



# Simulation and Physics Performance -WG update-

A. Mastroserio and S. Fazio

# WG overview : status and updates

- EIC Net MC by-weekly meeting main items:
  - EIC Software
  - Tracking & Vertexing
  - PID
  - Physics Performance
- Some progress after the ATHENA proposal
- Looking forward for the EIC Software scenario(s)

11:30	→ 11:45	<b>Software and Tools</b> Convener: Andrea Bressan (Istituto Nazionale di Fisica Nucleare)
11:30		<b>Updates from the SWGs</b> Speaker: Andrea Bressan (Istituto Nazionale di Fisica Nucleare)
11:45	→ 12:00	<b>Vertex</b> Convener: Domenico Elia (Istituto Nazionale di Fisica Nucleare)
11:45		<b>All Silicon Tracker in fun4all</b> Speaker: Shyam Kumar (Istituto Nazionale di Fisica Nucleare)
12:00	→ 12:20	<b>Particle ID</b> Convener: Roberto Preghenella (Istituto Nazionale di Fisica Nucleare)
12:00		<b>B field impact on forward RICH</b> Speakers: Chandray Chatterjee (Istituto Nazionale di Fisica Nucleare), Roberto Preghenella (Istituto Nazionale di Fisica Nucleare)
12:05		<b>Simulation of pressurised RICH vessel</b> ¶ Speakers: Francesco Noto (Istituto Nazionale di Fisica Nucleare), Vanessa Brío (INFN Catania)
12:10		<b>Simulation of SIPM performance</b> Speaker: Roberto Preghenella (Istituto Nazionale di Fisica Nucleare)
12:15		<b>Porting of dRICH</b> Speaker: Dr Evaristo Cisbani (ROMA1)
12:20	→ 12:30	<b>Physics report</b> Speaker: Salvatore Fazio (University of Calabria & INFN Cosenza)
12:30	→ 12:45	<b>Round table update</b>
12:45	→ 13:00	<b>AoB</b>

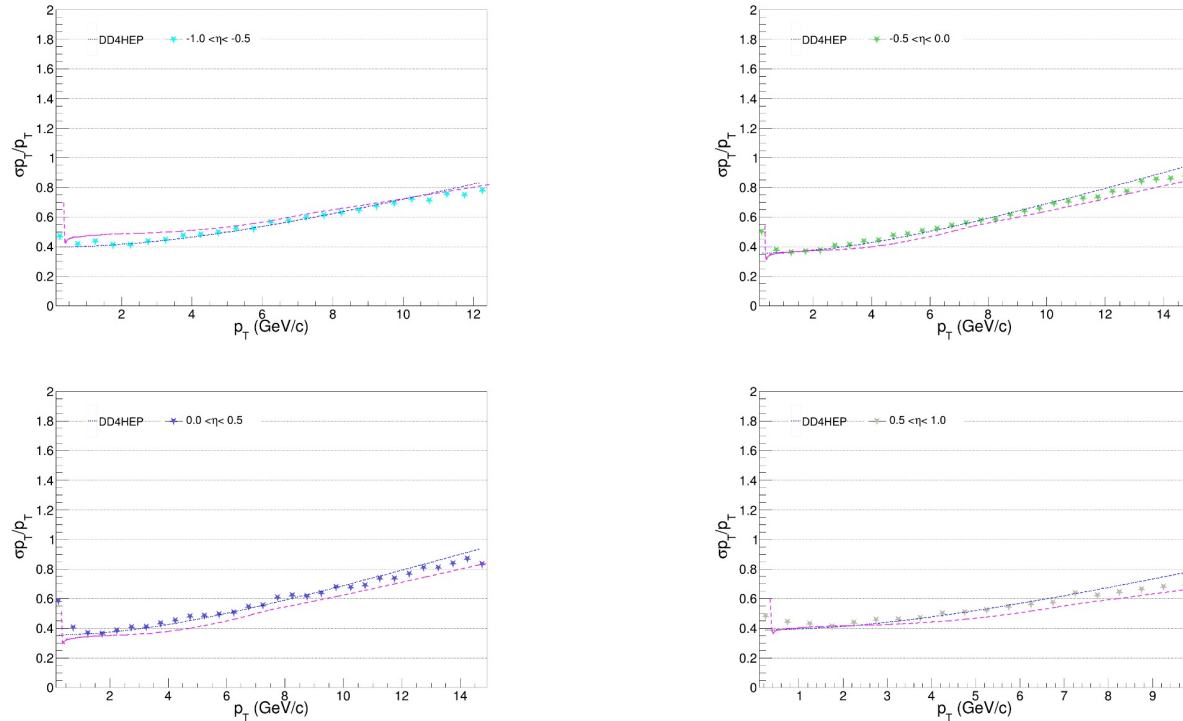
# Update 1/3

- Finalization of a fast simulation tool for a fast feedback on tracking performances (S. Kumar):
  - Tool taken initially from ALICE ITS2 performance studies (CDR)
  - Too tuned according to the tracking performances studied in fun4all and finally in DD4HEP
  - Useful for future studies on tracking performances
- EIC Software migration to DD4HEP
  - In our group the tracking performance studies (ATHENA detector) were done mainly on fun4all:  $\sigma_p/p$ , pointing resolution, all  $\eta$  dependent. Recently an effort was done to check them on DD4HEP (S. Kumar)
  - dRICH simulation already developed on DD4HEP (Chandra)

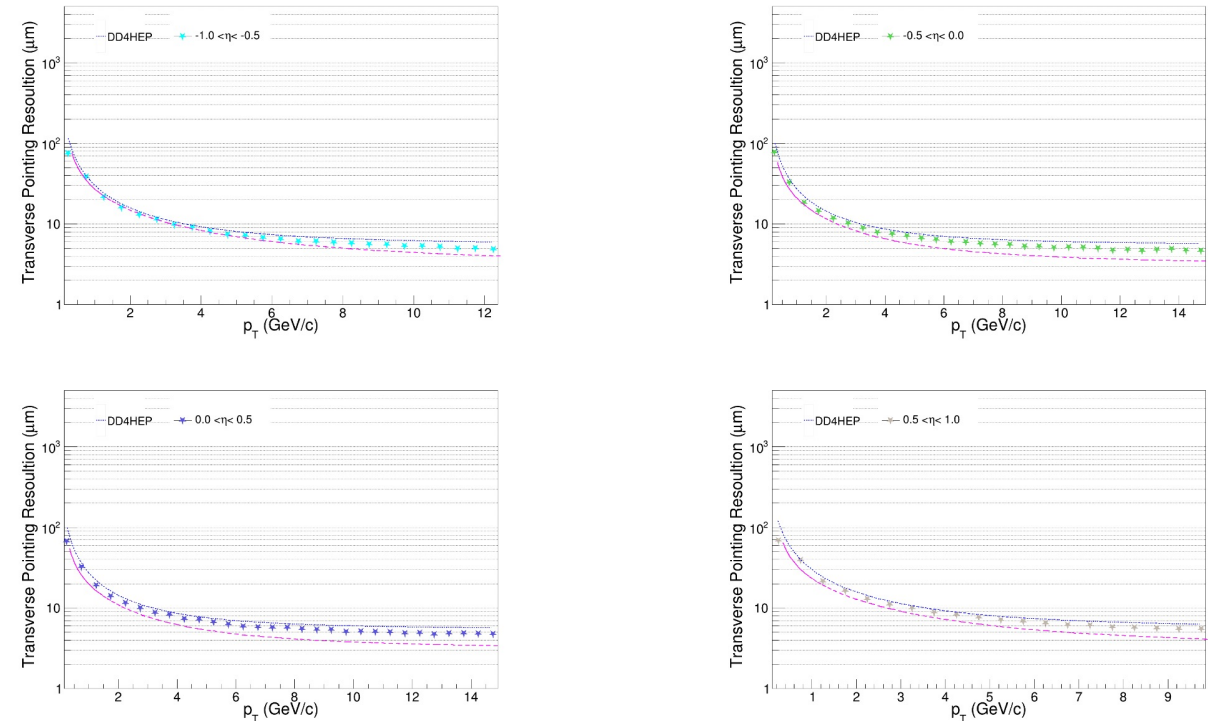
# Fast Simulation Tool

Several studies on tracking performances made on fully simulated events within fun4all. Fast Simulation Tool is an analytical tool that is versatile in providing a fast response on the tracking performances according to the desired geometry (-> radii, material budget, resolution) and B field

Marker Fun4All Points, Blue (DD4HEP), Magenta (Fast Simulation)



Marker Fun4All Points, Blue (DD4HEP), Magenta (Fast Simulation)



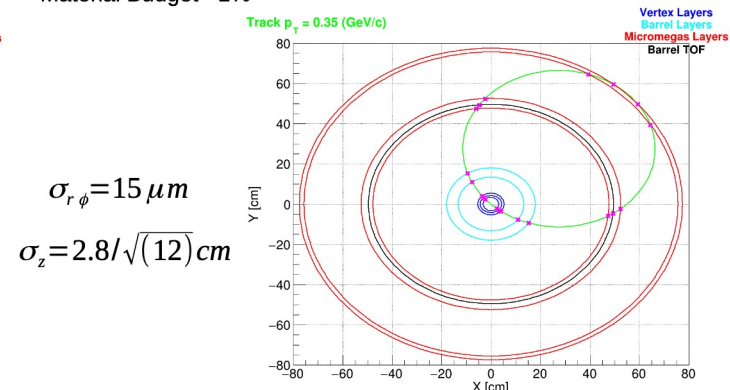
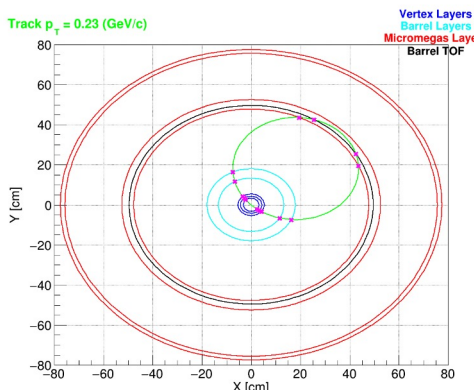
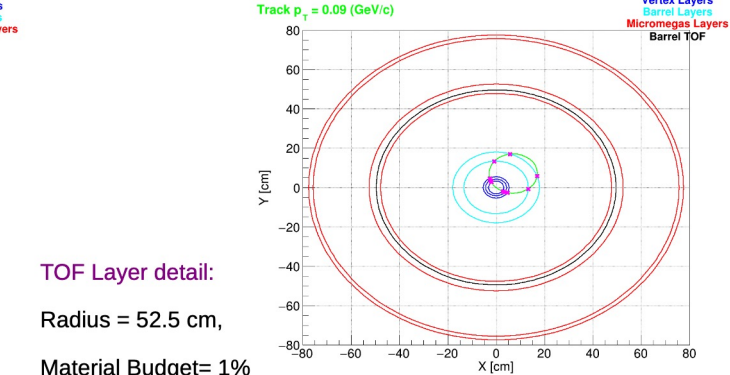
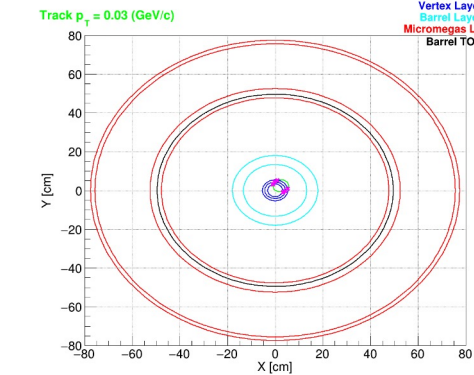
Shyam Kumar

# Fast Simulation Tool

Shyam Kumar

$$p_T \min = 0.3 * 3 * 0.027 = 0.0243 \text{ GeV}/c$$

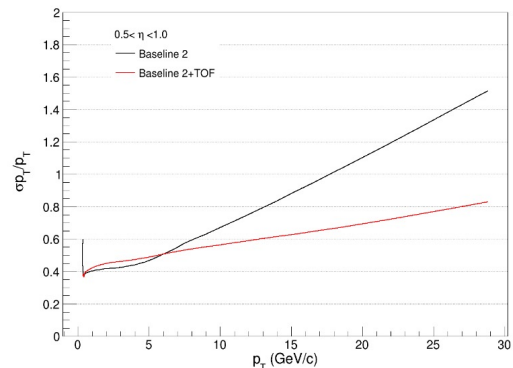
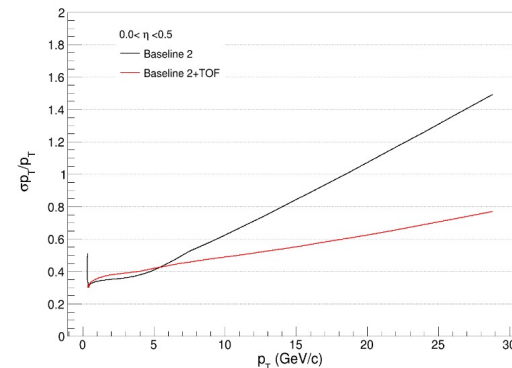
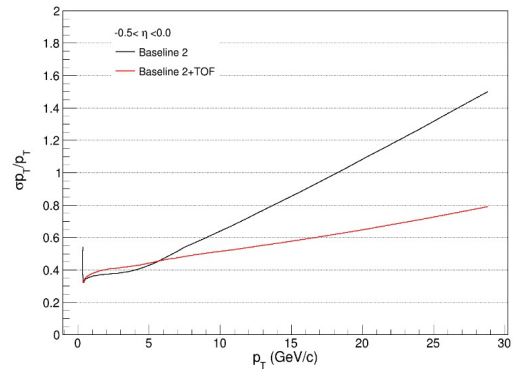
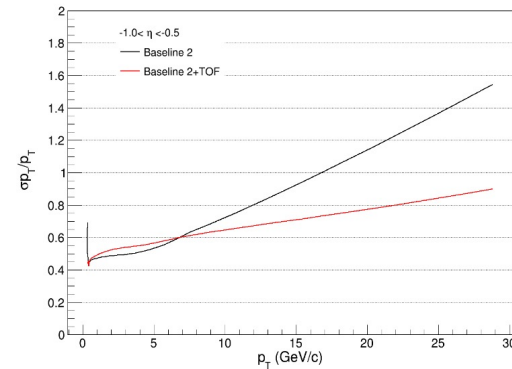
Track with Hit Points



TOF Layer detail:  
Radius = 52.5 cm,  
Material Budget = 1%

$$\sigma_r = 15 \mu\text{m}$$

$$\sigma_z = 2.8 / \sqrt{(12)} \text{ cm}$$



Fast feedback when changin geometry ( radii, material, resolution) . The B field can also be changed

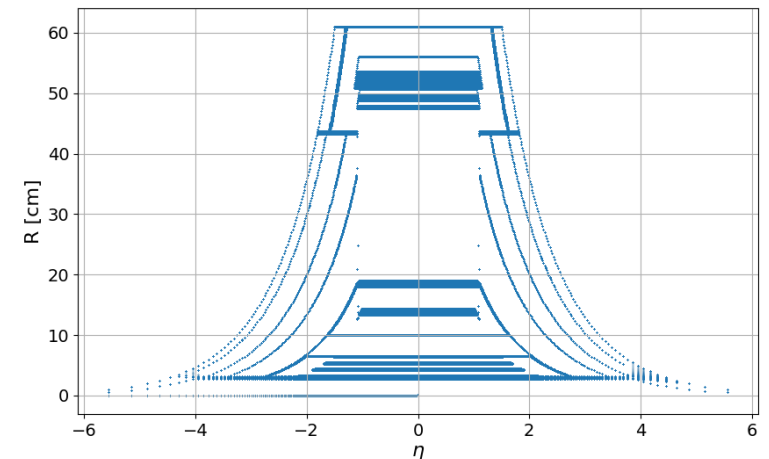
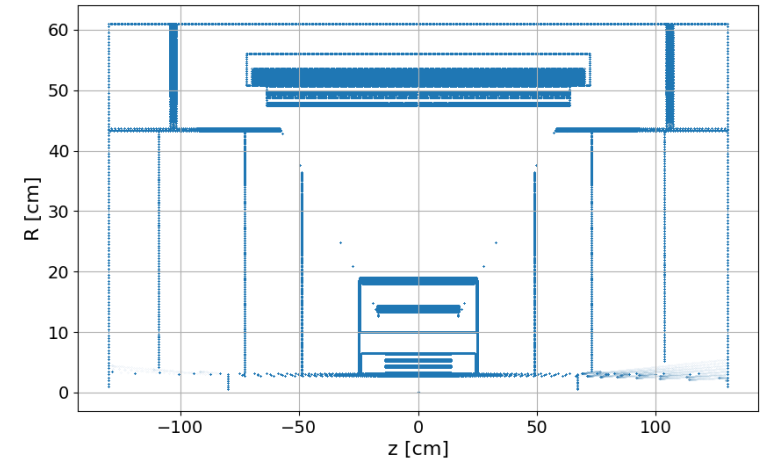
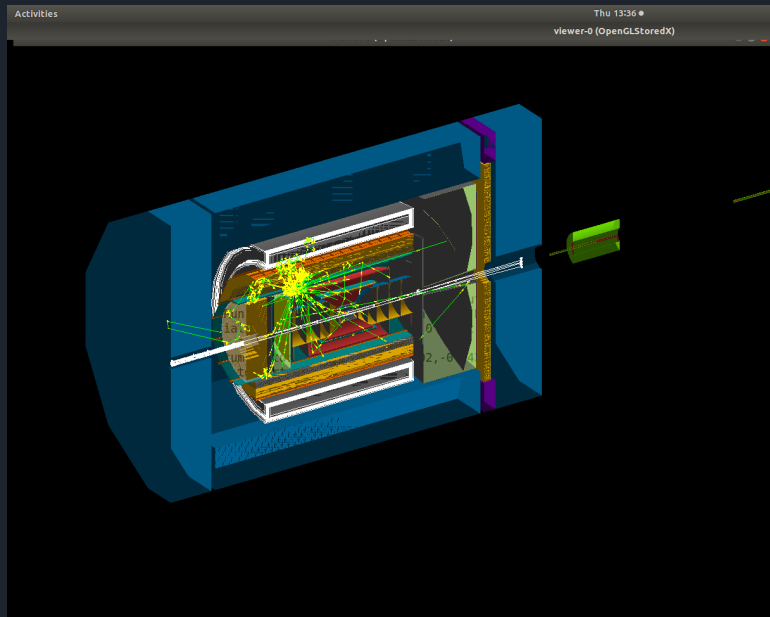


# DD4HEP

The installation was not completely straight-forward

- Issues with juggler
- solved soon by Shyam with a workaround

Abstract sent  
to INFN2022  
by S. Kumar



# Update 2/3

- dRICH:
  - No major activities after the submission of proposal.
  - Some bug fixing and merging have been completed.
  - Currently the software is unstable. The reason is known. We need to do some changes in the data model in our code to make it fixed. It is not yet clear how will the software evolve will be done when the situation is bit clearer.
  - We also foresee to restart the activities related to the pattern recognition. The working method and the group is to be decided.

**C. Chatterjee**

# Update 3/3

- Physics Studies:
  - ATHENA's Exclusive & Tagging PWG (S. Fazio convener)
    - After the the ATHENA proposal submission, the group has focused on refining/completing physics studies, including latest full detector simulation.
    - The group has been moving towards a detailed review publication of the physics studies (currently on hold due to transition following the the DPAP report outcome)
  - EpIC: novel Monte Carlo generator for exclusive processes
    - EpIC is a novel GPD-based event generator for exclusive processes (INFN-Cosenza, BNL, NCBJ-Warsaw, Saclay, Zagreb, Mainz) with TCS and DVCS fully implemented, has been now finalized by including radiative corrections.
    - A paper is in preparation and the Generator will be soon released to the community
    - Next to be done: add DVMP



# Future plans

- Activities will continue according to the decisions taken by the WGs and software coordination WG
- The experience gained so far is very useful for our future challenges
- In view of a new detector and modified magnetic field we would need to develop several studies in the tracking, PID and Physics simulations



# Open Tasks : tracking & PID simulations

- Tracking & Vertexing:
  - Check the tracking performances (  $\sigma_p/p$  and pointing resolution,  $\eta$  dependence) in several scenarios:
    - Fast simulation in more than one detector configurations
    - Full simulation in the simulated detector geometry(ies)
  - Check the same performances with two (or more) B fields
  - Check the reconstruction performance of particles as physics benchmarks (e.g.: D0)
    - Both local and MC simulations (generator)
    - Same checks with different fields
  - Contact persons : D. Elia, A. Mastroserio
- PID : dRICH, development of pattern recognition methods, studies in different configurations and B field
  - Contact person : C. Chatterjee

# Open Tasks : Physics simulations

- DVCS: quantify the effect of the ECAL energy resolution on the reconstruction of kinematics using a full simulation of the detector and realistic PID.
- Exclusive Processes: investigate the possibility of mitigating the systematic effects due to radiative corrections by measuring initial state radiation photons at zero degree with the Lumi detector.
  - contact person: S. Fazio
- Diffractive PDFs: perform a first EIC impact study. CFNS-Stony Brook Workshop on PDFs at EIC (M. Ruspa organizer) <https://indico.bnl.gov/event/14009/>
  - contact person (M. Ruspa)
- HERA4EIC: several analyses at HERA can help tuning EIC Physics Studies and train a younger generation of researchers on data analysis of e+p collisions in collider mode.  
See also CNFS workshop at Stony Brook: <https://indico.bnl.gov/event/9370/>
  - contact persons: M. Ruspa, M. Capua, S. Fazio)

# Summary

- Activities progressed smoothly in the group after the Proposal:
  - After all the studies done in fun4all (full simulations) a versatile analytical tool has been developed check tracking performances. Useful in future.
  - dRICH : well known issues ,to be solved as soon as the new software will be available
- Now waiting for a better idea on how the WG will be organized and which software will be developed /used
- Several open tasks from both detector simulation side and physics side.
  - New people are very welcome!