eRD18 – Precision Central Silicon Tracking and Vertexing for the EIC

Homework question: What software tools are currently missing and impede your progress in the detector development effort?

For basic detector layout and performance simulations all we really need is a GEANT description of the detector, ideal tracking, a parameterisation of the detector response to smear the hits in the detector layers and track fitting (e.g. GENFIT) to obtain realistic momentum and pointing resolutions.

This capability is provided by EicRoot, and was chosen by us, in part, because of our past experience with ROOT. Consequently, simulations have thus far been done only for the BeAST detector concept. EicRoot is built on PandaRoot and FairRoot. This was a pragmatic decision to reuse existing code and tools. However, not all functionality is available through EicRoot. This is because EicERoot was not foreseen to be a long-term solution for EIC simulations. However, being built on several layers of C++ classes means that it is not straightforward for the average user to develop. Nevertheless, it has been good enough for what we have needed to do up until now.

Currently, all our simulations have used the inbuilt "box" generator, which generates one particle at a time in specified transverse momentum and pseudorapidity ranges.

What is missing or not currently implemented in EicRoot is:

- The ability to read in event generator input to study full or partial events (such as heavy flavour decays generated by Pythia).
- Vertex fitting (e.g. RAVE) to study primary and secondary vertex resolutions.
- The ability to propagate tracks to an arbitrary radius (detector layer). This would be useful to constrain the spatial resolution (pixel size) of the outermost silicon barrel layer.

With these relatively small additions, we could complete our initial investigations. For inner tracking simulations there is not a strong argument for providing a common interface to the various simulation frameworks currently available (EicRoot, fun4all, eJANA, TOPSIDE). With knowledge of the beampipe configuration and the tracking capabilities of the outer tracker, we could simulate the JLEIC detector within EicRoot to reasonable accuracy without having a detailed geometry description of the entire detector. Similarly, from the point of view of tracking and vertexing in the central and forward regions, we could study an all-silicon detector concept similar to TOPSIDE within EicRoot.

Beyond detector layout and performance simulations, to complete our sensor design study we need an estimate of the global and local detector occupancies. This is expected to be dominated by synchrotron background radiation, not single events or event pileup. We are therefore interested in the results of eRD21 - EIC Background Studies.