UNIVERSITY OF BIRMINGHAM | SCHOOL OF PHYSICS AND ASTRONOMY

University of Birmingham simulations update

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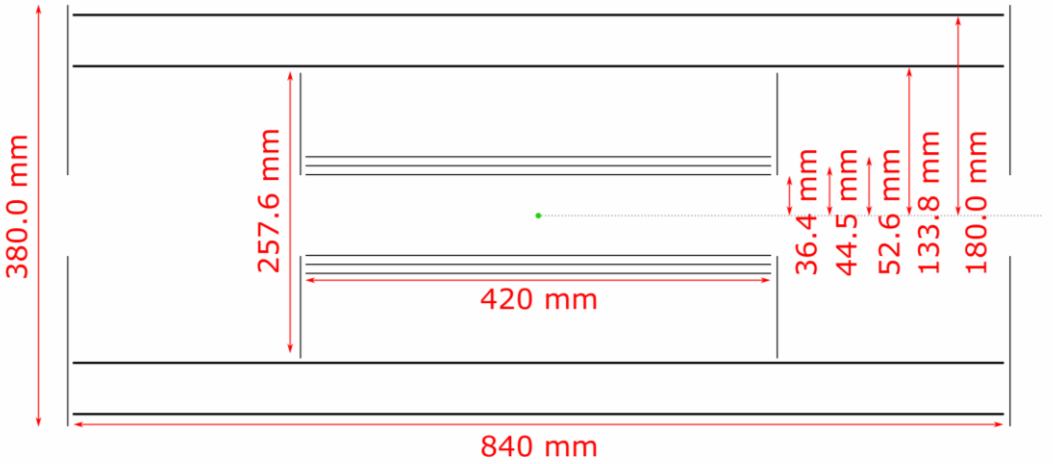
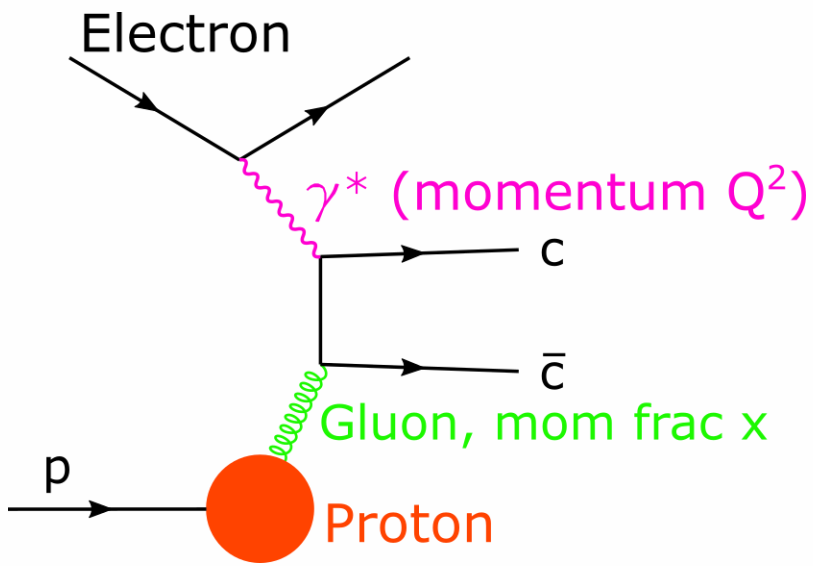
New baseline barrel layout used

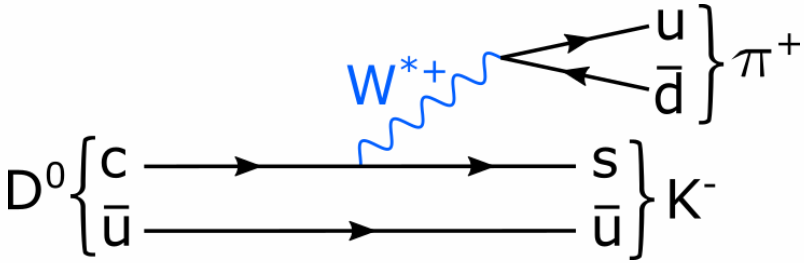
- 3 inner layers, 2 outer layers. **ITS3-like**
  - Inner: 0.05% X/X_0
  - Outer: 0.8% X/X_0
- Default pixel size: 10x10 μm^2
- Innermost disk close to the inner layers
  - Inside outer layers
- Second disk as close as possible to outer layers
- Radial space constraints:
  - From beampipe out to 200.0 mm
  - This is the default in `EIC-IR1-XX-v00.C` in EicToyModel already



Physics performance simulations

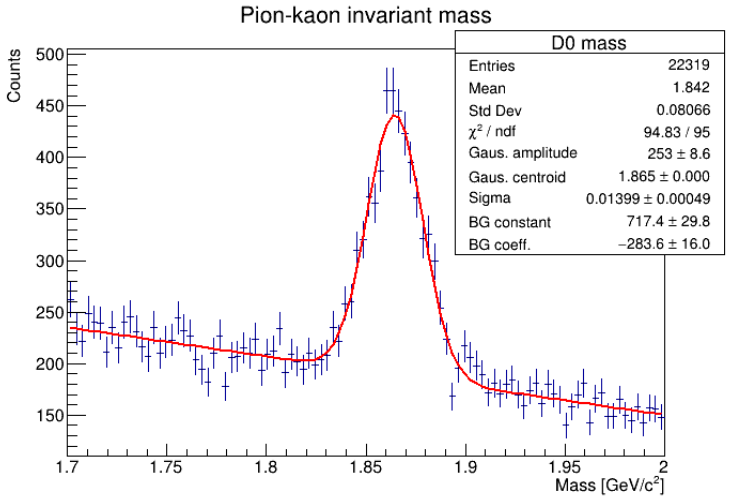
- Open charm events main interest
- Pythia 8 used for event generation
  - Electron-proton collisions at a few different energies
  - Photon-gluon fusion to $c\bar{c}$ process
  - Allowed to hadronise freely
- Figure of merit: D^0 reconstructed mass, from hadronic decay to pion-kaon pair



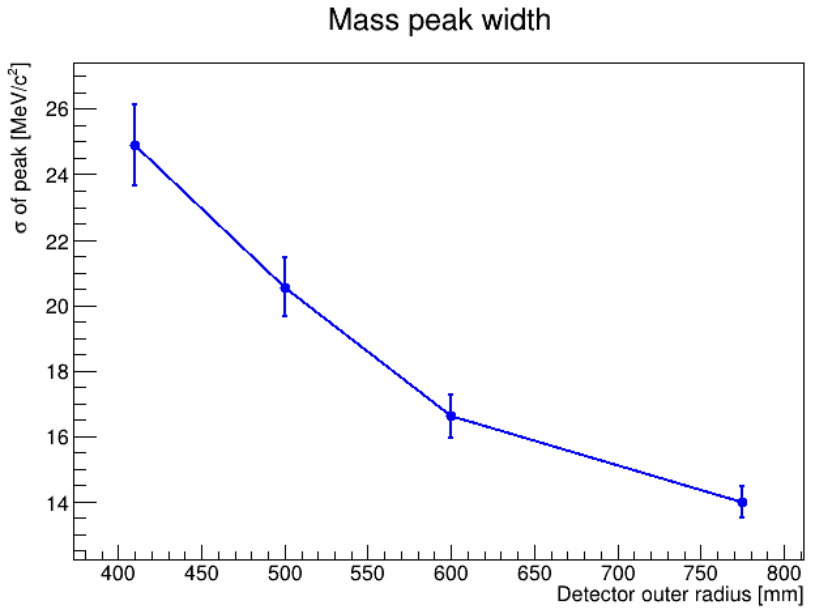


Initial all-silicon outer radius study

- All-silicon layout used, with varying outer radii
- Ideal particle ID assumed
- All pion-kaon pairings used in creating invariant mass spectrum
- Centroid value of D^0 peak (1865 ± 14 MeV/c^2) is within errors from PDG mass value (1864.84 ± 0.18 MeV/c^2)

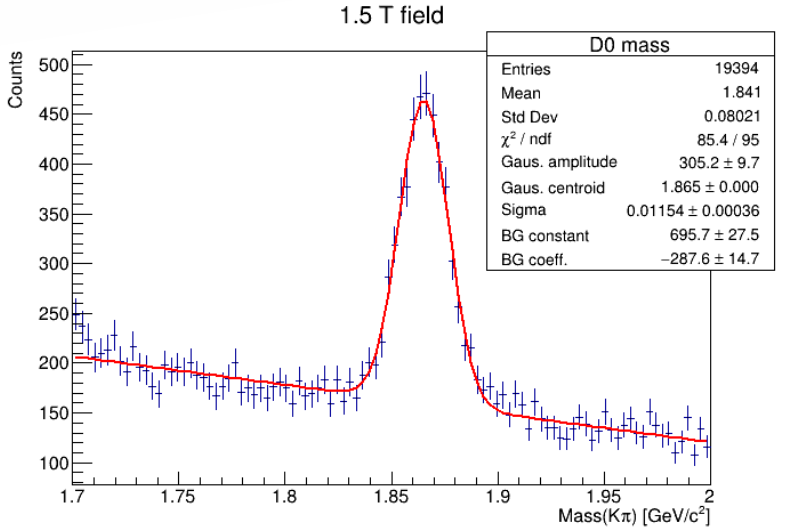


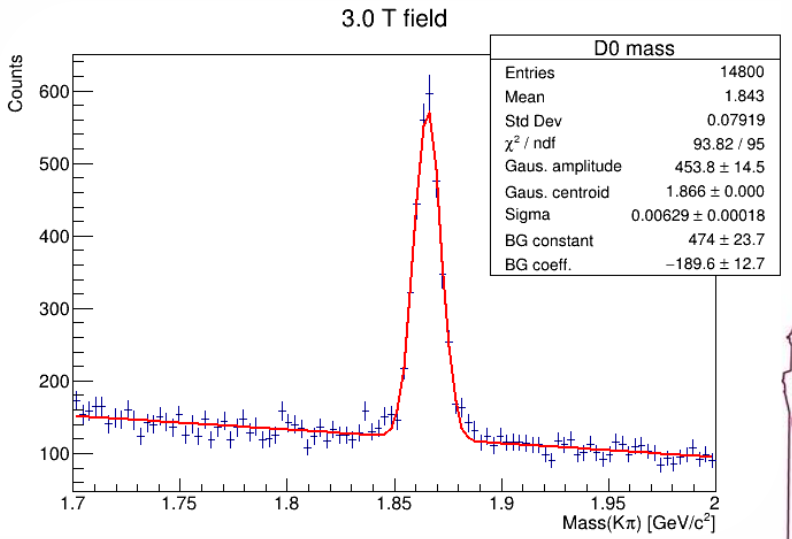
- Clear improvement in mass peak width as outer radius increases
  - Matches theoretical prediction for improved momentum resolution well



Initial magnetic field strength study

- All-silicon layout used, in ITS3-based design, with full outer radius
- Magnetic field varied
  - 1.5 T
  - 3.0 T
- Initial results shown
  - Using 3.0 T **improves mass resolution** at this particular collision energy of $\sqrt{s} = 29$ GeV
  - Further studies ongoing
- Risk: higher field causes low-momentum particles to spiral before hitting the detector
  - This study made with ITS3-like and 3 inner layers to mitigate this risk





Low-p_T limit discussion; thoughts and experience

- Which limit is requested?
  - Analytical solution for where particles spin out too early is around 50 MeV/c for a 3 T field
  - **Material and multiple scattering** dominates here, however
- Pointing resolution steadily deteriorates below a few GeV/c
  - Quick deterioration below 1 GeV/c
  - Main region where concepts differ. Smaller difference at higher momenta
- Magnetic field makes little difference for pointing resolution