ARTIC
Advanced PFA in Pandora (EoI-145)

Gérald Grenier & Vincent Boudry

IP2I, CNRS/UCBL@Lyon   LLR, CNRS/IPP@Palaiseau

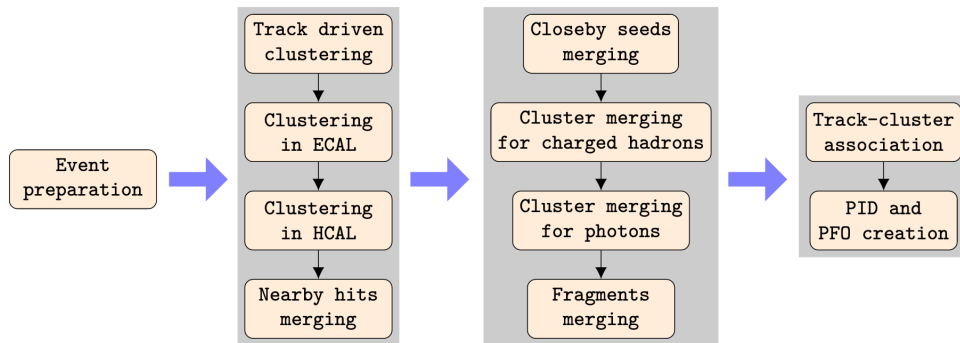**AIDA++ Software WP preparation**
22/11/2019

ARBOR like PFA sw

ARBOR PFA SW in continuous development:

– LLR + IHEP (M. Ruan + H. Videau + VB) → **ARBOR** in use for CEPC + some ILD Studies

- Partial re-writing in AIDA (Bo LI @ LLR + IPNL)
- implementation of Lepton ID (LICH)

APRIL (Algorithm of Particle Reconstruction for the ILC   LCWS'2019 ↗)

– IPNL (R. Été + B. Li + GG) : Complete re-write in Pandora SDK

- **ILCSoft** (`https://github.com/iLCSoft`)
  - ▸ **Marlin** [9]
  - ▸ Geometry: ILD detector model (ILD_l5_o2_v02) implemented in **lcgeo**, which is based on **DD4hep** [10]
  - ▸ Digitizers of SDHCAL: SimDigital in **MarlinReco**)
  - ▸ **LCCalibration**: automated energy calibration for calorimeters at ILC (`https://github.com/iLCSoft/LCCalibration`).
- **mlpack** [11]: NeighborSearch, DBSCAN(Density-based spatial clustering of applications with noise).

AIDA++ Completion, tentative planning

Deliverable 1: APRIL PFA

> Long standing work
> @ LLR and IPNL, IHEP

- M1: usable code: [M12]

- D1: optimised for various setup (ILD, CEPC, FCC) ? [M36+]

Deliverable 2: PFA performance detailed comparison tools.

- M1: Beyond the global performances: comparison of clustering results (distance, Rand-index), e.g. wrt to MC truth

- D2: provide tool [M18]

Deliverable 3: 3D+ pattern recognition tools for particle PFA

- M1: Pattern recognition for reclustering [M24]

  - Application of various algo, esp. EM [F. Magniette, 2018]

    - using CALICE data (shower shapes)

- M2: Application to and from PID [M36]

Cluster merging

- For cluster merging, the **order of cluster connection is proposed** for cluster merging in analog to $\kappa = \theta^{p_\theta} \times d^{p_d}$ in hit clustering, and the geometrical properties of cluster are utilized

  - Distances: COG distance; closest distance approach;
  - Angles: cluster axis; direction between clusters.

- The energy criteria for cluster merging

  - $\chi = (E_c - p_t)/\sigma_{E_c}$
  - σ_{E_c}
    - HCAL: $0.55/\sqrt{E_c}$ for hadrons.
    - ECAL: $0.15/\sqrt{E_c}$?
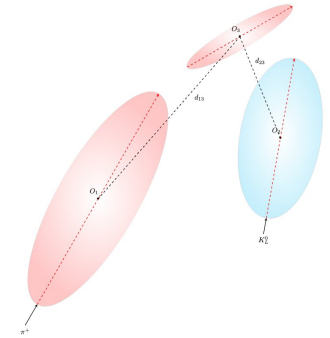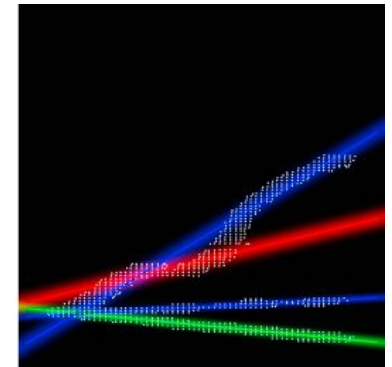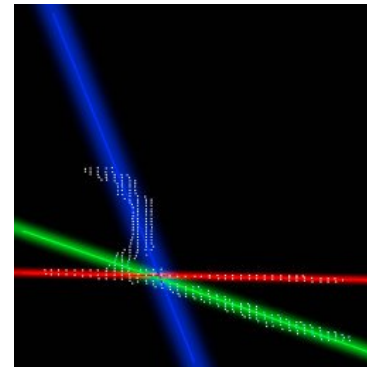

Figure: Merging between charged and neutral cluster.

HARPO (B-less TPC), track finding of triplet

Ressources

Too Scarce (off course)!!!

Request:

- ~ 190k€ for 390k€ matching
    - (a) = one PhD student for 3 years + 10k€ missions
    - (b) =   0.25 FTE salary for 4 years × 3 *(VB, J.C Brient, PD-LLR)
        0.25 FTE, G. Grenier, assistant professor, for 4 years = 90 kEUR
- With 6M FTE... no travel (?)
    - Contract extension of existing PD only...
    - Delay in production → planning to be reviewed

Institutes

- Full benef: CNRS + UCBL ? (only IPNL ?)
- Collab: IHEP