ILD tracker meeting
TPC
Introduction

CERN, January 15, 2024

- A TPC is essential for PID using dE/dx, though a TOF with 10 ps or less resolution can help for moderate momenta (<20 GeV)
- However, at Z pole (we assume lumi of 2.10^{36} cm^{-2} s^{-1} for circular colliders) there is a huge production of (slow) positive ions, plus possibly a feed-back from the multiplication space. At the HZ max rate energy
- A drift chamber can also use dE/dx (by cluster counting), but has certain difficulties (more matter, high mechanical tension, possible lack of robustness for 40,000 wires). As the drift distance is O(few cm), it is less sensitive to distortions from space charge than a TPC – but the study has not been made so far.
- Gaseous detectors are more transparent than solid-state (unless extremely thinned sensors can be made)
- On a circular collider, to reach the maximum lumi at the Z pole, the B field has to be lowered to 2T (possibly 3T with a reduction of lumi). This also has consequences on the point resolution (higher diffusion because of lower $\omega\tau$, larger radius of curvature) .

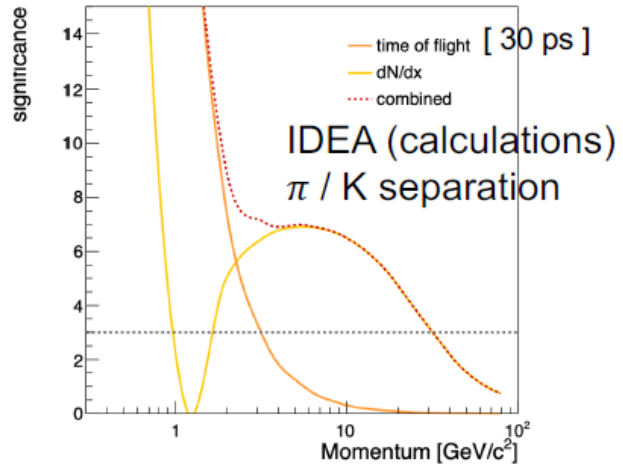
Charged hadron PID

- Essential for flavour physics / spectroscopy - from very low p to ~ 40 GeV
- Key input for strange tagging

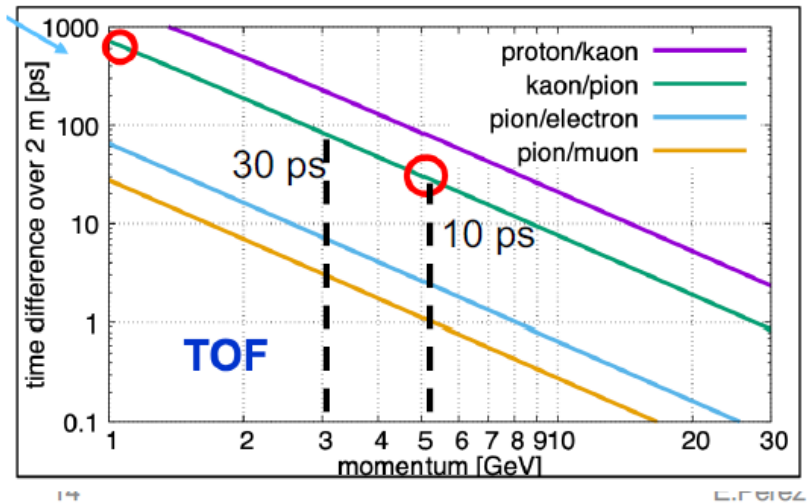
Gaseous tracker: powerful separation via ionisation measurements, dE/dx or dN/dx
- IDEA DC: resolution of dN/dx typically 2% (calculations)

TOF measurements at 2m from the IP: fill the gap around 1 GeV
- but TOF alone: pi/K separation at low p only, e.g. 3σ up to 3 (5) GeV with 30 (10) ps resol

Compact RICH: design exists, could provide separation in whole p range



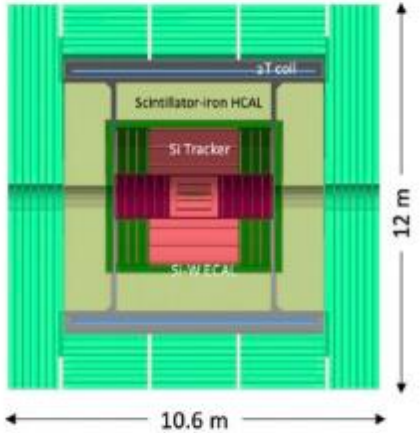
M. Dam



E. Perez

FCC-ee Proto Detectors – Overview

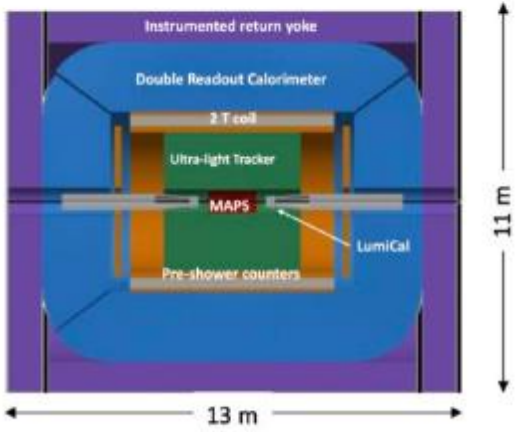
CLD



- Well established design
  - ILC -> CLIC detector -> CLD
- Full Si vtx + tracker;
- CALICE-like calorimetry;
- Large coil, muon system
- Engineering still needed for operation with continuous beam (no power pulsing)
  - Cooling of Si-sensors & calorimeters
- Possible detector optimizations
  - σ_p/p, σ_E/E
  - PID ($\mathcal{O}$(10 ps) timing and/or RICH)?
  - …

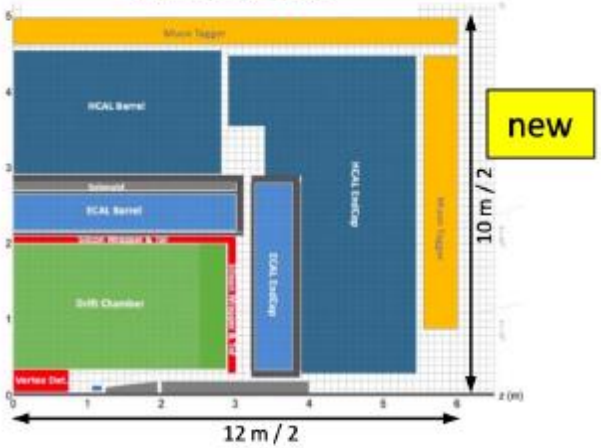
CDR

IDEA



- A bit less established design
  - But still ~15y history
- Si vtx detector; ultra light drift chamber w powerful PID; compact, light coil;
- Monolithic dual readout calorimeter;
  - Possibly augmented by crystal ECAL
- Muon system
- Very active community
  - Prototype designs, test beam campaigns, …

ALLEGRO



- A design in its infancy
- Si vtx det., ultra light drift chamber (or Si)
- High granularity Noble Liquid ECAL as core
  - Pb/W+LAr (or denser W+LKr)
- CALICE-like or TileCal-like HCAL;
- Coil inside same cryostat as LAr, outside ECAL
- Muon system.
- Very active Noble Liquid R&D team
  - Readout electrodes, feed-throughs, electronics, light cryostat, …
  - Software & performance studies

FCC-ee CDR: https://link.springer.com/article/10.1140/epjst/e2019-900045-4

TPC-Introduction *Paul Colas et al.*
4/S-056, CERN 15:30 - 15:50

TPC in a circular collider environment *Daniel Jeans et al.*
4/S-056, CERN 15:50 - 16:10

16:00

The Alice TPC in lead-lead collisions at LHC RUN3 : space…
Matthias Kleiner

Status of Pixel TPC R&D *Peter Kluit*
4/S-056, CERN 16:30 - 16:50

Gating ideas and gating discussion *Ron Settles*
4/S-056, CERN 16:50 - 17:10

17:00

CMOS technology Overview *Marc Winter*
4/S-056, CERN 17:10 - 17:30

Adding precise timing to detectors (T.b.c)
4/S-056, CERN 17:30 - 17:50

Discussion time
4/S-056, CERN 17:50 - 18:30

18:00