Software Coordinators Report

ILD Software and Analysis Meeting

11.05.22

Frank Gaede, DESY

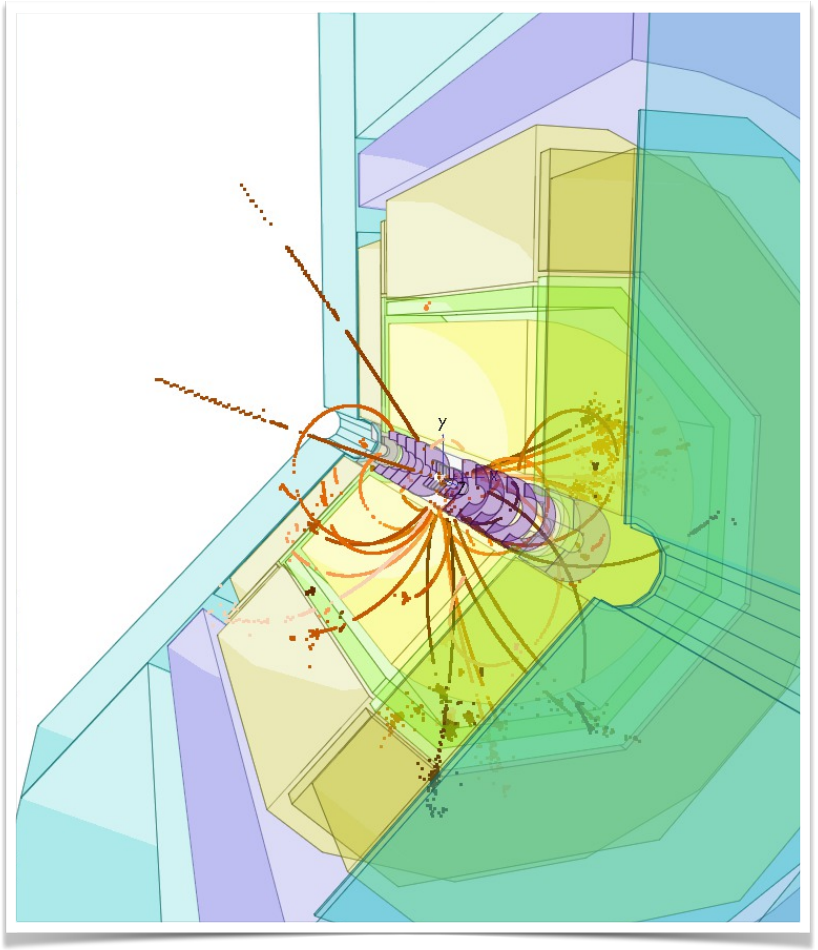
HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

Outline

- Generator
- Simulation
- Reconstruction
- Monte Carlo Production

some highlights from ECFA Higgs factory topical meeting at DESY last week

SW convenors meeting last Friday was cancelled



Generator

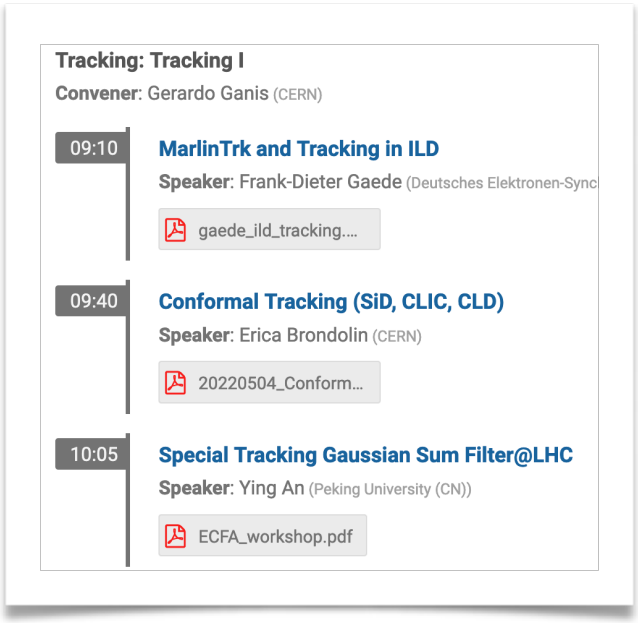
J.Tian, M.Berggren

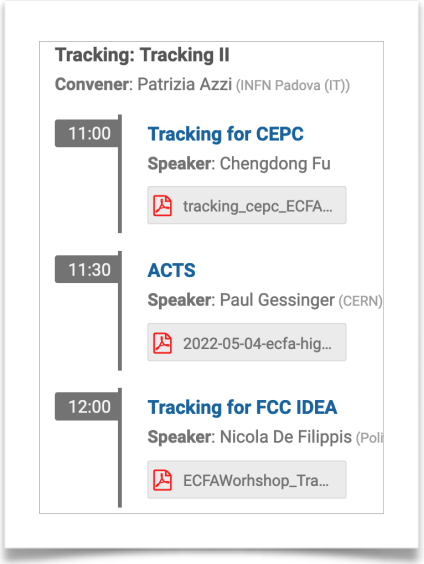
- started to prepare generation of Adrian's request for 2f-hadronic at 500 with the mc2020 chain
  - ~900 files, each with 100k events, i.e. 90 million events
  - 300 MB/file -> total of 300 GB for generated files
    - more for DSTs
- details of exact production version to be used for reconstruction to be discussed

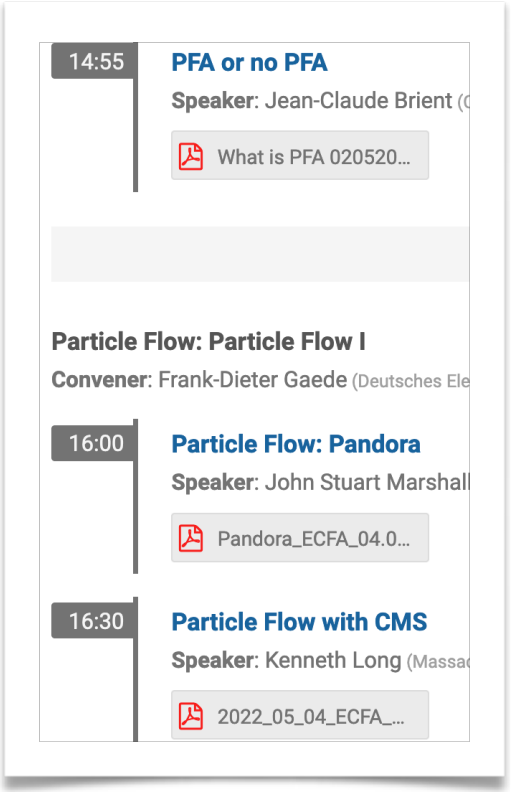
- recently generated new sample at 550 GeV for H-self-coupling study
  - see talk by Julie Torndal today

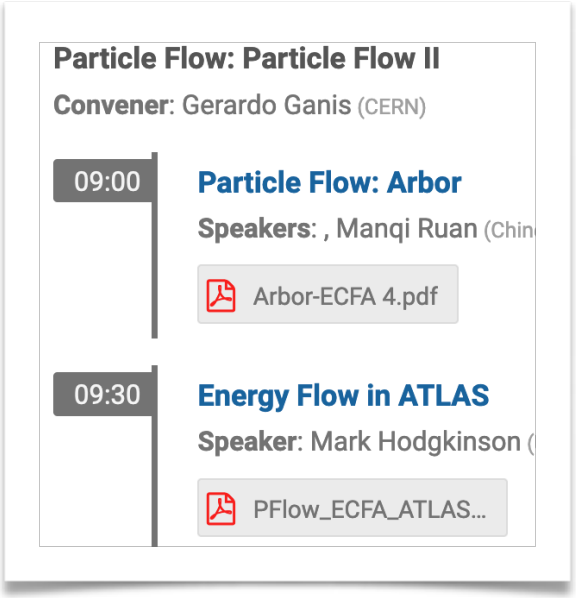
ECFA Higgs Factories: 1st Topical Meeting on Reconstruction

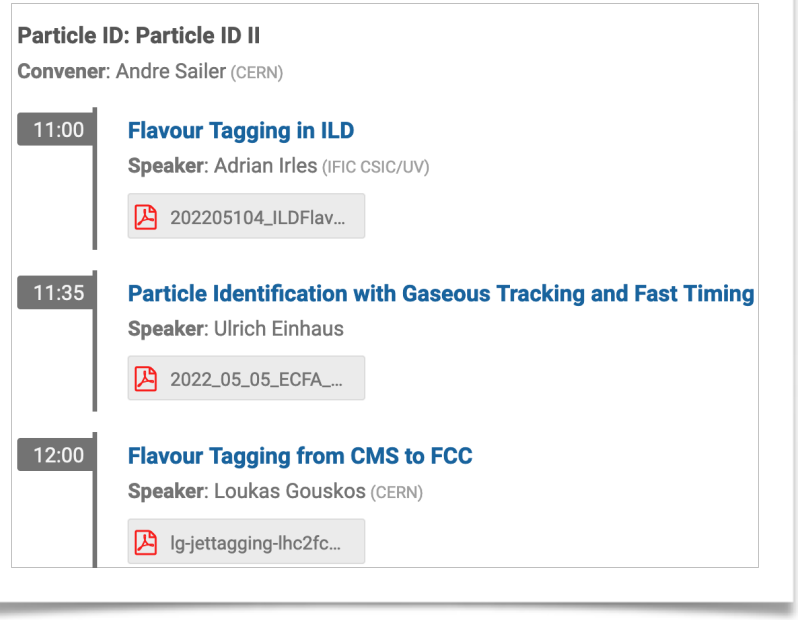
4./5. may at DESY











- organized by WG2 of the ECFA Higgs study group
- take stock of reconstruction tools and algorithms
  - what is currently used
  - under development
  - common activities

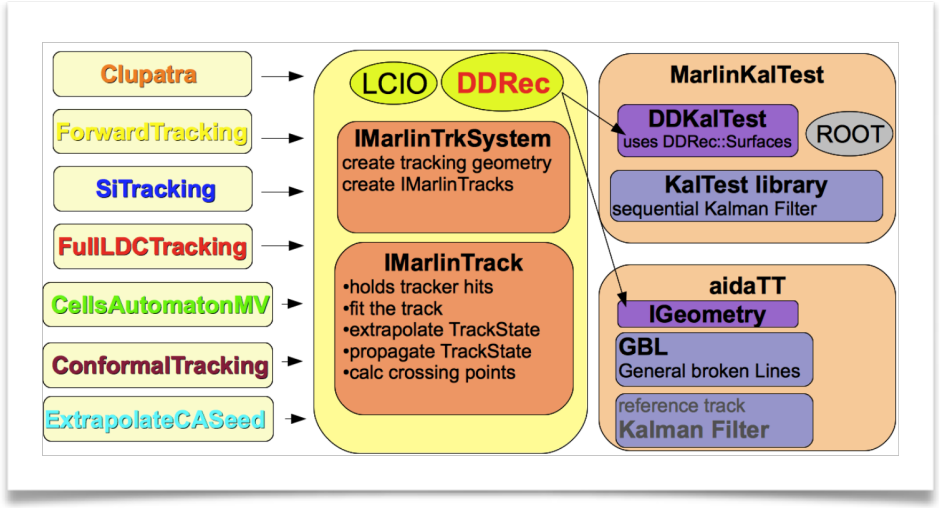
https://indico.cern.ch/event/1124095/

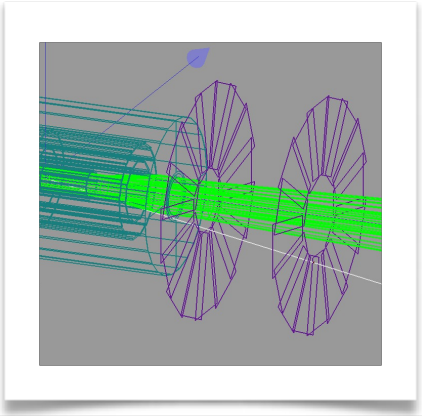
FG, E.Brondolin

Tracking at LCs

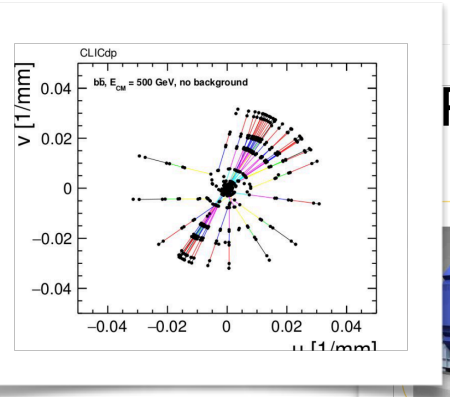
ILD, CLIC, SiD, …

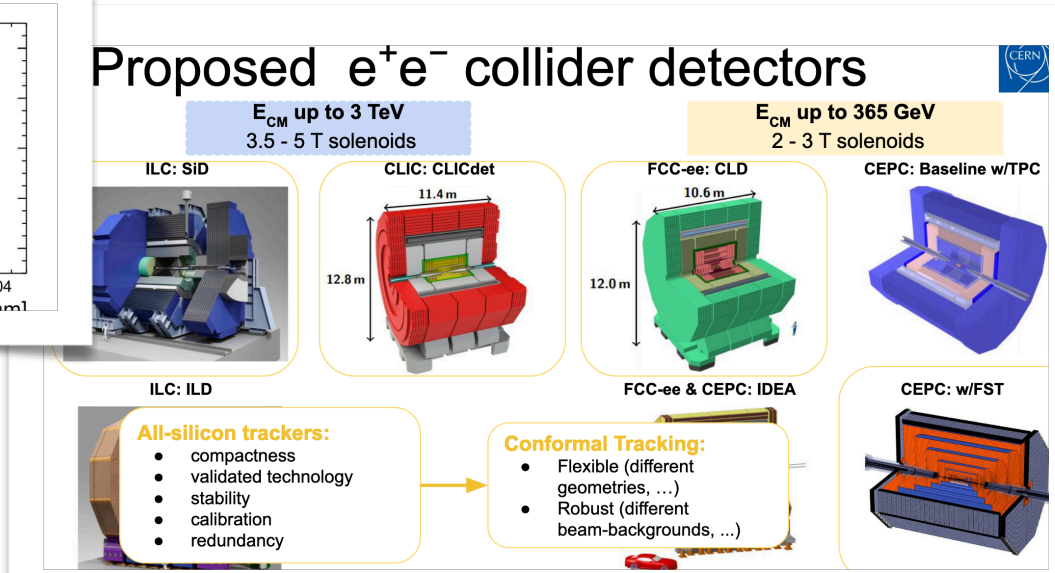
- large production quality code base for track finding and fitting exists in iLCSoft
- needs to preserved when moving to **Key4hep**
- possible w/ MarlinWrapper

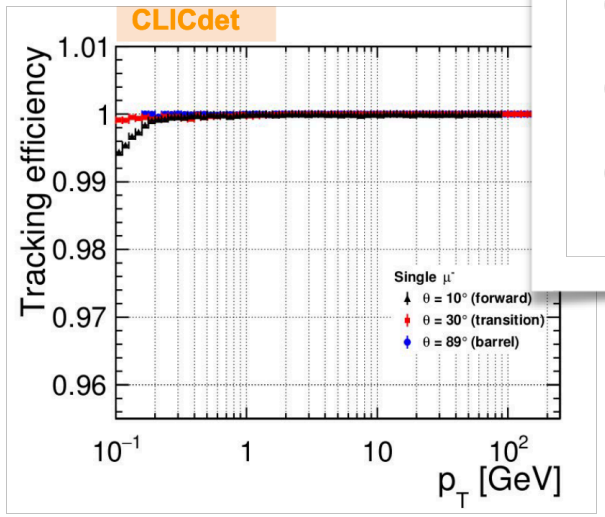


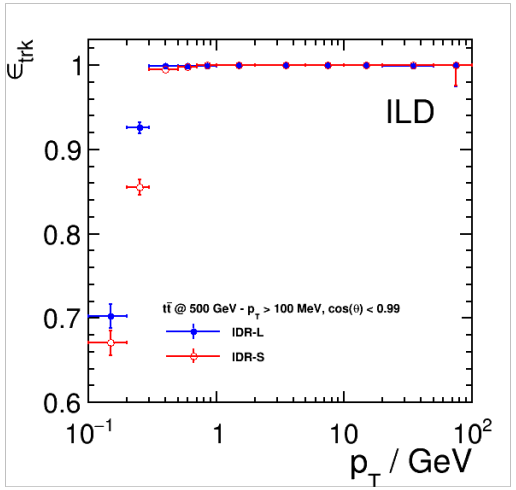


plan to add **ACTS** to MarlinTrk







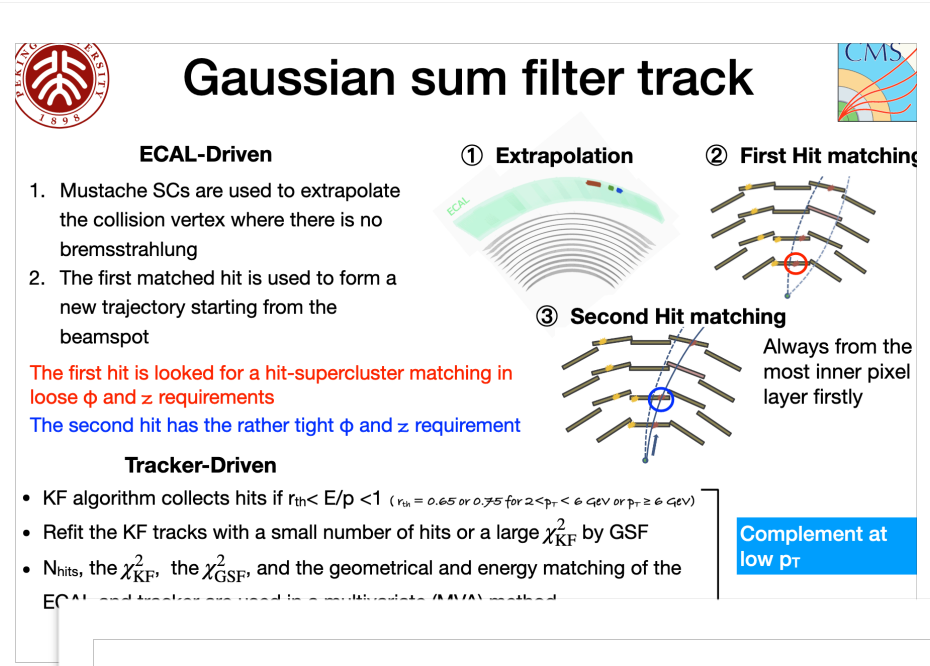


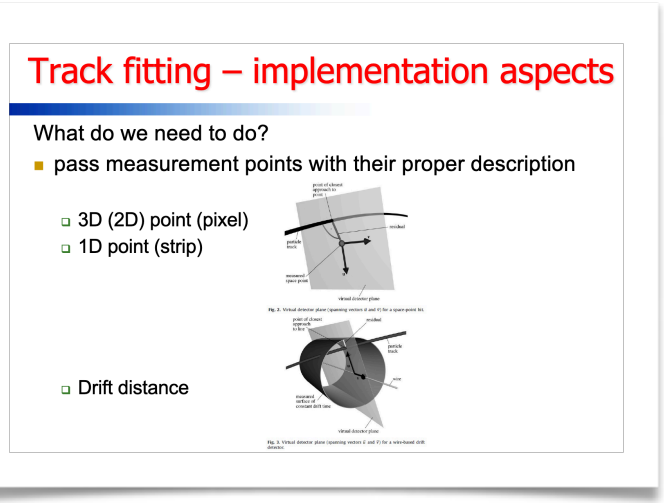
Other Tracking

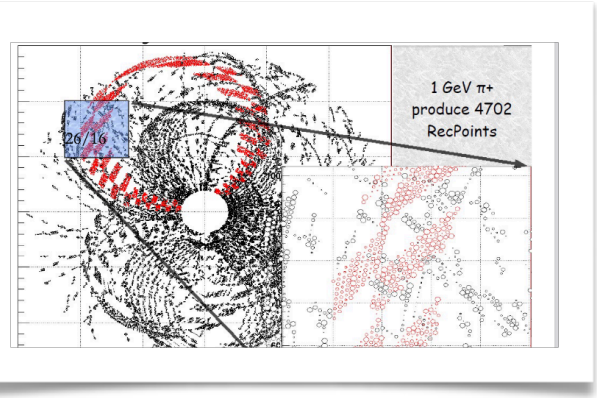
at LHC, CEPC

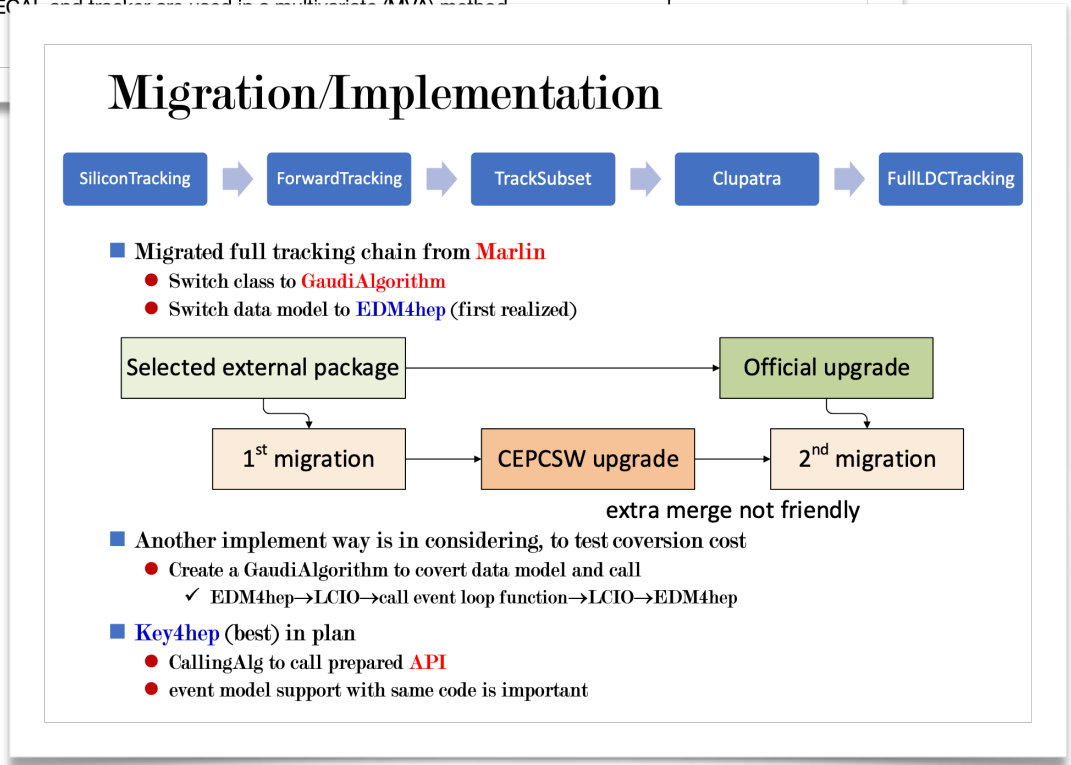
C.Fu, Y. An, N. de Filipips

- @LHC use of Gaussian sum filters for e-reco
  - do we really need this at ILD ?
- @CEPC: started to investigate porting of existing parred code to key4hep
- @IDEA: need tracking code for a drift chamber
  - not (yet) available in iLCsoft, MarlinTrk, key4hep







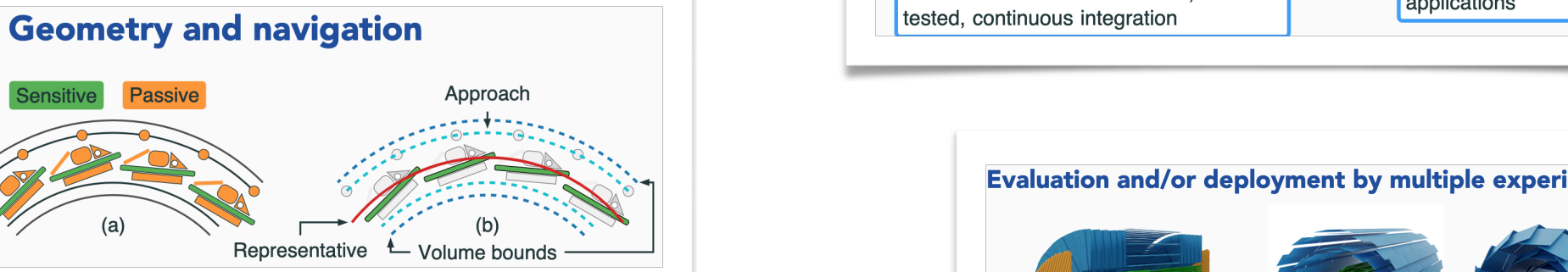


ACTS

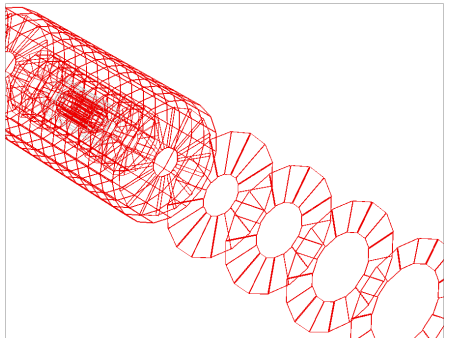
the new community tracking toolkit

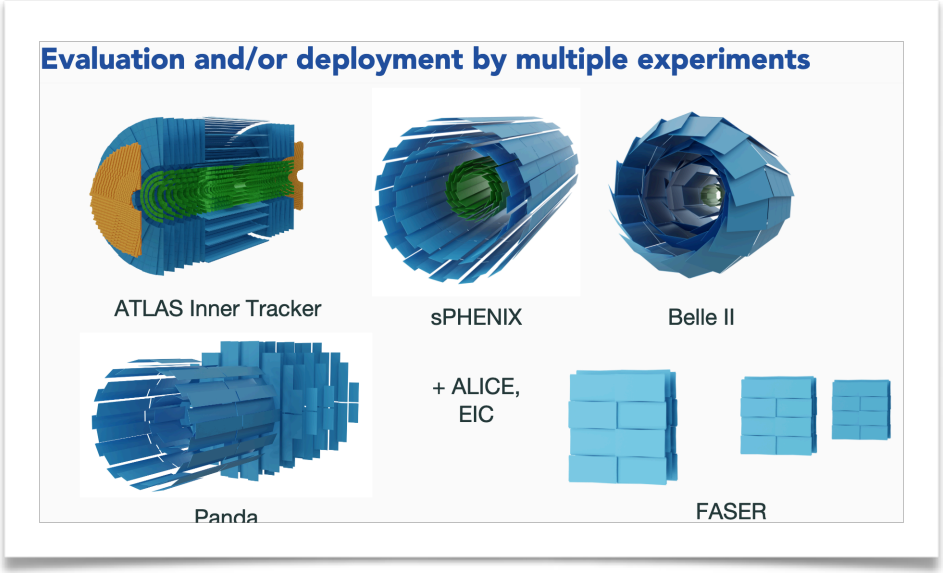
P.Gessinger

- based on ATLAS tracking code
- much faster filters and navigation
- need to investigate the use of ACTS in ILD tracking
- biggest question: can we re-use our *ddrec::surface* geometry for this ?



work on DD4hep geometry for ACTS has started…

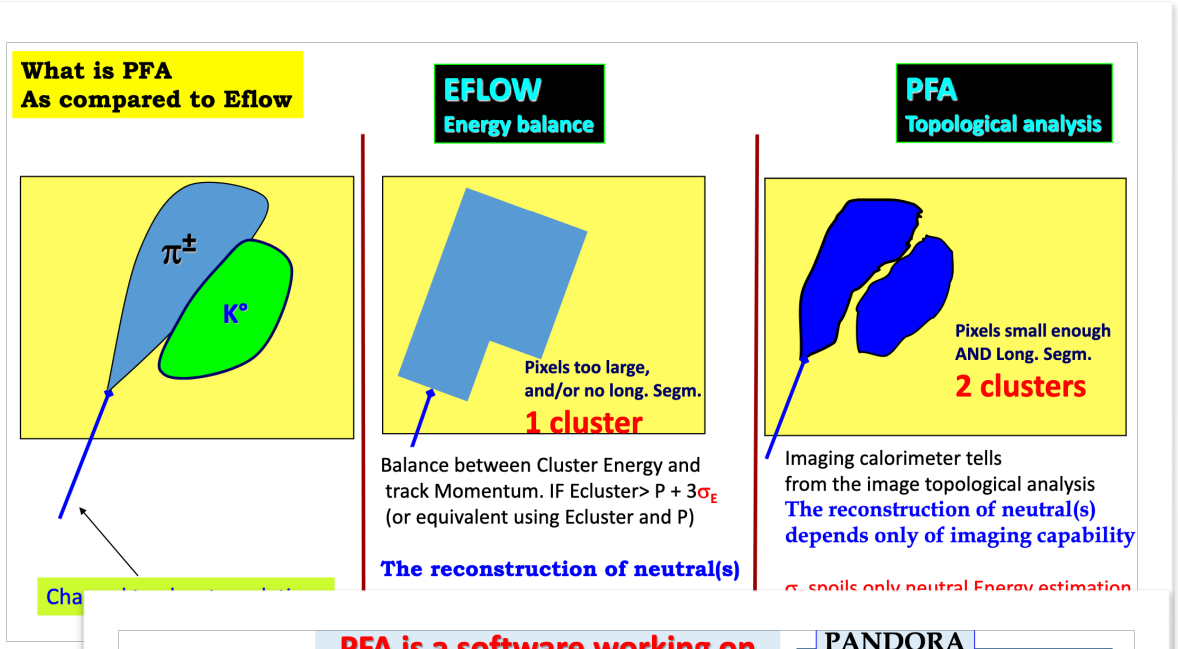


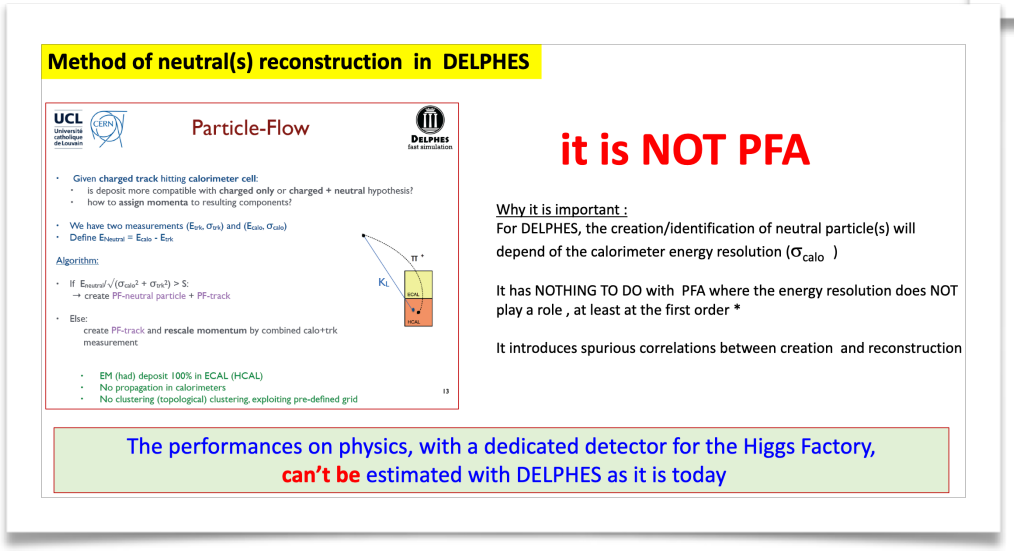


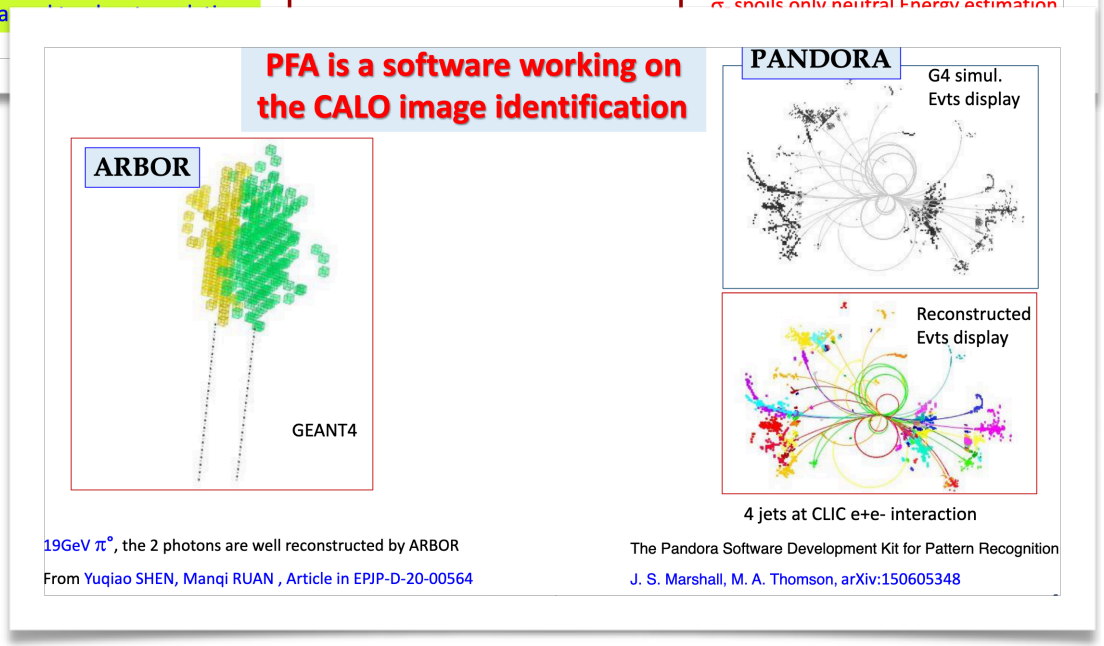
PFA and fast simulation

J.C.Brient

- reminder that PFA cannot be developed and understood w/ fast parameterised (smearing) simulations such as Delphes
- **confusion in imaging calorimeters is important**
- some attempt mad in SGV to parametrise this…





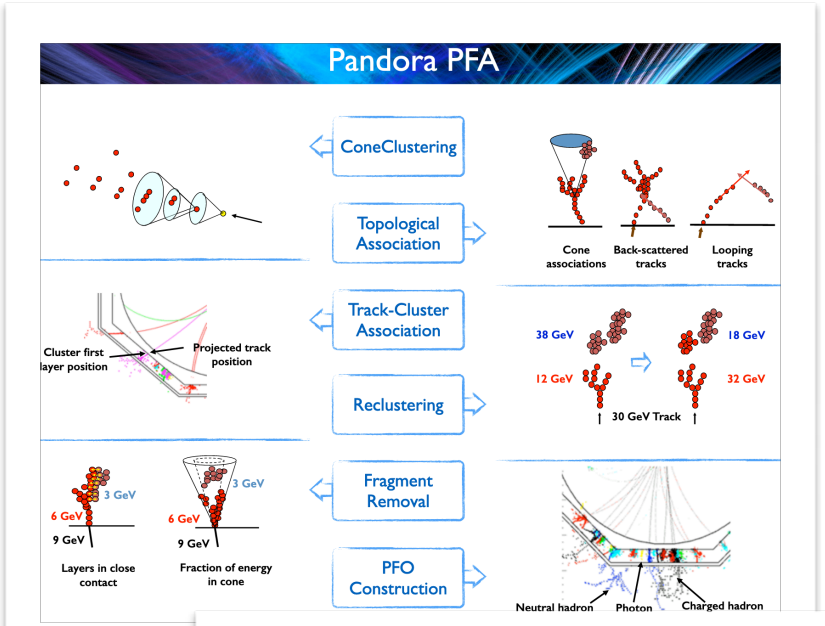


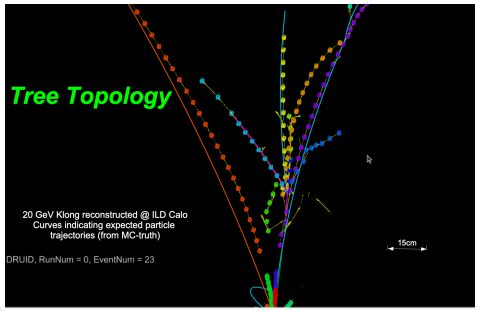
J.Marshall, M.Ruan

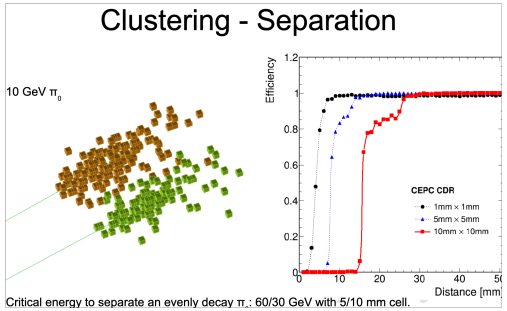
PFA at ILC, CLIC & CEPC

PandoraPFA and Arbor

- linear collider and CEPC have sophisticated PFA algorithms
- set the standard for JER w/ highly granular calorimeters at Higgs factories







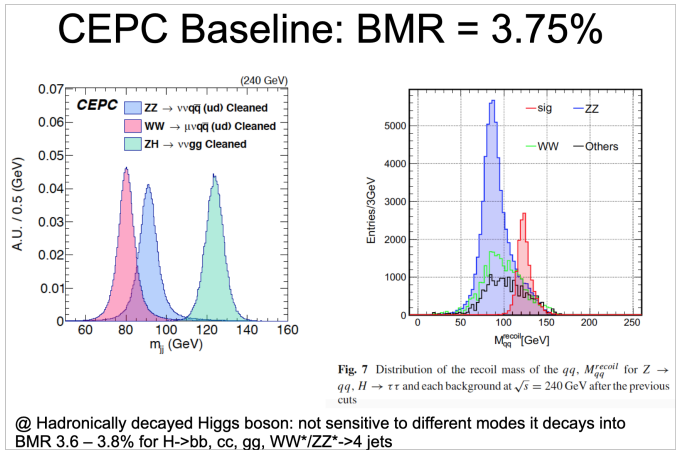
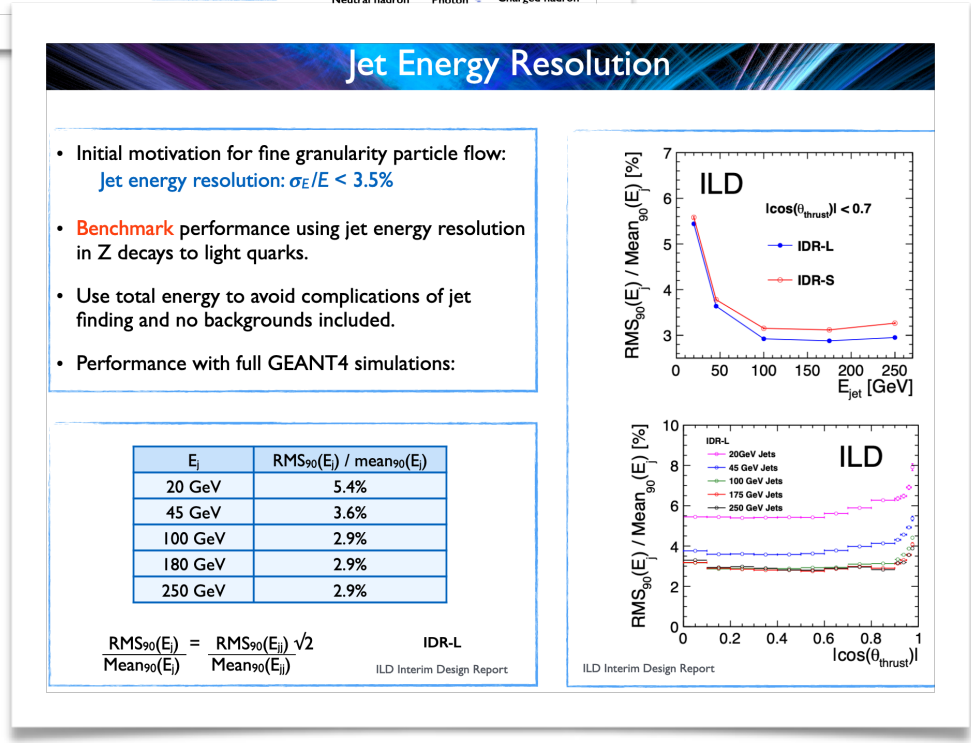


Fig. 7 Distribution of the recoil mass of the qq, M_{qq}^{recoil} for $Z \to qq$, $H \to \tau\tau$ and each background at $\sqrt{s} = 240$ GeV after the previous cuts



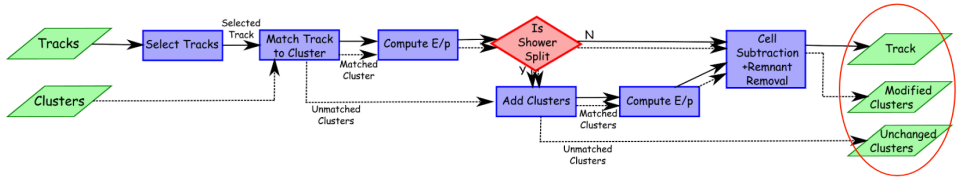
M.Hodginson, K.Long

PFA at LHC

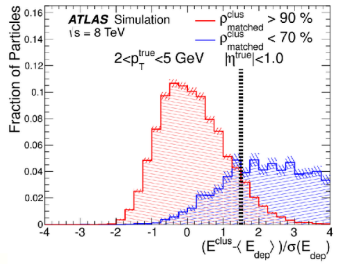
ATLAS and CMS

- also at LHC Particle(Energy) Flow algorithms used
  - yet much coarser calorimeters (except HGCal)
  - not clear that we can benefit from these algorithms

Particle Flow for Jets



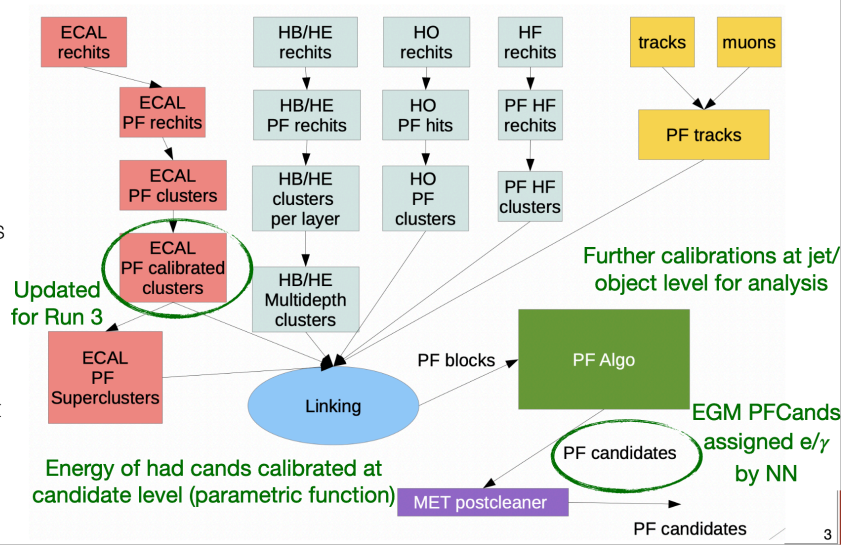
ATLAS EXPERIMENT



- A key part to the improvement in the resolution is the successful removal

Quick overview of CMS particle flow

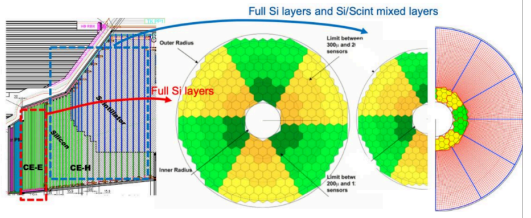
- Reconstructed hits in detector (rechits) originally calibrated in test beams
- Hits collected into clusters and tracks
- Linking step builds "blocks" of elements (tracks/clusters)
- Further calibration steps at cluster/ candidate level
- Event-level checks modify PF object list in cases where artificial MET is created

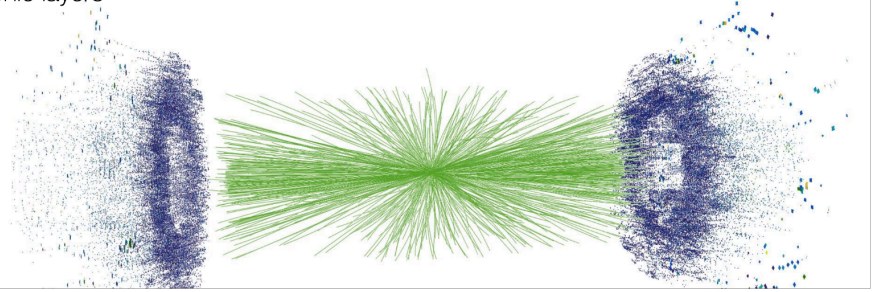


Kenneth Long 3

CMS upgrade and particle flow

- The high granularity calorimeter (HGCAL) is one of the ways CMS will **combat the challenges of high pileup**
  - Sampling calorimeter with very high longitudinal granularity
  - ~6 M hexagonal silicon sensors, ~1 cm²
  - ~14 layers with plastic scintilator, ~240k channels
  - 28 EM layers + 22 hadronic layers
- "Imaging" calorimeter that presents unique challenges wrt current CMS calorimeters

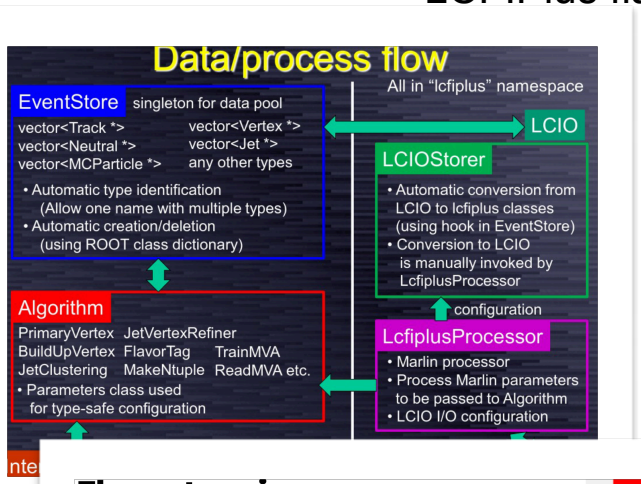




Particle ID

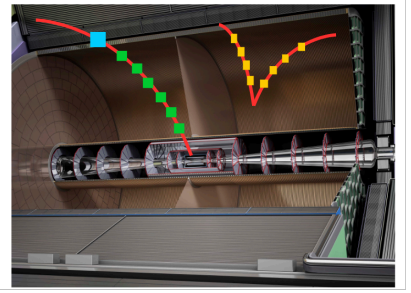
HLR tools developed in ILD

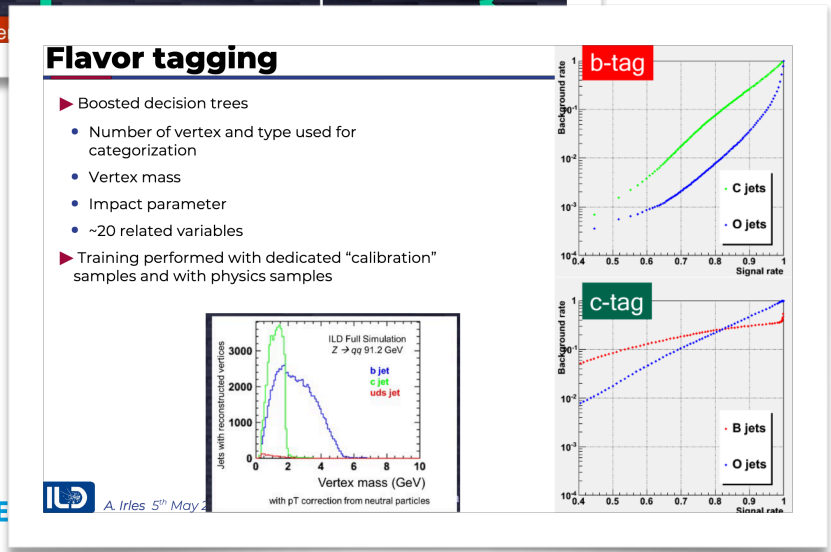
- very nice talks on ILD HLR tools
  - dE/dx and TOF based PID
  - LCFIPlus flavor tagging

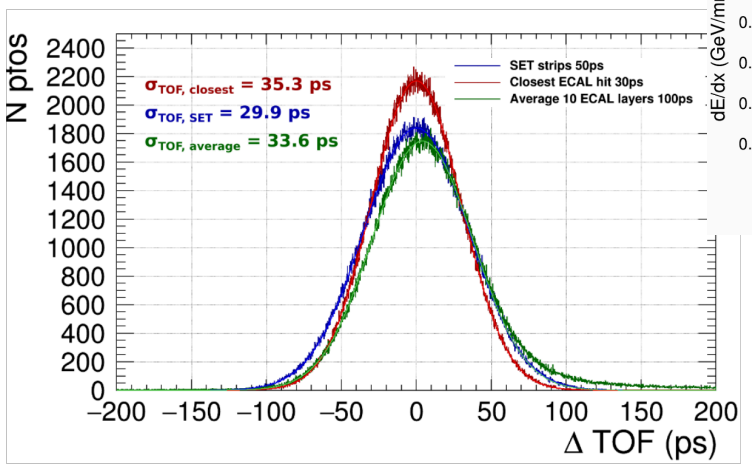


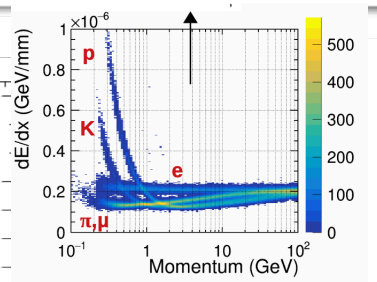
Particle Identification at ILD

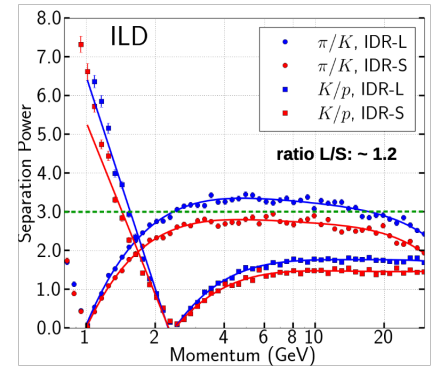
- Pandora particle flow: electrons / muons / charged hadrons / photons / neutral hadrons
- **Time projection chamber dE/dx**: (electrons / muons /) pions / kaons / protons
- **Time of flight**: (electrons / muons /) pions / kaons / protons
- **Appearing double tracks = V0 finding**: K^0_S, Λ^0, photon conversion
- Low momentum muon/pion separation
- Shower shapes analyser (adds to particle flow)
- π^0, τ, J/Ψ finding, e.a.
- Combined in LikelihoodPID











Summary

personal impression

- very interesting workshop
  - great to have (some) participants in the room again
- good overview on reconstruction algorithms for future Higgs factories
  - a significant fraction provided by the iLCSoft tools developed in the community over the last decade(s)
- implication for ILD
  - need to continue to work w/ the larger future collider community
  - continue the transition to key4hep while preserving all the existing tools and knowledge
- major next steps:
  - ACTS integration and LCIO->EDM4hep transition