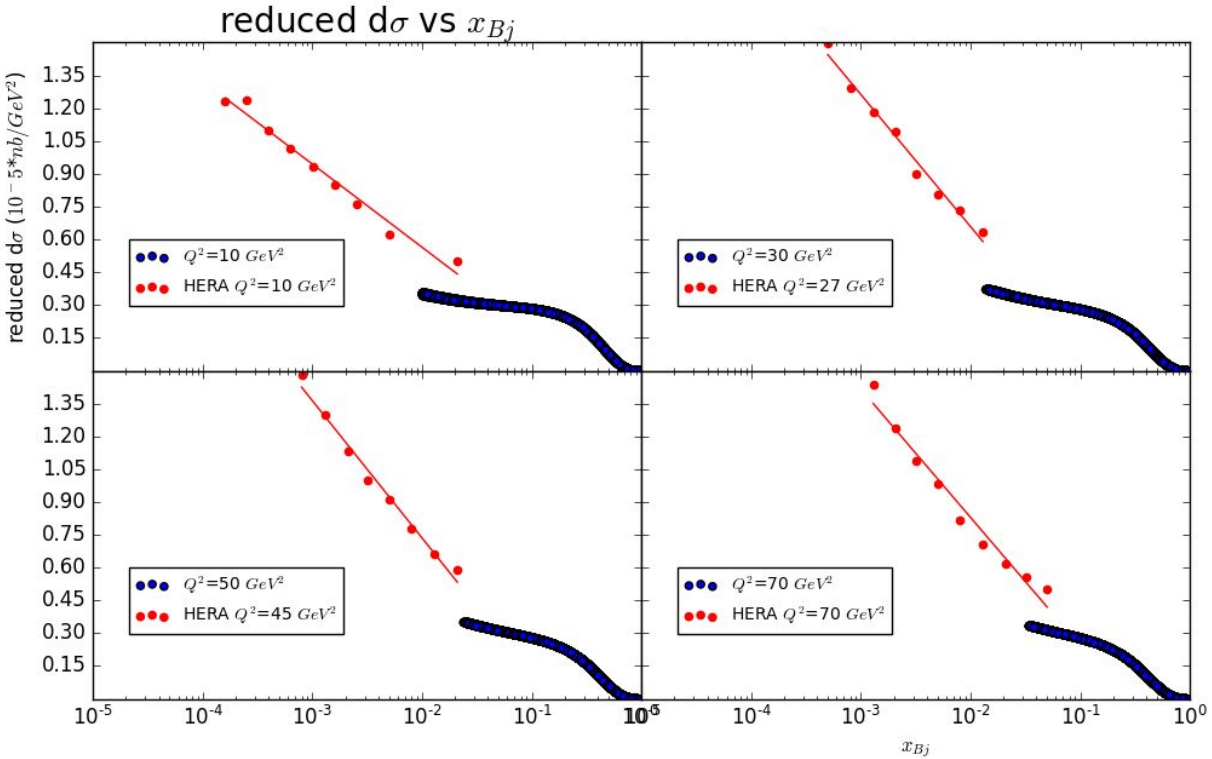
Structure functions

- For projections use a Fast Monte Carlo that includes the Sullivan Process
  - PDFs, form factor, fragmentation function projections
- Progress with generator development since EPJA article:
  - fixes made in generator to remove fixed-target leftovers
  - now can make pion structure function (pion SF) projections
- Current final states: pi/p, pi/n, k/□
- Beam energies: 18 on 275, 10 on 100, 5 on 41

Validation: Reduced cross section compared with HERA

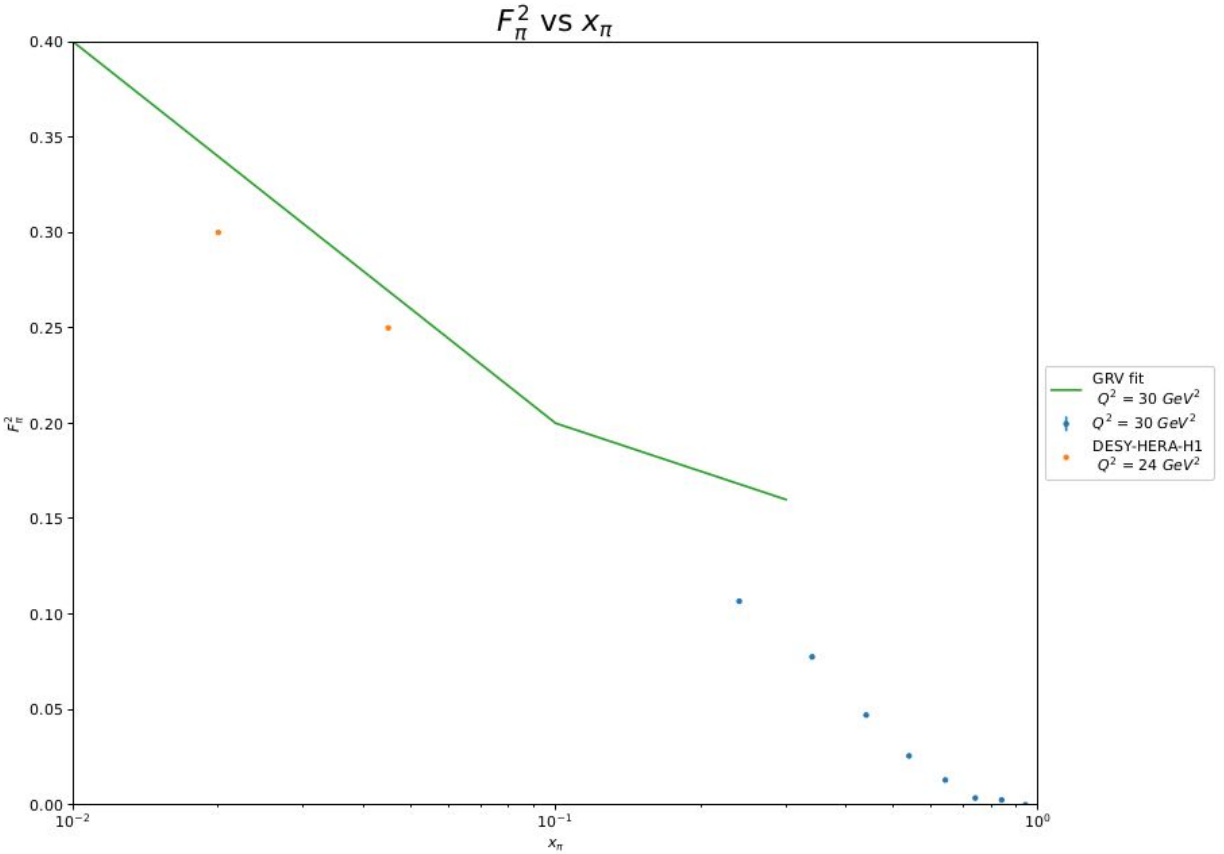
- HERA data from *ZEUS collab, Eur. Phys. J. C 21 (2001)*
- Proton beam = 100 GeV/c
- Electron beam = 5 GeV/c
- x_{Bj}=(0.01-1.0)
- Q^2=(10-100)

$$\tilde{\sigma}^{e^+p} = \left[\frac{2\pi\alpha^2}{xQ^4}Y_+\right]^{-1}\frac{d^2\sigma^{e^+p}_{\text{Born}}}{dx\ dQ^2}$$



Validation: F2π with GRV fit/DESY-HERA-H1 data [Q^2= 30(30/24) GeV]

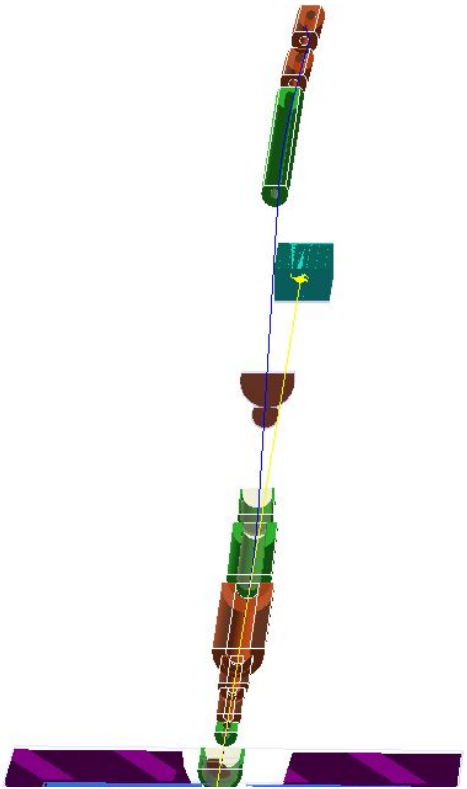
- F2π = (0.461)*F2P
  - (ZEUS Parameterization)
- DESY-HERA-H1 data and GRV fit (for three points) were eyeballed from plots
  - *J. Lan et. al., arXiv preprint (2019) arXiv:1907.01509*
- HERA F2pi data appear to be consistent with the MC projections though the x-dependence seems stronger at higher x



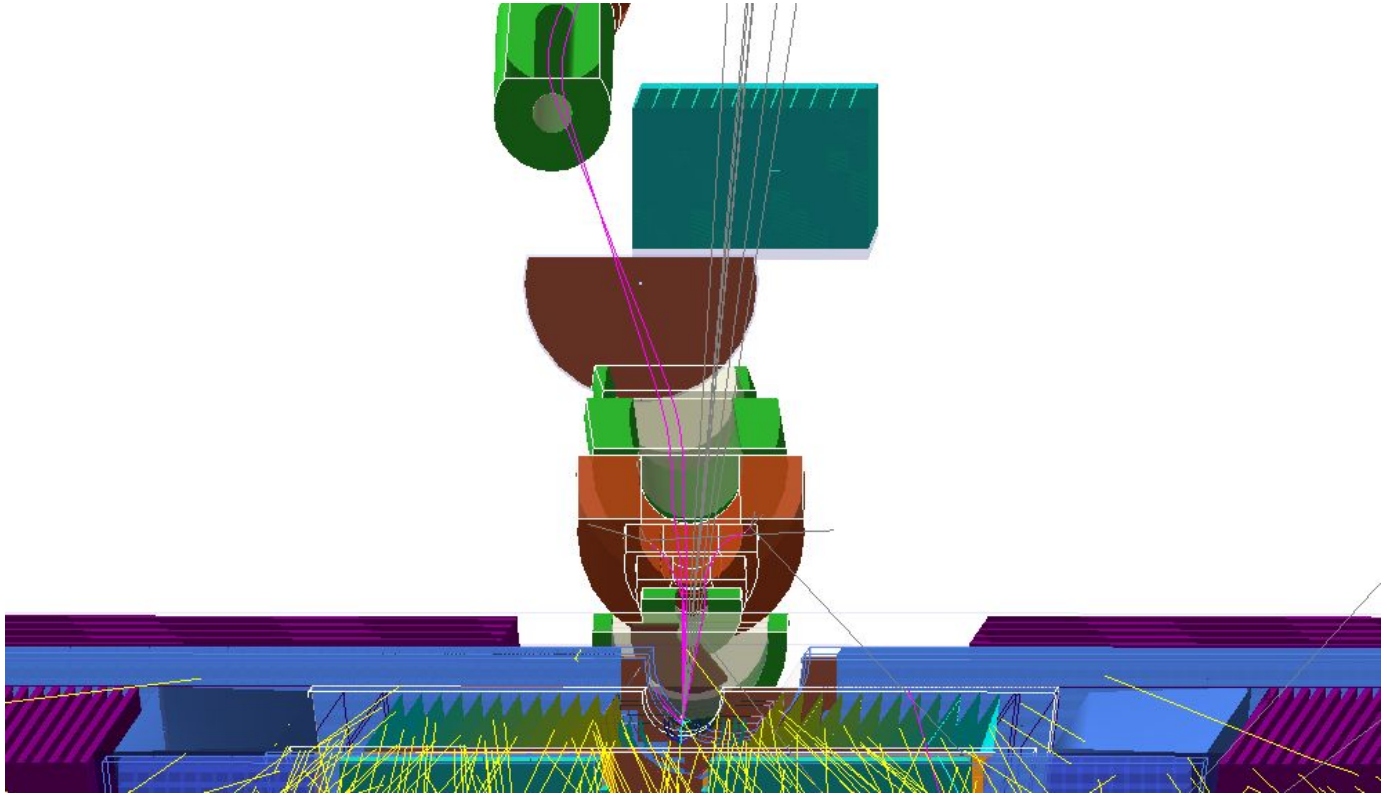
GEANT4 for EIC

- Meson structure MC outputs lund files for use in GEANT4
- Detector MC updated with eRHIC specifics (crossing angle changes primarily)
- Updating electron beam line
    - Solenoid centered at zero - this cannot be changed as it affects the beamline
    - IR region was the same size for JLEIC and eRHIC design, so can use JLEIC detector in eRHIC beam line.
    - Modulo beam line required changes in end caps, crossing angles

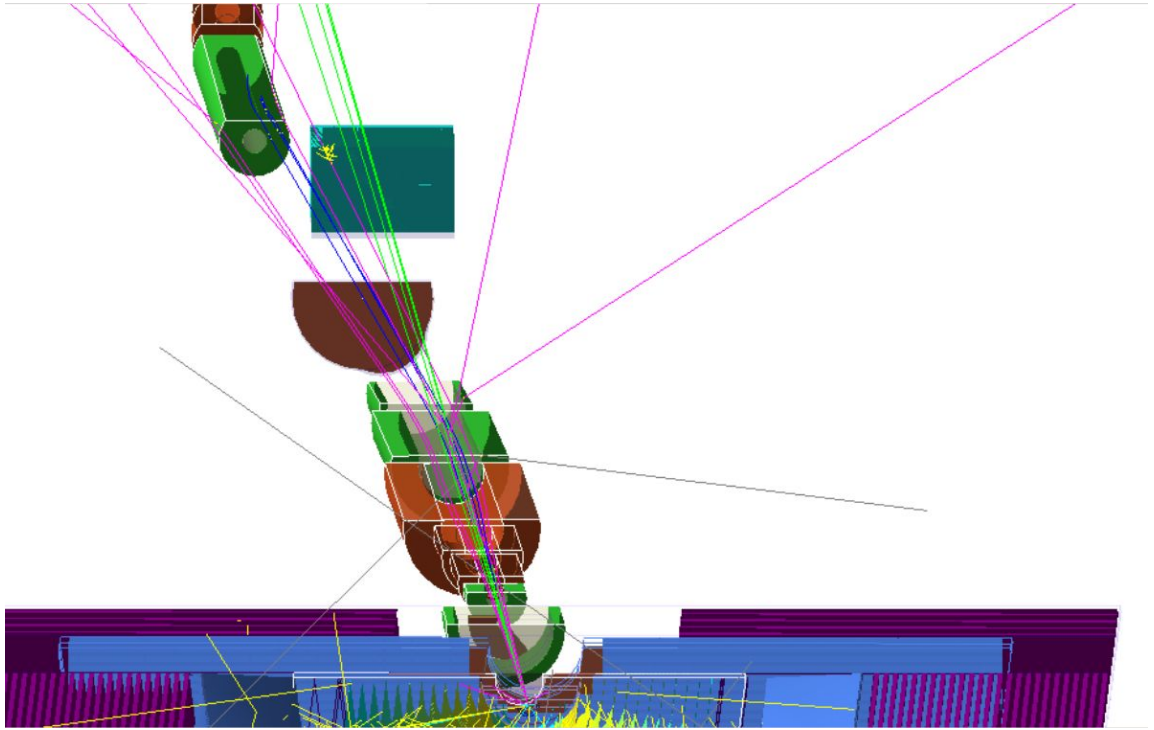
e+p->π+p+e'



e+p->π+n+e'



e+p->K+□+e’



GEANT4 for EIC

- For neutron final state use ZDC -> need to know detection fractions, for Lambda/Sigma need in addition detection of particle
- Have the beamline CAD - generally looks similar to JLEIC
- Currently only have Roman Pots in forward region - ok for DVCS, but need more detectors for meson structure measurements
- General approach: put virtual detectors at different z-locations in between the magnets - based on this determine what space is needed for these additional detectors

Conclusion and Outlook

- Make Analyzer plugin for physics variables including smearing
- Implement virtual detectors and determine detection fractions
- First rough projection of detection fraction
- Determine where detectors should go
- Come up with a method to distinguish decay products, e.g. □ and Σ
- Currently have π with proton and neutron final states and K with □
- Check that detection fractions are included
- More updates and details in upcoming talk at TEMPLE