ePIC BHCal
Software Planning

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BHCal Specific Tasks | To-do and in-progress

Integrating calibrations in EICrecon

1) Update training to use *associations* rather than single particle events
   - ☞ Tracking info can/should also be integrated
2) Re-optimize (if needed) on realistic event topologies
3) Port models to ORT-compatible framework
   - ☞ Not strictly necessary, but desirable
4) Develop EICrecon tooling to deploy model in a reco algorithm
5) Compare against baseline (manual) regressions

Longer term to-do

- Supporting test-beam studies
  - › Importing test-beam geometry
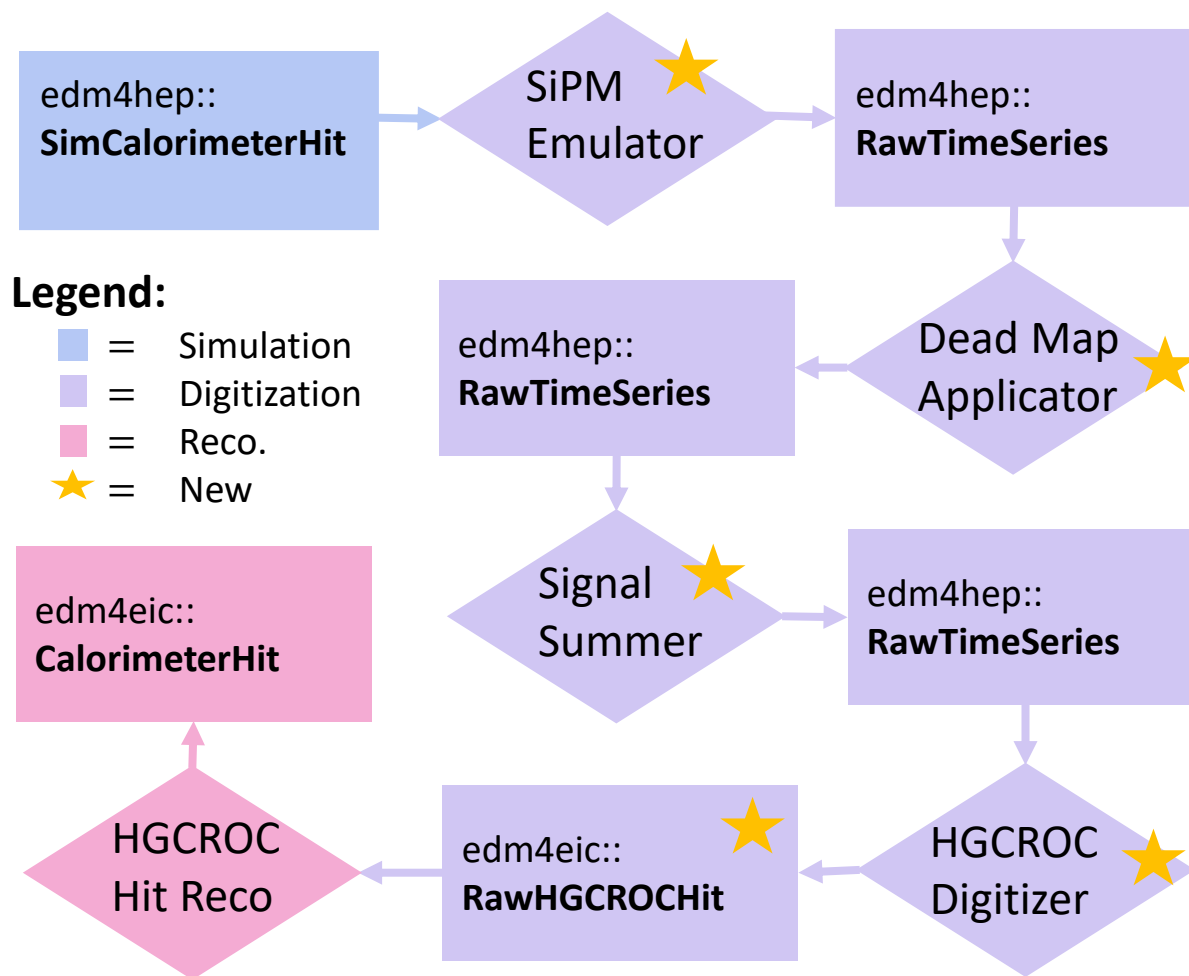 - › Developing data-2-JANA2 infrastructure

In progress tasks/studies

1) Fix misplaced tiles [epic#829]
2) Finish manual calibrations & compare against ML [EpicBHCalPTDRStudies#5]
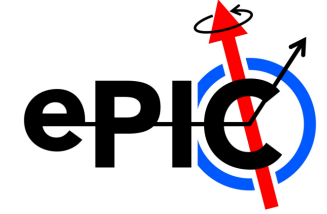3) Muon study from Jihee Kim (BNL)

Studies to-do

- Re-run calibrations after fixing tiles
- Check role of cluster splitting in calibration
  - › Use split/merge clusters, use sum of clusters
- Event reconstruction: EtMiss, JB variables (fig.s 8.195, 8.194)
- Jet reconstruction:
  - › Jet charged/neutral fractions vs. eta (fig. 8.177)
  - › JES/R for full jets (fig.s 8.196, 8.178)

HGC/CALOROC Digitization | Overview

edm4hep::**SimCalorimeterHit**

SiPM Emulator ⭐

edm4hep::**RawTimeSeries**

Legend:
- ▢ = Simulation
- ▢ = Digitization
- ▢ = Reco.
- ⭐ = New

edm4hep::**RawTimeSeries**

Dead Map Applicator ⭐

edm4eic::**CalorimeterHit**

Signal Summer ⭐

edm4hep::**RawTimeSeries**

HGCROC Hit Reco

edm4eic::**RawHGCROCHit** ⭐

HGCROC Digitizer ⭐

- ○ **Longstanding goal of LFHCAL group:**
  - Under discussion for a while…
    - › [02.28.2024] LFHCAL mtg.
    - › 2024 EIC UGM
  - Haven't had the FTEs to implement, though!

- ○ **BIC DSC also studying CALOROC digitization in simulation**
  - See Maria's slides from previous Calo CCWG

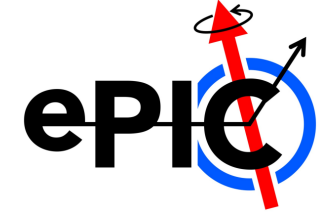- ○ **Now hoping to kick off joint effort b/n LFHCAL, BIC, and BHCal (and more?) to actually implement!**

HGC/CALOROC Digitization | Preliminary Task List

Item	PR/Issue	Assignee/Interested	Target	Notes
Add SiPM++ to shell	n/a	Wouter D. (UM)	Done	See here in eic/spack
SiPM waveform generation algo	To-Do	Afnan S. (LLR), Deepa T. (UT)	TBD	i.e. run SiPM++
HGCROC raw hit type	EDM4eic#101	Derek A. (ISU)	April	Under discussion
Waveform summation algo	To-Do	Fredi B. (ORNL)	TBD	
HGCROC digitization algo	To-Do	Derek A. (ISU)	TBD	
HGCROC reconstruction algo	To-Do	Matt Ng. (LLR)	TBD	

o **Above:** preliminary list of tasks as sketched out during 2024 Lehigh discussion
  – **Likely will evolve significantly after discussion with BIC team!**

o **Note:** SiPM++ (a.k.a. SimSiPM) will need a little vetting
  – Alternatively, can build on approaches other subsystems have taken
    ☞ e.g. TOF and dRICH

Particle Flow | EICrecon Development

Item	PR/Issue	Assignee	Target	Notes
Track-Cluster Matcher	EICrecon#1694	Tristan P. (Lehigh)	Late-Feb.	
PFA0: Update Merge/Splitter	EICrecon#1699	Derek A. (ISU)	Mid-Feb.	Review in-progress!
PFA1(a): Track-Cluster Subtractor	EICrecon#1627	Derek A. (ISU)	Late-Feb.	In dev branch
Charged/Neutral Particles Candidates	EDM4eic#97	Derek A. (ISU)	March	In dev branch
PFA1(b): Charged Candidate Regressor	To-Do	Derek A. (ISU)	March	
PFA2: Remnant Combiner	To-Do	Derek A. (ISU)	April	Might overlap w/ topocluster
PFA3: Particle Converter	To-Do	Derek A. (ISU)	April	
Cross-Calo Topocluster Maker	EICrecon#1561	Tristan P. (Lehigh)	April	

o **Reco WG Priority:** implement PF baseline by 1st half of this year
  – *Significant synergy* with BHCal DSC (and others)!
  – See PF Summary at January CM

o PFA and related machinery critical for BHCal physics:
  a) Full jet reconstruction,
  b) Calo-based lepton ID (i.e. muons),
  c) Neutral reconstruction (i.e. neutrons),
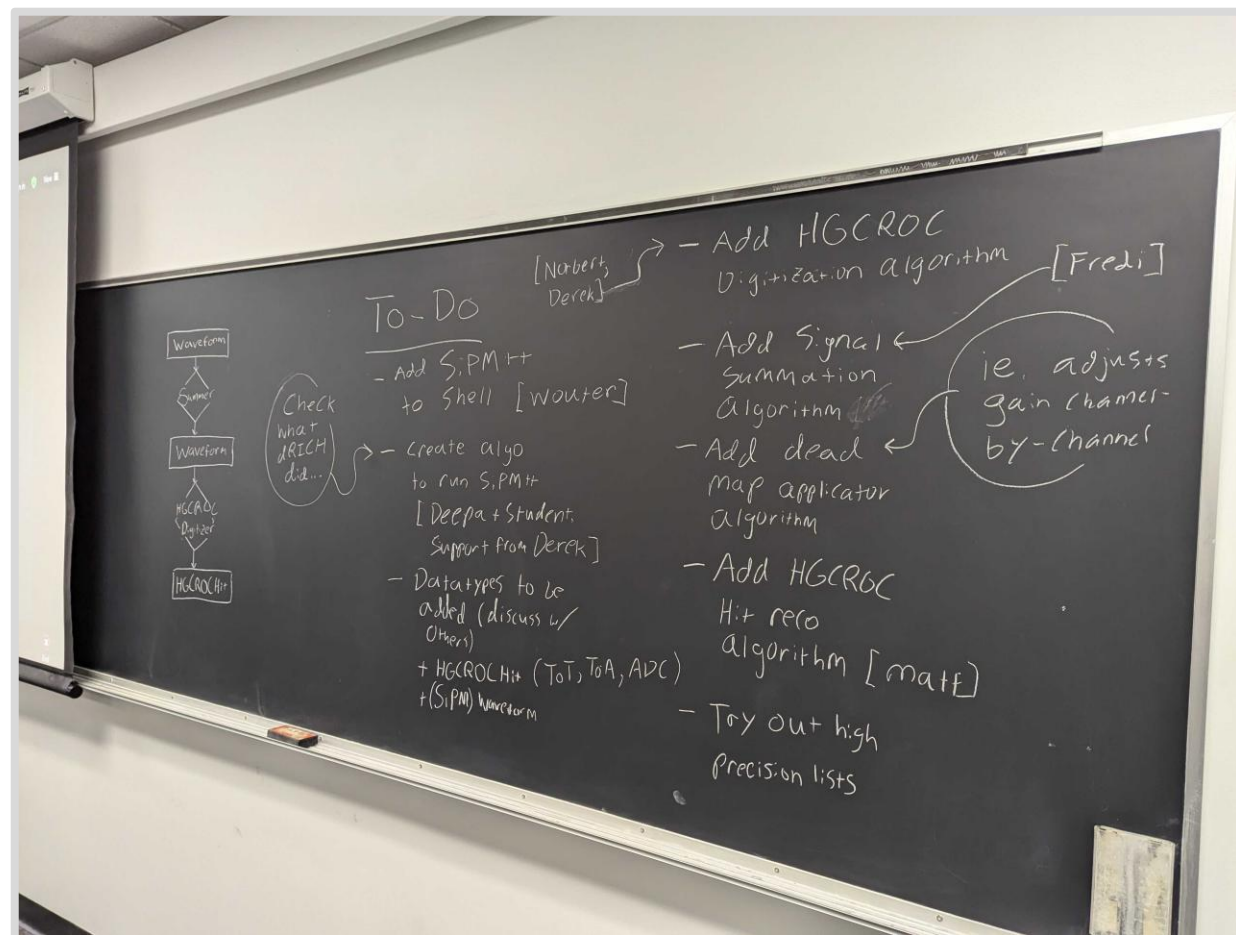 d) Hadronic final state

Particle Flow | Associated tasks

Component	Parameter Tuning	Benchmarking
Track-Cluster Matcher	In progress	To-Do
PFA0: Merge/Splitter	Some done*	To-Do*
PFA1(a): Subtractor	To-Do	To-Do
PFA1(b): Charged Regressor	To-Do	To-Do
PFA2: Remnant Combiner	To-Do	To-Do
PFA3: Neutral Regressor	To-Do	To-Do
CC Topocluster Maker	In progress	To-Do

- **Beyond development:** significant amount of work to be done tuning parameters/benchmarking implementations!
- **New workforce!** Several additional people expressed interest in helping out
  - Olaiya Olokunboyo (NHU)
  - Subhadip Pal (CTU)
  - David Ruth (NHU)
  - Peter Steinberg (BNL)
  - **Thanks!!** 🙏

* **Notes:**
  - Some parameter tuning done for initial implementation
    - ☞ BIC still needs tuning, NHCal should be revisited
  - Benchmarking can build off existing plugin used for testing
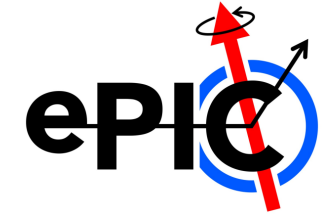
Backup | The Infamous Blackboard

- **Right:** picture of notes from LFHCAL/NHCal discussion at the 2024 Lehigh UGM
  - Sketches out individual tasks/path towards implementation
  - But we need to find the time to actually do it :/

- **Note:** other tasks specified in list
  - Check impact of high-precision physics lists on LFHCAL response
  - Implement BHCal, LHFCAL test beam geometries in DD4hep

Backup | PFA Algorithm Flow

o **Right:** schematic of the proposed sequence of PF algorithms/types
  - Also illustrates how output will interface with jet reconstruction