

Summary of EIC-India Participation and Future Plans for the Software Working Group

Fun4All

Primary Goals:

- Perform quality assurance of calorimeters (forward and barrel) and trackers
- Characterization of calorimeters and QA of tracking geometry
- Test different input generators for actual physics signals with full detector simulations.

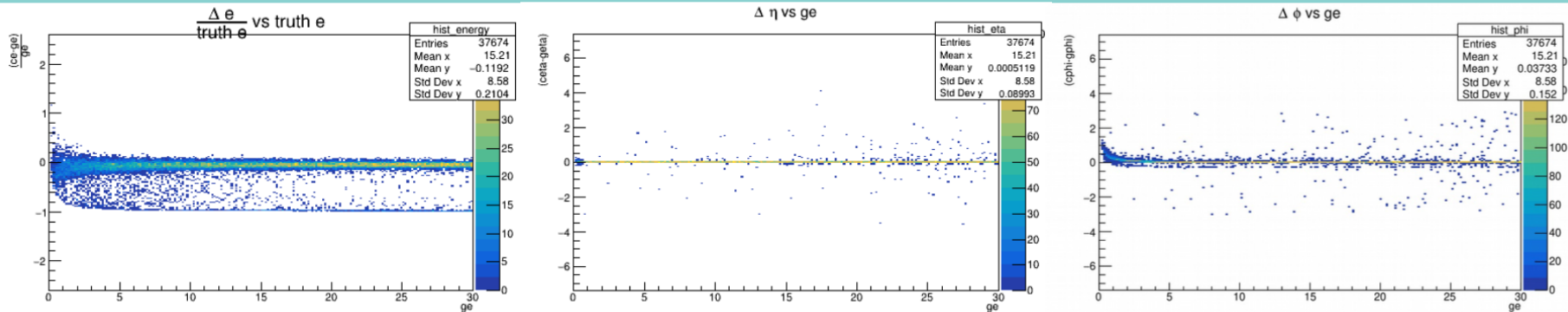
Ongoing work:

Study of energy resolution of calorimeters in Fun4All framework to be used in EIC-Smear.

Resolution plots have been obtained for energy, eta and phi using a streamlined version of Fun4All

Fun4All

CEMC



Energy Resolution

Eta resolution

Phi Resolution

Future plan:

- Switch between different calorimeters to characterize them.
- Work on tracking QA.
- Study different input generators (Pythia6, Pythia8, SARTRE) for actual physics signals

Escalate

Primary Goal:

Create a framework that read and write generated particle interaction events

(Ex: lund , pythia, beagle etc) Github repo -<https://github.com/eic/eicmcio>

Ongoing Work:

Framework:

- Build, test and validate the software in GitLab
- Make cmake compilation scripts: Support directory hierarchies and applications
- Pybind: Coverting and using c++ library in Python
- Build architecture and ready to use package, Publish on spack

G4e:

- Data Generation : Create reference plots for sensitive detectors
- Modify Lattice Code: Modify it's structure for multithreading
- Incorporate the Lattice Code to the detector construction file

Future Plans:

- ✓ Escalate Development: Improve reliability, performance, user experience.
- ✓ Implementation of new features of the framework
- ✓ Contribute towards EIC Validation effort

MC-Data Comparison

Primary Goal:

To study the global properties of hadronic final states in DIS events and other observables at EIC energies using different event generators.

Ongoing Work:

- Study and comparison of observables from different event generators with the existing HERA data and improvise the models to account for the differences or discrepancies, if any.
- The HERA /ZEUS data is currently being compared with events generated using Pythia8, Herwig7, Sherpa7 and Sartre:
 - Charged particle multiplicities in deep inelastic scattering at HERA (H1).
 - Measurement of charged particle transverse momentum spectra in deep inelastic scattering (H1).
 - D^* production at center of mass energy of 318 GeV in DIS.

MC-Data Comparison

Ongoing Work:

- The HERA /ZEUS data is currently being compared with events generated using Pythia8, Herwig7, Sherpa7 and Sartre:
 - Transverse energy-energy correlations Observation of scaling violations in scaled momentum distributions at HERA (ZEUS)
 - Energy flow and charged particle spectra, Single differential cross-section of J/Ψ meson and D^* meson production.
 - Study of inclusive J/Ψ meson production using Sartre, Pythia8 and eSTARLIGHT and comparison with the data at HERA
 - Hepmc3 interface development for Sartre and eSTARLIGHT

Future Plans:

To contribute towards required modifications in different software tools/event generators etc. with the help of experts/authors. (eg. recent project opportunity floated by Dr. Christian Bierlich)

EIC-Smear

Primary Goal: Get the smearing for fast-simulation and from Geant4, develop unit tests for the repository using Catch2

- Simple tests for eic-smear developed:
<https://github.com/deepaksamuel/eic-smear/blob/master/tests/test-BuildTree.cxx>
Another unit test block development for Kinematics.cxx file
- Observations: Basic tests passed, Some tests took a long time (in fact they had to be killed), some hints as to why this happens.
- Smearing: Study underway using the MC data provided by Fun4all group for various Calorimeters.
- QA plots for exclusive processes using EIC smear

Future Plans:

- For unit tests to run - integrate catch2 framework and the EIC Smear cmake builder files.
- Write unit tests for code files in the EIC Smear repository.
- Development of tracking and PID packages.

**Writing tests requires some guidance from the developers,
more guidance needed from developers.**