UNIVERSITY OF BIRMINGHAM | SCHOOL OF PHYSICS AND ASTRONOMY

University of Birmingham simulation effort update

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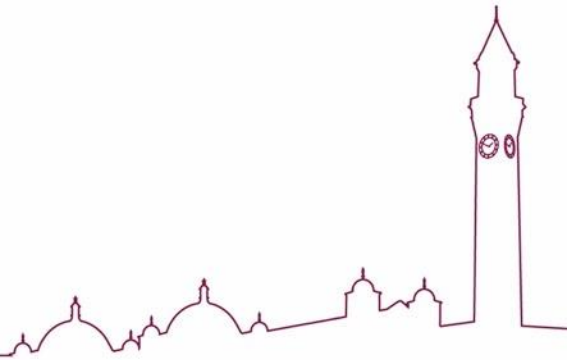
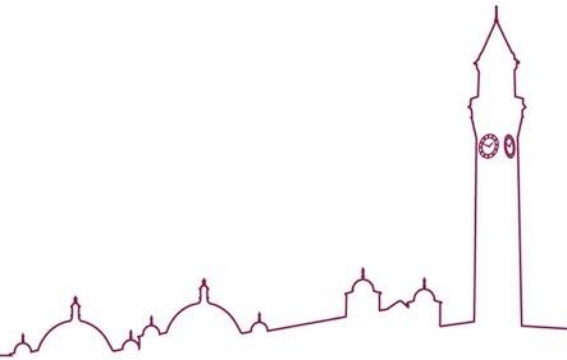
Outline

- EICROOT simulations overview
- G4E – UoB status
- G4E – UoB needs and questions

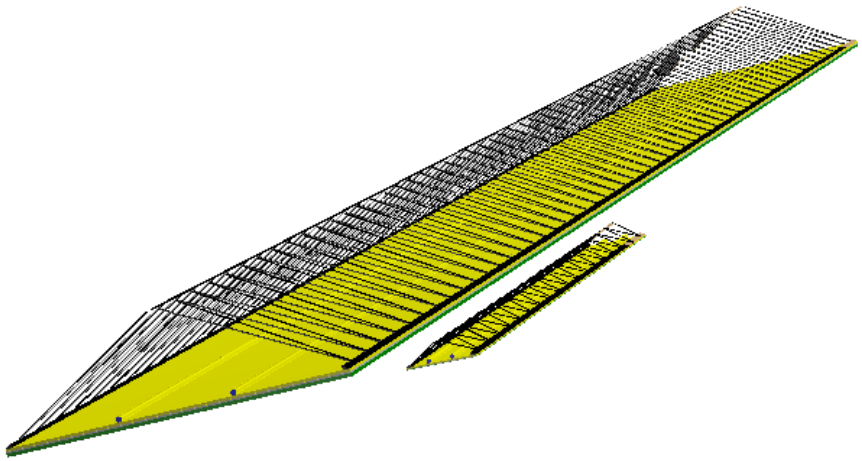


EICROOT simulations

- Momentum resolution and pointing resolution investigated.
- Pixel size and detector layout investigated, as well as silicon disks, and an all-silicon layout.
- Complete list and details of the simulations carried out can be found in the simulation report (“Simulations of a silicon vertex tracker for a future EIC”).



EICROOT stave detail



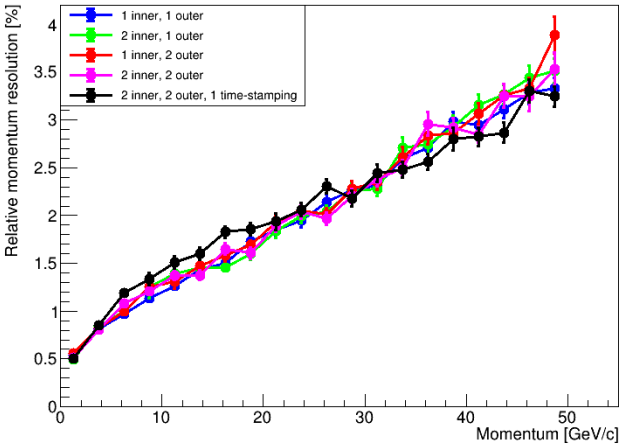
EICROOT representation of inner and outer staves, based on the ALICE ITS upgrade.

- TGeo implementation.
- Composed of several materials;
  - Silicon
  - Kapton flex cable
  - Aluminium flex cable
  - Carbon fibre cold plate
  - Carbon fibre support beams
  - Kapton water pipes with water
- Thicknesses based on ALICE ITS Upgrade TDR.

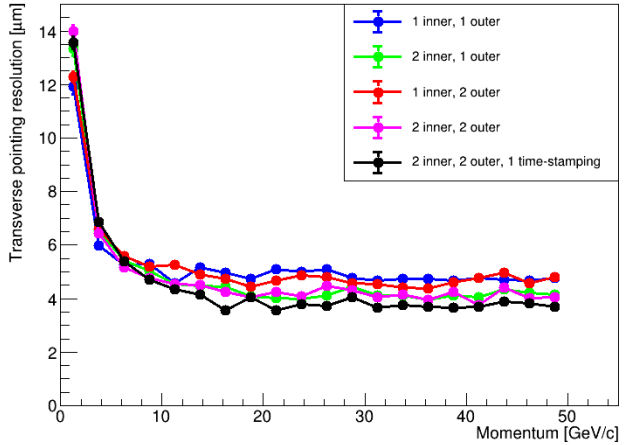
Example simulation and results

- Barrel layout studies.
  - Different number of silicon layers tested
- Simulation parameters:
  - Particle: π^+
  - Transverse momentum range: 0 to 50 GeV/c
  - Pseudorapidity range: $-0.5 \leq \eta \leq 0.5$
  - Number of events: 100 000
  - Silicon pixel size: $20 \times 20\ \mu m^2$
  - Gas TPC present outside the silicon barrel
  - Magnetic field: 1.5 T
- Resulting resolution plots shown on the right. Details available in simulation report.

Relative momentum resolution

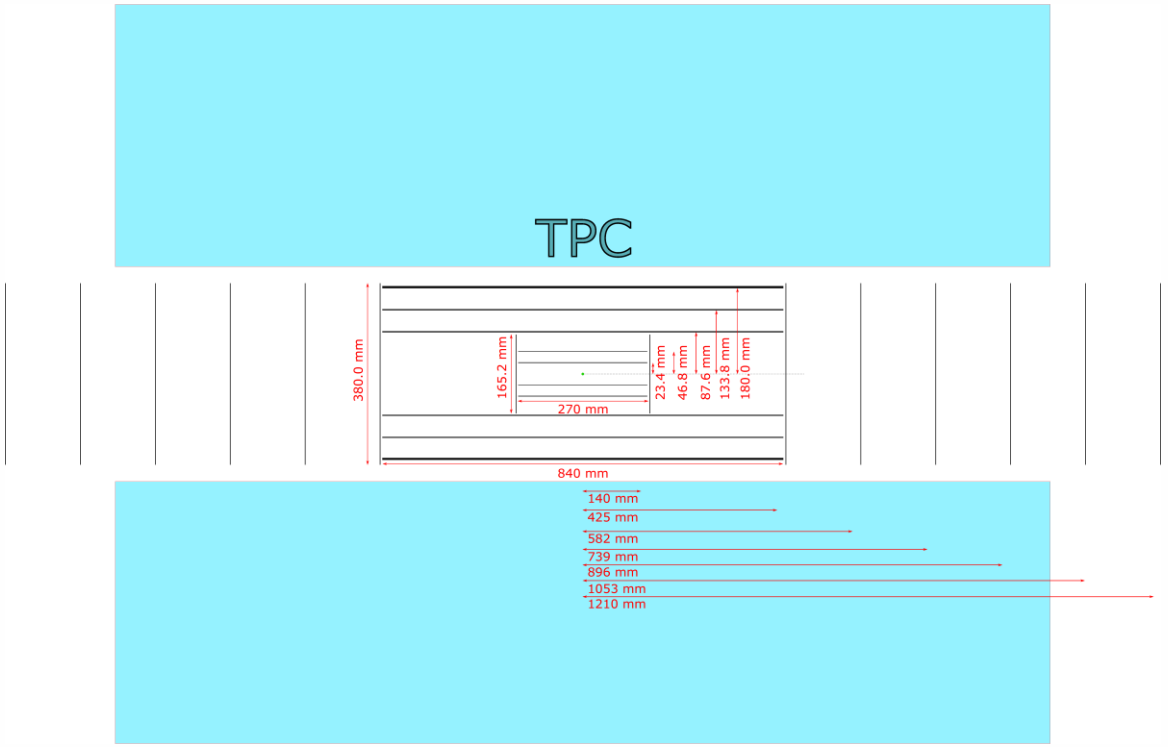


Transverse pointing resolution



EICROOT simulations – key results

- Best silicon vertex tracker layout:
  - two inner layers
  - three outer layers
  - disks in the forward and backward regions
- Detector benefits from small pixel size. Optimum currently considered to be 20x20 μm^2.

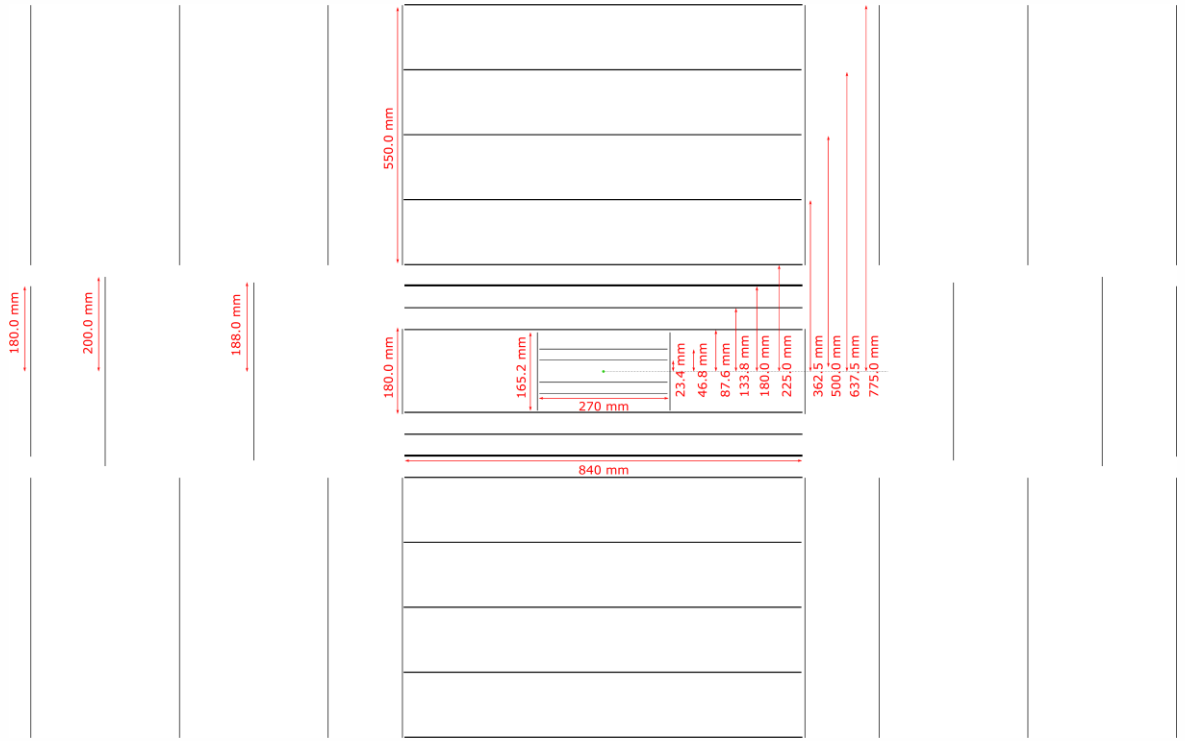


Sketch of silicon vertex tracker layout, with disks and gas TPC.

EICROOT simulations – key results

- All-silicon concept viable. If more compact design desired, all-silicon concept with disks and rings is preferred compared to Si+gas.

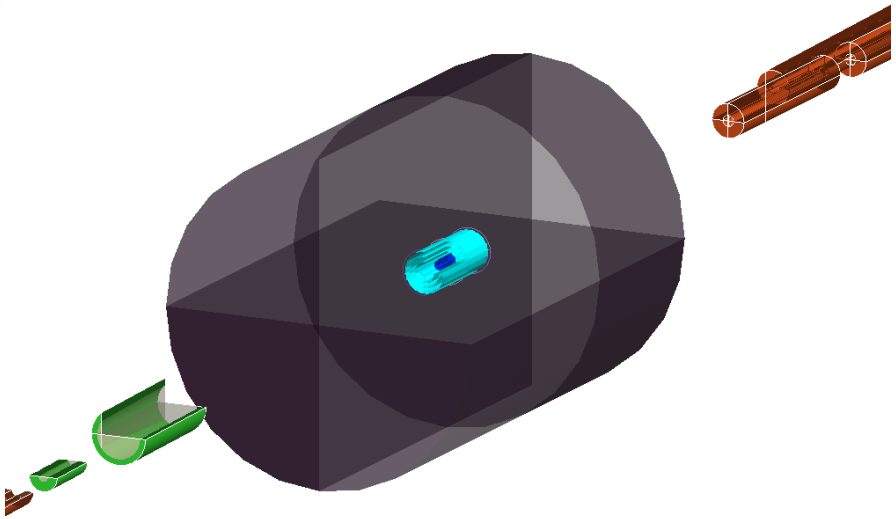
- Details can be found in the simulation report (“Simulations of a silicon vertex tracker for a future EIC”).

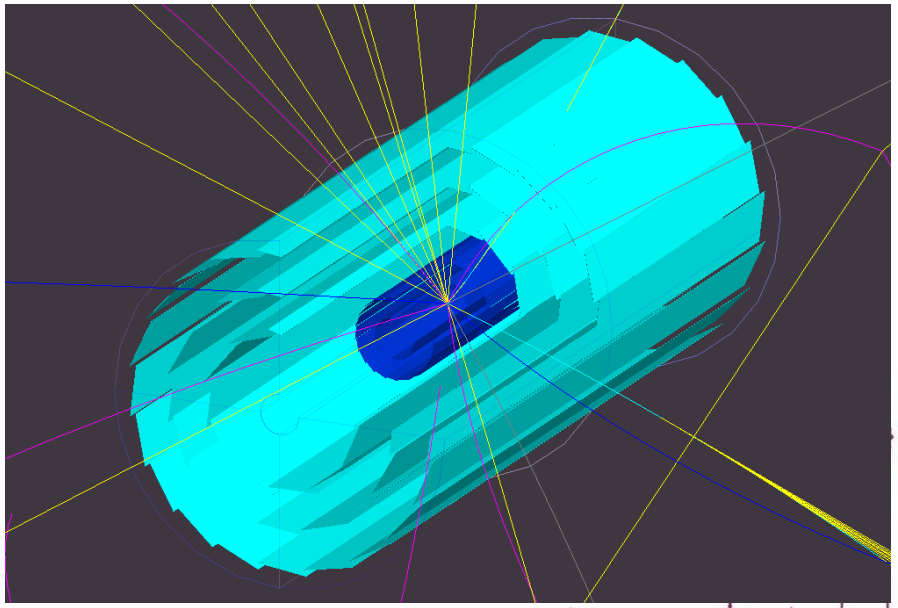


Sketch of all-silicon concept, with disks and rings.

G4E – UoB status

- Installed locally using a combination of ejpm and CMake
  (instructions used found here: https://g4e.readthedocs.io/en/latest/install.html).
  - Able to modify active detector parts, and details about the detector parts.
  - eRHIC beamline selected.
- Constructed basic version of the SVT in G4E
  - Slabs of silicon (i.e. not as detailed as EICROOT) with correct total radiation length.
- Can import and propagate Pythia events through the detector.
- Can extract hit information.





G4E – UoB needs and questions

- Gas TPC simulation?
  - Currently silicon layers and straw tubes implemented.
  - EICROOT gas TPC implementation was basic, by track length.
- Reconstruction
  - Some tools available, but I need help to understand and modify.
  - Can get the MC hits out, but how to smear them properly?
    - EICROOT does Gaussian smearing around detector hit.
  - After smearing: reconstruction using smeared hits. Ideal tracking implementation?

- What level of detail do we need?
  - G4E SVT implementation currently a step back in detail compared to EICROOT.
- Help needed to proceed further with smearing and reconstruction.