

Summary of Work Fest: Observables and Detector Performance

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 ePIC General Meeting – Aug 21st, 2025



○ Context:

- pre-TDR “science chapter” – presenting the holistic ePIC detector performance

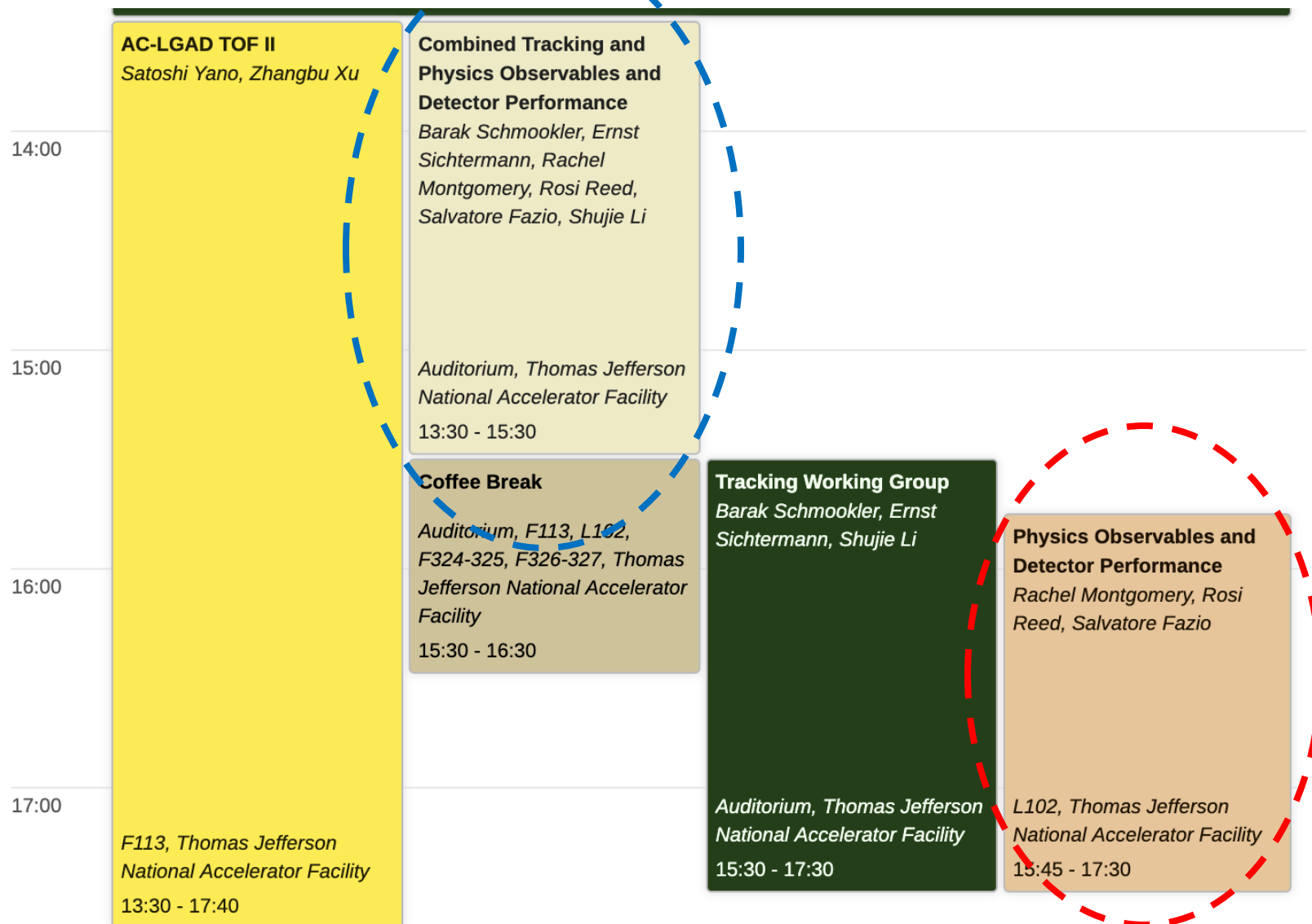
○ Goal of the Work Fest:

- Show progress and ideas towards linking physical observables of different processes and objects/variables reconstruction to detector performance

○ Deliverable:

- Initiate a discussion on the most appropriate global variables (e.g. E-pz, etc.) to showcase performance
- Initiate a conversation between the PWGs and the Cross Cutting WGs

The Agenda



Slot: Wed July 16 afternoon

- First part combined with Tracking
- Second Part stand alone

The Agenda - first part

14:00	Tracking information saved to output ROOT file <i>Barak Schmookler</i>	Electronics (ZOOM) <i>Tonko Ljubicic</i> F113, Thomas Jefferson National Accelerator Facility 13:30 - 14:00
	Vertexing information saved to output ROOT files <i>Dongwi H Dongwi</i>	STOF FPC+Interposer <i>Takashi Hachiya</i> F113, Thomas Jefferson National Accelerator Facility 14:00 - 14:30
	Overview of tracking/vertexing benchmarks <i>Barak Schmookler</i>	Assemble <i>Mathieu Benoit</i>
	Discussion: Physics observables and tracking layout <i>Barak Schmookler et al.</i>	Mechanics Integration and support structure (ZOOM) <i>Andy Jung</i>
	Study of track DCA distributions with DIS events <i>Rongrong Ma</i>	
15:00	Discussion	
	Coffee Break <i>Auditorium, F113, L102, F324-325, F326-327, Thomas Jefferson National Accelerator Facility</i> 15:30 - 16:30	
16:00	Coffee Break	Open Pull Requests <i>Barak Schm...</i>
	Sensor <i>Simone Mazza</i>	Track projections <i>Auditorium, Thomas Jeffers...</i> 16:00 - 16:30
	FCFD (ZOOM) <i>Artur Apresyan</i>	Tracking with background and noise <i>Shujie Li</i>
	First performances of EIC <i>Arzoo Sharma</i>	Benchmark developments
	Discussions <i>F113, Thomas Jefferson Nat...</i> 17:10 - 17:40	
17:00		Inclusive variables - table <i>Tyler Kutz</i>
		Lambda ⁰ benchmark for <i>Sebouh Paul</i>
		Observables benchmarki. <i>Jihee Kim et...</i>
		Physics bechmark for Lo. <i>Derek Glazi...</i>
		Muon ID capabilities <i>Ciprian Gal</i>

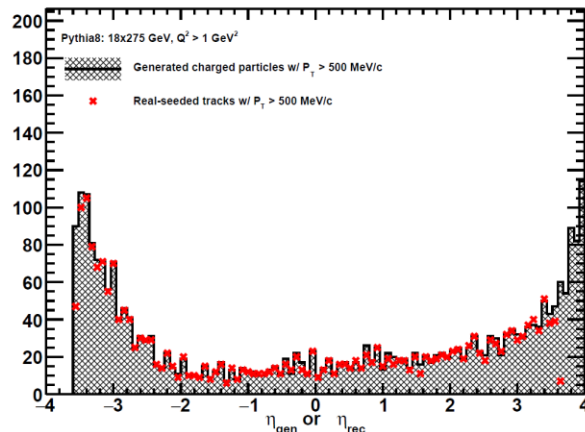
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- First part combined with Tracking
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- Info in the output
- Tracking benchmarks and physics observables + discussion
- Track DCA distributions using DIS simulated events + discussion

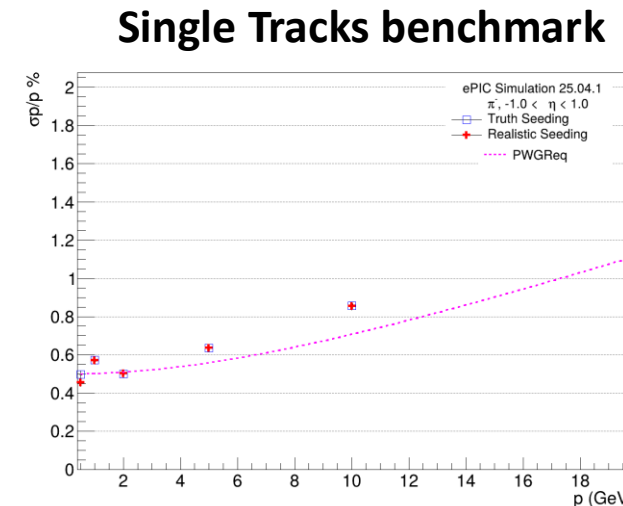
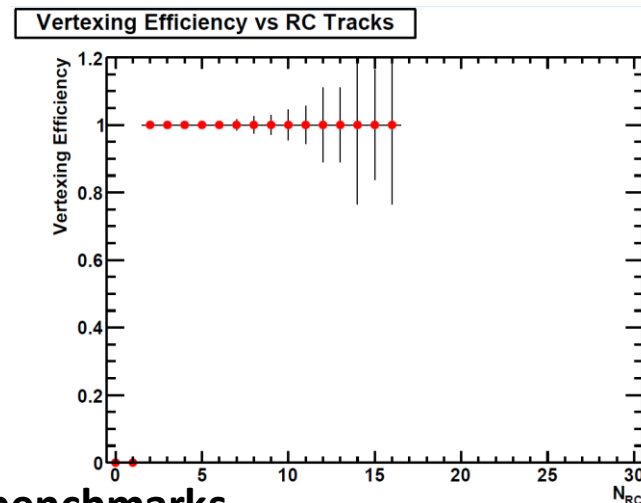
We will work closer together with tracking team in moving forward. For this we have adjusted one of our monthly PAC meeting time slot

Topics touched during the combined session

- Status and progress of **Tracking** and single and secondary **Vertexing** reconstruction codes (Barak and Dongwi)
 - Importance of secondary vertex reconstruction in enabling heavy flavor physics
- Track DCA distributions (Rongrong)
 - Differences in single track DCA distribution between primary vs. secondary tracks are mostly washed out when using reconstructed vertices
- Benchmarks for tracking (Barak)
 - Single tracks benchmarks
 - DIS benchmarks



DIS benchmarks



Topics touched during the combined session

Main points touched at the common **discussion** (chair: Barak)

- Can we determine trackers requirements?
 - E.g., what if the YR momentum requirement for the trackers will be missed?
 - explore the holistic performance: e.g. add the EEEMC and see how it helps [Y.R. requirement was based on the tracker alone!]
- What are the best physics observables to benchmark the current tracking layout?
 - Lower-level physics observables can help, e.g. $E - p_z$
 - Used at HERA to suppress background
 - By conservation of energy and momentum, the sum of $E - p_z$ of all final-state particles equals to twice the electron beam energy
 - PWGs are investigating analysis cuts and resolution of $E - p_z$ in different processes
 - Higher-level physics observables like cross sections: diffractive ϕ in $e+A$, HF production, Charged jets etc.

The Agenda – second part

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- Reconstruction of inclusive variables
- HF (Λ^0) benchmark to ZDC
- Observables sensitive to EEMC
- Low Q2 performance benchmarks
- Can we have Muon ID ?

Session showed that many physics studies exist or are in progress to benchmark our detector

Main takeaways from the second part

- Reconstruction of kinematics (Tyler) is a good first benchmark of detector performance
 - Kinematics rely on different methods, sensitive to different detector components
- $\Lambda^0 \rightarrow n\pi^0 \rightarrow n\gamma\gamma$ events (Sebouh) are a good benchmark for the ZDC performance
 - All three neutrals in the final state go the ZDC
 - Reconstruction of Λ^0 has been implemented in EICrecon and incorporated into detector benchmarks
- Impact of increasing energy threshold in Forward EMCAL (Jihee and Minjung) [upon request by the Calorimetry group]
 - Charmonium ($J/\psi \rightarrow \eta_c + \gamma$) and π^0 productions used as benchmarks
 - A $\sim 2\text{-}3\%$ reduction in photon acceptance observed for charmonium
 - Little to no impact observed on π^0 reconstruction efficiency
- Benchmarks for low- Q^2 (Derek and Simon) scattered electron tagger are in place
- Reasonable job discriminating between pions and muons in the barrel region (Ciprian)
 - Study needs to be extended to FWD and BWD regions



ePIC and EIC Physics Readiness Workshop

Sep 17 – 18, 2025
Europe/London timezone

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The discussion on performance continues!

- **PAC Meeting** dedicated on systematics: <https://indico.bnl.gov/event/29192/>
- Dedicated discussions on holistic performance at the **Physics Readiness Workshop**
 - **Hosted by the Institute of Physics, London [Sep. 17-18]**
 - Indico: <https://indico.global/event/15249/overview>
 - Please register even if attending online (select proper option)