

EIC Early Science WS | Snapshot



- Rachel & Sal already gave detailed summary at 03.27 General Meeting
 - **Today:** drilling into relevant points for reconstruction
 - **Note:** wasn't able to attend all sessions, so perspective is a little skewed
 - ☞ Let me know your perspectives during discussion!
- Two blocks directly relevant to reco:
 - a) **Day 2 discussion on PID & Jet Reco**
 - b) **Day 3 joint S&C session**
- **General impression:** nothing blocking immediate ESR work
 - ☞ But existing priorities remain critical (naturally)

Time	Session Title	Speaker
10:30 - 11:00	HERA to EIC - synergies and prospects (25' + 5')	Paul Newman
11:00	Coffee break	
11:30 - 12:00	Simulation of the dRICH Aerogel and planned performance studies (25' + 5')	Luisa Occhiuto
12:00 - 12:30	Holistic PID reconstruction (25' + 5')	Alexander Kiselev
12:30 - 13:00	Jets reconstruction and control of systematics (25' + 5')	Brian Page
14:00 - 14:20	PID Reconstruction Update	Chandradoy Chatterjee
14:20 - 14:30	Discussion	
14:30 - 14:40	Particle Flow and Electron Finder Algorithms: Update	Dr Derek Anderson
14:40 - 14:50	Muon Finder Algorithm: Update	Stephen Kay
14:50 - 15:00	Discussion	
15:00 - 15:25	Mini-tutorial on background data structure and analysis	Dmitry Romanov
15:25 - 15:45	Background effects in Tracking and Vertex reconstruction	Shujie Li
15:45 - 16:00	Discussion: Machine Backgrounds in Physics Analyses	Dmitri Kalinkin
16:00 - 16:30	Coffee break	
16:30 - 17:15	Simulation Campaign Update	Sakib Rahman
17:15 - 18:00	Rucio	Stephen Kay



- **Right:** end goals of a possible, LHCb-inspired holistic PID development
 - **Excellent thought exercise!** Very useful to me as a PID-outsider!
 - This slide did a good job of summarizing targeted features for w/e scheme we land on

Instead of a summary

The end goal of such a development

- For a PID assignment, treat all ePIC Cherenkov & TOF detectors in a same (or a very similar) way in EICrecon
- *Per default, fit a global event t_0 together with a simultaneous PID assignments to all charged particle tracks across all PID subsystems in the event at once*
 - In addition, for each track give $\log(\mathcal{L})$ estimates for other four PID hypotheses
- Be able to optionally handle any subsystem (or any group of tracks) independently if needed
 - Using perhaps an AI or a different algorithm
- Seamlessly account for contributions of all PID subsystems, even outside of their “nominal” kinematic range
- Account for calorimetry info, in some way
- Be able to retrieve $\log(\mathcal{L})$ contributions of individual subsystems *a posteriori*
 - Just by fixing a t_0 value to its optimal value and re-running for a subset of detectors?



Jet Reco

- **Right:** EICrecon to-do's wrt. jet reconstruction
 - Need to translate this into task list to bring to Jet/HF PWG
 - These are good development tasks to onboard users!
- **Note:** related to discussion on jet reco, Dima & Akio opened [a PR to add calo-only jets!](#)
 - I'll give it a review ASAP...

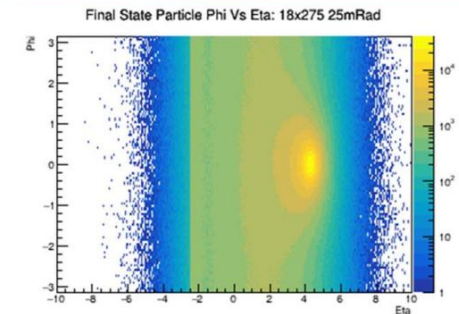
Jet Reconstruction To-Do's

❑ EICrecon To-Do's:

- 1) Investigate performance of Centauro jet factory
- 2) Move to head-on frame to remove crossing angle effects
- 3) Update [algorithm](#), [benchmarks](#) to use new jet datatype when ready
- 4) Wire in PF output to full jet collections when ready
- 5) Remove DIS e^- candidates from *Reconstructed*, *Generated Particles*, wire in filtered collections
- 6) Reassess/optimize kinematic cuts + jet finding algorithms (e.g. p_T^{jet} not ideal to cut on for forward jets)

❑ Notes:

- Jet datatype (right) approved and should be in 26.04 release
- EICrecon jet reconstruction algorithm can be used in analysis code (see snippet [here](#))



```
edm4eic::Jet:
Description: "A reconstructed jet, inspired by the FastJet PseudoJet"
Author: "D. Anderson"
Members:
- uint32_t      type           // Jet type as enumerated in fastjet::JetAlgorithm
- float        area           // Jet area
- float        energy         // Jet energy [GeV]
- float        backgroundEnergyDensity // Background energy density [GeV/area]
- edm4hep::Vector3f momentum // Jet 3-momentum [GeV]
OneToManyRelations:
- edm4eic::ReconstructedParticle constituents // constituents of this jet
ExtraCode:
declaration: ""
/// Compute the background energy in [GeV]\n
float getBackgroundEnergy() const { return getArea() * getBackgroundEnergyDensity(); }\n
-
```



- **Right:** ongoing PID reconstruction work
 - Chandra gave very thorough update on status of all things PID in EICrecon!

Work Ongoing

[PID Update](#)

- Integrating IRT v2 into EICrecon **main**
 - Irt-2.1x branches of IRT v2 already works in EICrecon with several eic-shell versions. Tested, validated.
 - Thanks to Alexander and Dmitry, IRT v2 merging to production state is pretty much in a final configuration. There are few technical factors that Dmitry is taking care. Major issues related to optics port, sandbox quality check are fixed according to main branch standard.
 - Data-model has been approved.
 - Preliminary output to podio standard has been tested.
- hpDIRC has validated their geometry in DD4hep: recent (2 weeks) merged PR in DD4hep geometry to match mechanical model.
- Tests with optical photons are ongoing.

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EIC Early Science WS | eID Work Planning



eID Tasks | Toward Milestone 2 PF/eID Update

Task	Description	Issue/PR/Notes	Exp Campaign	Assignees
eID5	Wire reco DIS electrons into kinematics (step 2)	EiCrecon#2333	26.06.0	OPEN
eID6	Improve DIS selection (adding p_T ranking, etc.)	TBD	CY26.Q2	OPEN
eID7	Improve kinematic calculations (different beams)	TBD	CY26.Q3	OPEN
eID8/PFA4	Integrating PFAalpha + eID	Contingent on PF	CY26.Q3	OPEN

Milestone 2: overlaps with event reco priority to some extent

- Further improvements to DIS selection
- Integration with PF

ETA: still needs more planning to determine scope of work of a few tasks

Notes:

- These tasks might be better done sequentially to assess impact
- Tough to assign specific campaigns for eID6 – eID8 before having clearer picture of work scope

March 19th, 2026 Derek Anderson (JLab), EIC Physics Readiness WS 2026 8/10

eID Status | Longer Term eID/lepID Tasks PF/eID Update

- Below:** longer term eID/event reco topics to keep on our radar, 1st advertised at CM
 - Generalized lepton ID is new! Will discuss more in [Stephen's talk](#)
- Longer Term Topics:**
 - Handling multiple HFS***
 - Multiple e^- candidates means multiple HFS need to be checked
 - Handling multiple eID algorithms***
 - Each will have a HFS + kinematic set attached
 - Doing calculations in EiCrecon can help with combinatorics downstream
 - Algorithm to combine multiple kinematics, HFS***
 - Ideally would have algorithm to integrate over combinatorics, provide default values
- Longer term topics (cont.)
 - Standardized benchmarks + assessing backgrounds**
 - Critical for performance eval.
 - More efficient boost calculation**
 - Boost to CoM really only needs to be calculated once per beam setting
 - Settling boundary between reconstruction, analysis**
 - Broader question which touches on every PWG
 - Where do analysis tools like [RAD](#) fit in?
 - Generalized lepton ID**
 - IDing e^- , μ^- , τ^- crucial to many EIC physics programs
 - Should take principled, unified approach to lepton ID

* **Note:** synergy w/ event reco priority

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- **Left:** milestone 2 tasks for eID development need some elaboration
 - Should coordinate discussion w/ Win & Stephen to work out scope & detailed plan for these tasks
 - Maybe later this month or early May?

- **Right:** longer-term lepID/event reco tasks
 - These are important (and big!) points we need to clarify!
 - Should also coordinate w/ SCC & PAC on organizing discussions on these
 - ☞ The multi-HFS + eID algos points are ones we should also coordinate w/ Win & Stephen



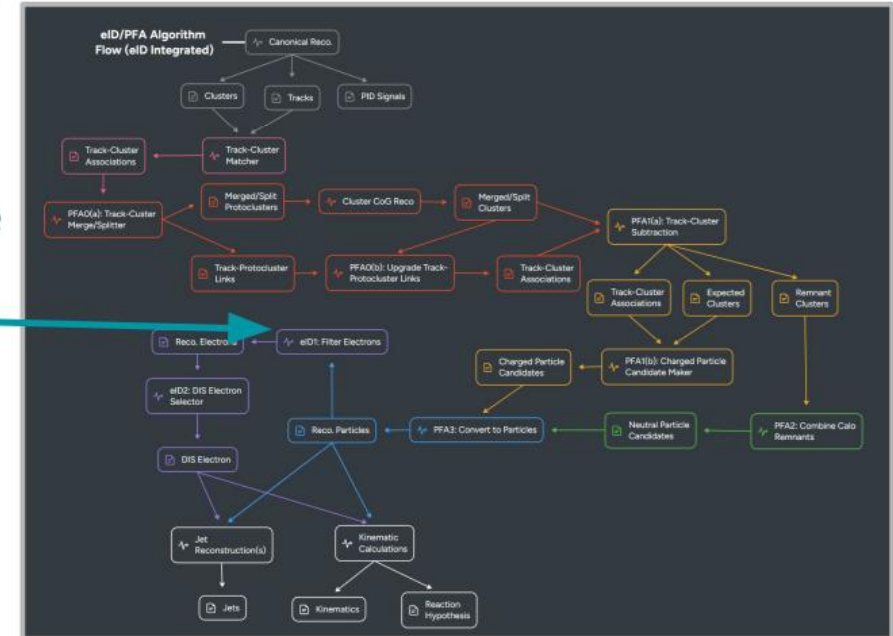
- **Right:** discussion points for generalized lepID
 - Will discuss a little more today!
- ☞ Should reach out to MIT/LANL groups about their tauID studies
 - See [Yasser's talk](#)
 - Will be a useful datapoint for mapping this out...

Discussion

[mulD Update](#)



- Want to shift towards a probabilistic approach
 - Parallels holistic PID
 - Distill cuts down to this
 - Cuts/quantities shown here are part of this
- Fit in as part of eID1?
 - -> lepID1 -> Filter Leptons?
 - [Generic E/p algorithm](#)
- OR separate out?
 - Filter electrons
 - Filter Muons
 - ...



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- **Right:** overview of tau tagging and motivation

- ☞ Should reach out to MIT/LANL groups about their tauID studies
 - See [Yasser's talk](#)
 - Will be a useful datapoint for mapping this out...

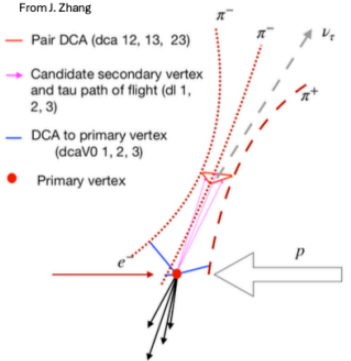
CLFV and Tau tagging at EIC

EIC provides:

- a precise electron - quark collider
- highly polarized electron and proton beams
- great opportunity to search BSM physics signal with displaced vertices.

tauID study

From J. Zhang



— Pair DCA (dca 12, 13, 23)
— Candidate secondary vertex and tau path of flight (dl 1, 2, 3)
— DCA to primary vertex (dcaV0 1, 2, 3)
● Primary vertex

1. $ep \rightarrow \tau X \rightarrow e + E + X$
2. $ep \rightarrow \tau X \rightarrow \mu + E + X$
3. $ep \rightarrow \tau X \rightarrow X_h + E + X$

➔

CLFV study via novel τ -tagging method using ML technique with the ePIC detector:

- Required full ePIC simulation with events containing τ decays
- We did not find official ePIC simulation useful for this study

However...

Yasser Corrales
ePIC and EIC Physics Readiness Workshop
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Machine Backgrounds

Ongoing Discussions

1. **Minimum number of hits per track:**
Coordinator: Barak Schmookler
 - Default (2026.03): **3 hits**
 - Related settings in EICrecon:
 - CKF tracking [config](#)
 - Ambiguity Solver [config](#)
 - Primary Vertex Finder [config](#) → [previous study](#) with 3 hits have issues.
Needs to check vertexing performance with 10um coating and 4 hit cut
 - Learned from tracking studies:
 - 3 → 4 hits: much better purity, slightly lower efficiency
 - 4 → 5 hits: trade off between purity and efficiency
 - Each physics WG is strongly encouraged to check this cut dependence with your [physics channels](#) of interest.
 - Plan to [change the default](#) from 3 to 4 hits if it will not hurt the physics analysis concerning the detector acceptance gaps.

Track/Vtx Backgrounds

Ongoing Discussions

2. **Understand the impact of detector (SVT etc) bad channels**
Coordinators: Ernst Sichtermann(SVT), Barbara Jacak(Tracking), Rachel Montgomery (PWG)
 - **Question:** detector can have bad channels, modules... What is the **acceptable** percentage?
 - **Need plan and coordination:**
 - **Tracker:**
 - in EICrecon, update the digitization algorithm to randomly disable a fraction of sensor units at a given tracking surface
 - Check the impact on tracking through the standard set of performance studies
 - **Other detectors:**
 - is similar study desired?
 - **PWGs:**
 - Acquire simulation with disabled sensor channels, evaluate the impact on specific physics, define "acceptable".

Track/Vtx Backgrounds

Cases to consider

Strawman points:

- Reconstruction with 3 hit tracks (discussed in the [previous talk](#) by Shujie)
 - A cut can be implemented in analysis
 - can become the default for "ReconstructedChargedParticles" - need discussion and decision
 - However, these tracks enter at reconstruction time into
 - primary vertex fitter (see previous slide)
 - "ReconstructedJets" (see slide 3 study by J. Gupta et al.)
 - used to combine tracks and clusters for "ReconstructedParticles" - should become obsolete with implementation of the Particle Flow
 - "HadronicFinalState" ([definition](#)) feeds into some of the "InclusiveKinematics..."
- Calorimetry
 - Currently a challenge question to DSCs
 - Question for us what can be done on the side of the [reconstruction](#)? Clustering algorithms should be "robust" against backgrounds.
- PID (in works by SIDIS and DSCs with current EICrecon integration)
- FF/FB

ePIC and EIC Physics Readiness Workshop, March 19, 2026



- **Left 2 Panels:** ongoing discussions wrt. Background impacts on track/vertex reco
 - Physics analyses can provide very useful input to these discussions!

- **Right Panel:** points to consider when discussing impact of background on reconstruction/physics