What can be done for p/K PID separation in 30-40 cm radial space ?

Jerry Vavra

Possible candidates

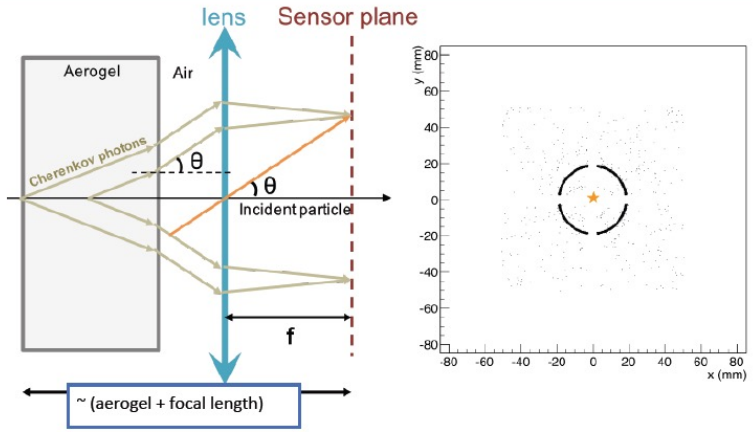
- DIRC (EIC, Panda or SLAC's ultimate designs): 6-7 GeV/c
- Focusing Aerogel RICH (EIC mRICH design): 9-10 GeV/c
- Gaseous RICH (with SiMPT readout): 10-30 GeV/c

EIC mRICH

Georgia State University, INFN Ferrara and LNF, Duke University, University of Hawaii, University of South Carolina, Brookhaven National Lab, Jefferson Lab, Argonne National Lab

Smaller, but thinner ring improves PID performance and reduces length

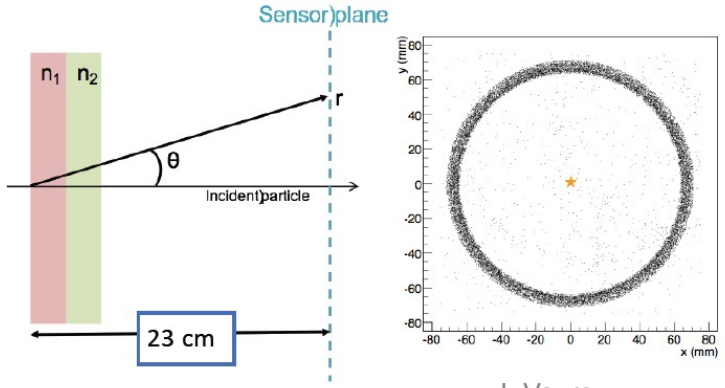
Lens-Based mRICH Design



- 9 GeV/c pion beam launched at the center of xy plane in simulation
- **Smaller and thinner ring image**

Two-Layer Proximity Focusing Design (BELLE-2 ARICH)

9 GeV/c pion beam launched at the center of xy plane in simulation

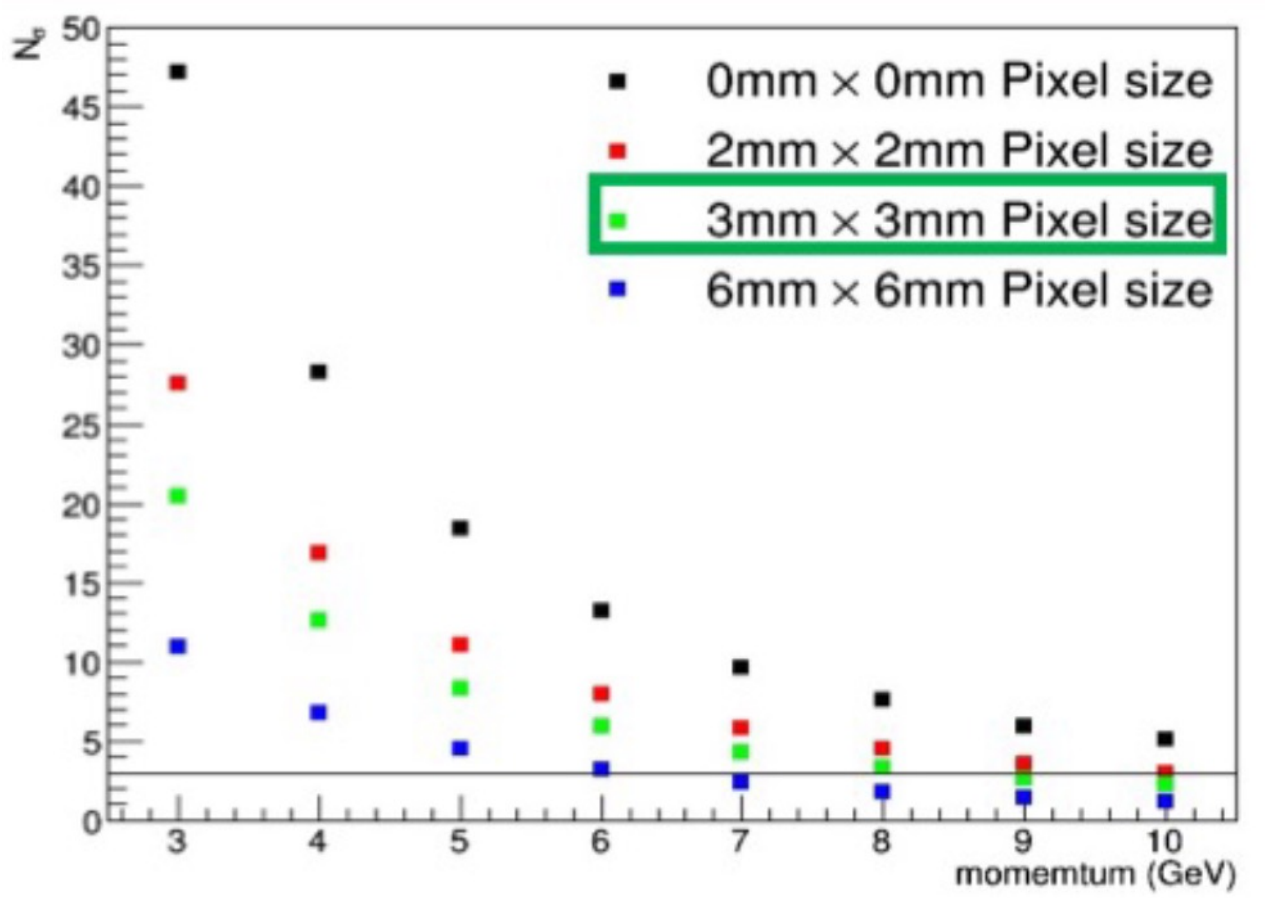


- EIC mRICH designed for K/pi ID up to 9 GeV/c
- BELLE-2 ARICH aims to separate pion and kaon up to 4 GeV/c

SuperB has considered focusing with a 3-layer Aerogel

EIC mRICH

Xiaochun He et al., GSU, EIC review 2021

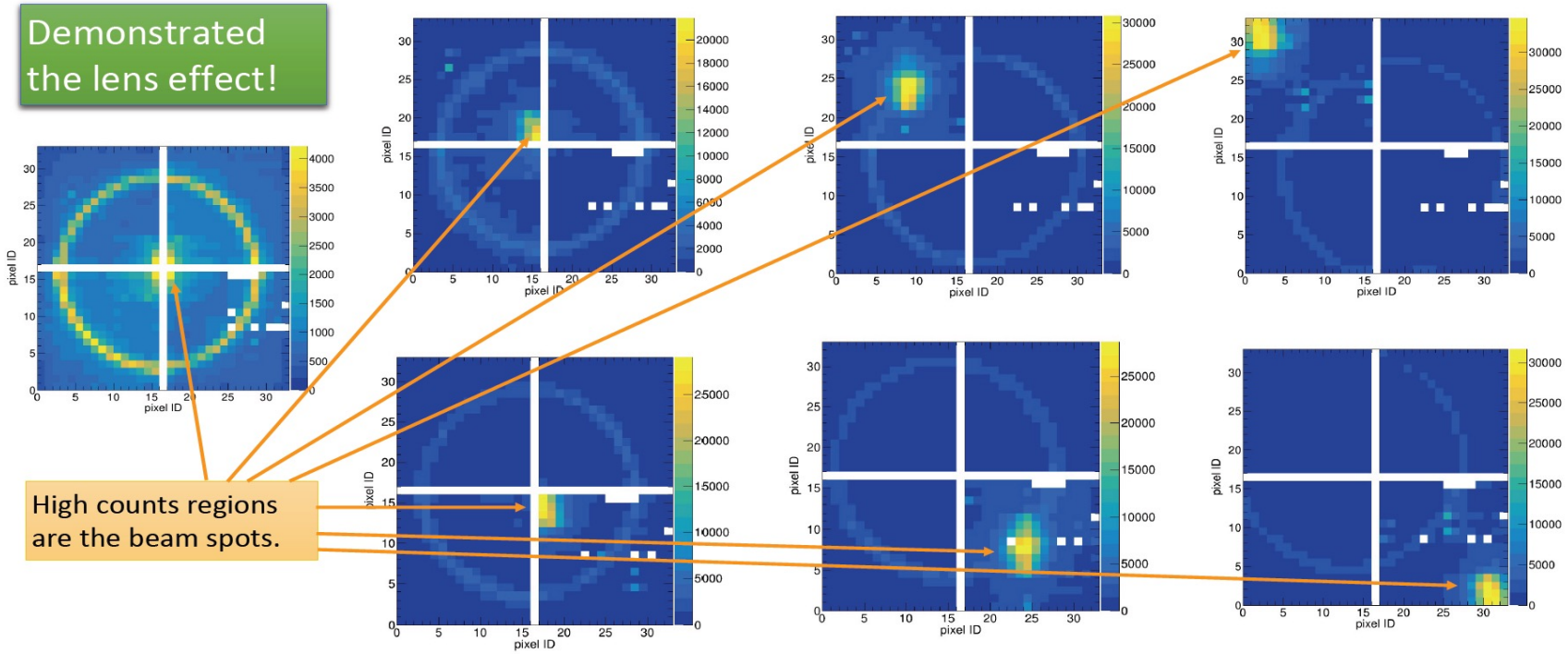


- Projected K/pi separation of mRICH 2nd prototype detector (**Green dots**)

EIC mRICH – possible geometry problems

Xiaochun He et al., GSU, EIC review 2021

Position scans with 120 GeV/c proton beam

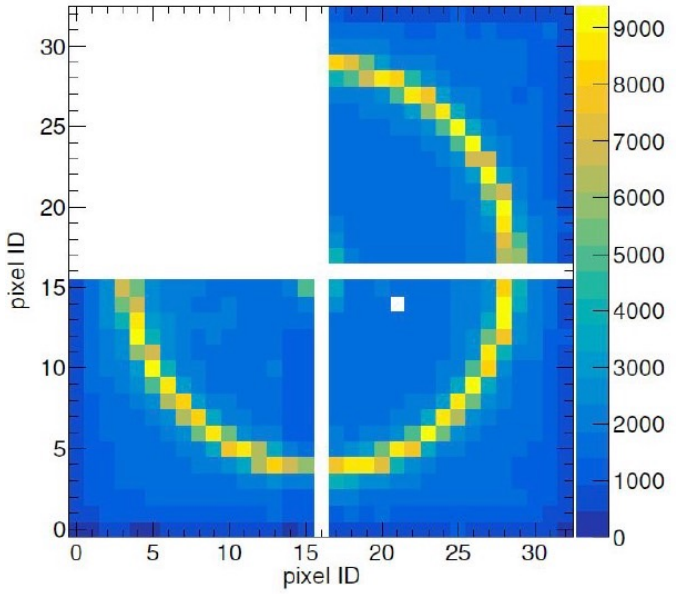


- Distortions due to (a) off-axis tracks and (b) inclined tracks. All these distortions must be corrected to achieve advertised performance !

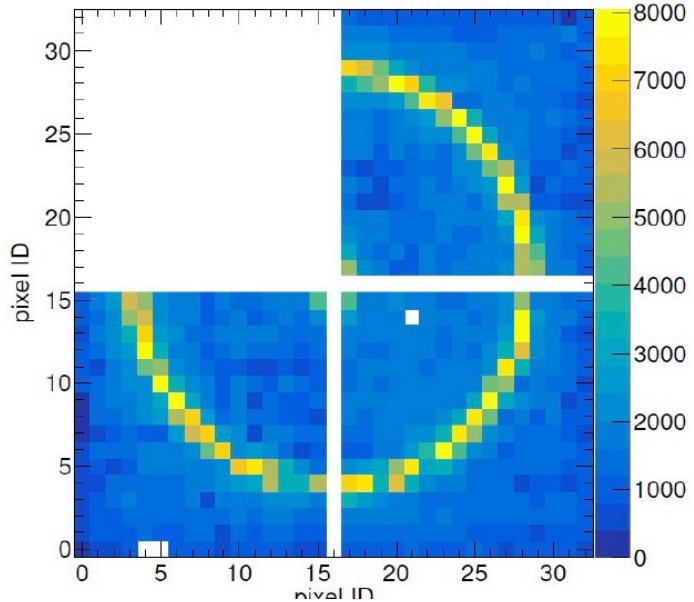
EIC mRICH – possible SiPMT noise problems

C.P. Wong et. al., NIM A 871, 13 (2017)

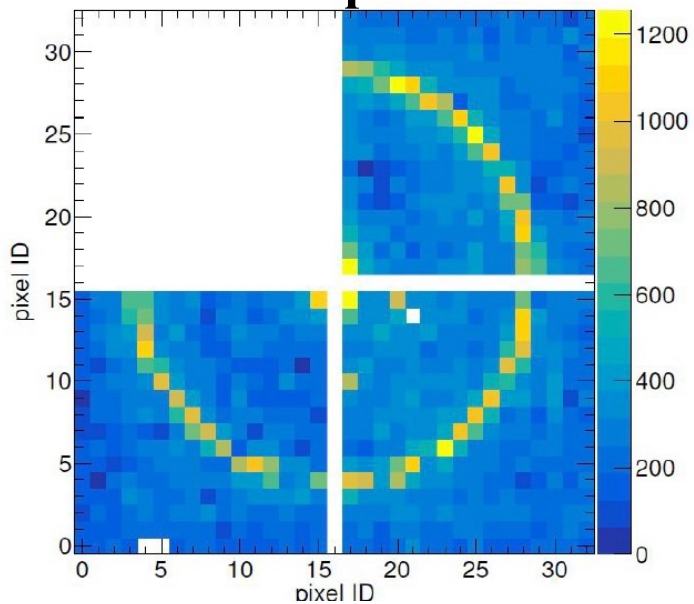
-30 °C:



-20 °C:

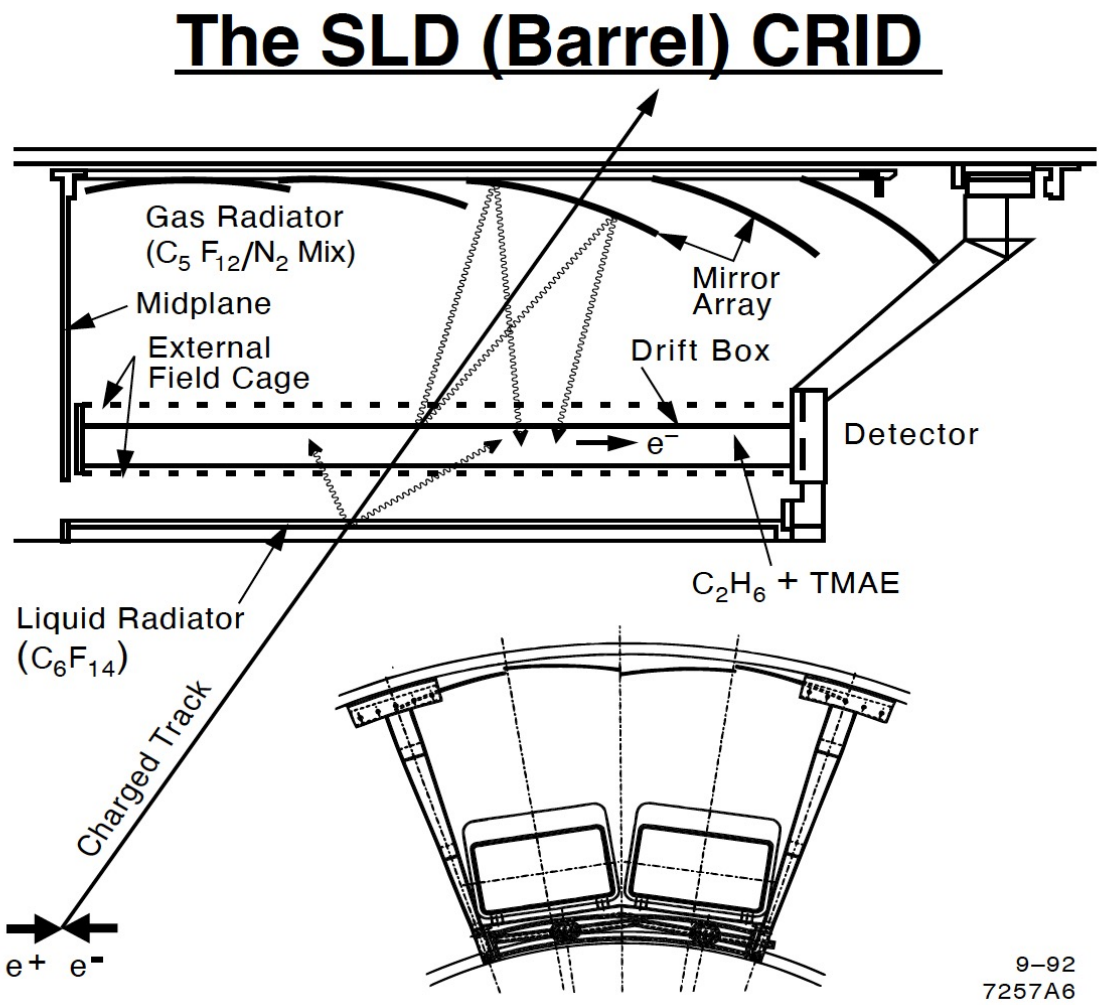


Room temperature:



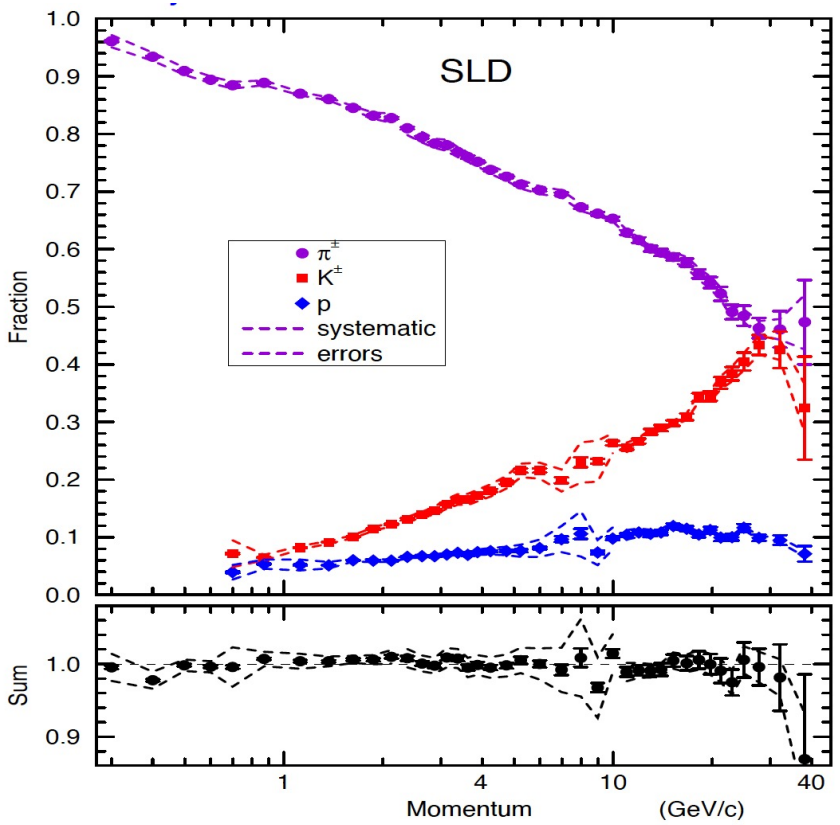
- Do not know what timing window they used to integrate SiPMT noise.
- Our question: Can one tolerate SiPMT noise at room temp. with very tight TOF cut ?

PID at SLD

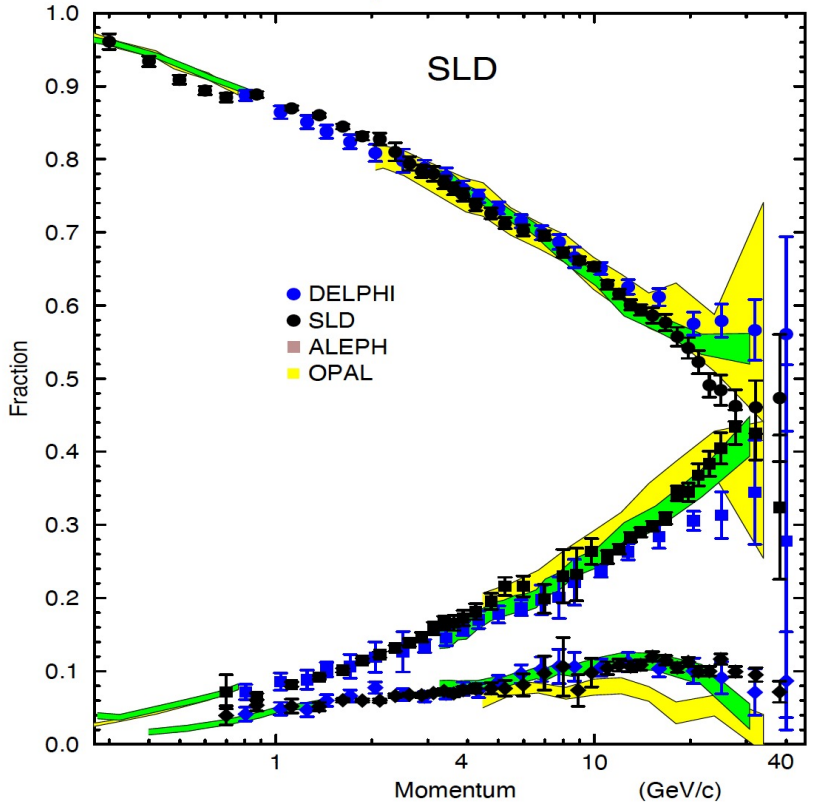

The SLD (Barrel) CRID
Gas Radiator
($C_5 F_{12}/N_2$ Mix)
Midplane
External
Field Cage
Mirror
Array
Drift Box
Detector
e^-
C_2H_6 + TMAE
Liquid Radiator
(C_6F_{14})
Charged Track
e^+ e^-
9–92
7257A6

Gaseous RICH – SLD and DELPHI

D. Muller at al., CRID analysis meeting, ~1990



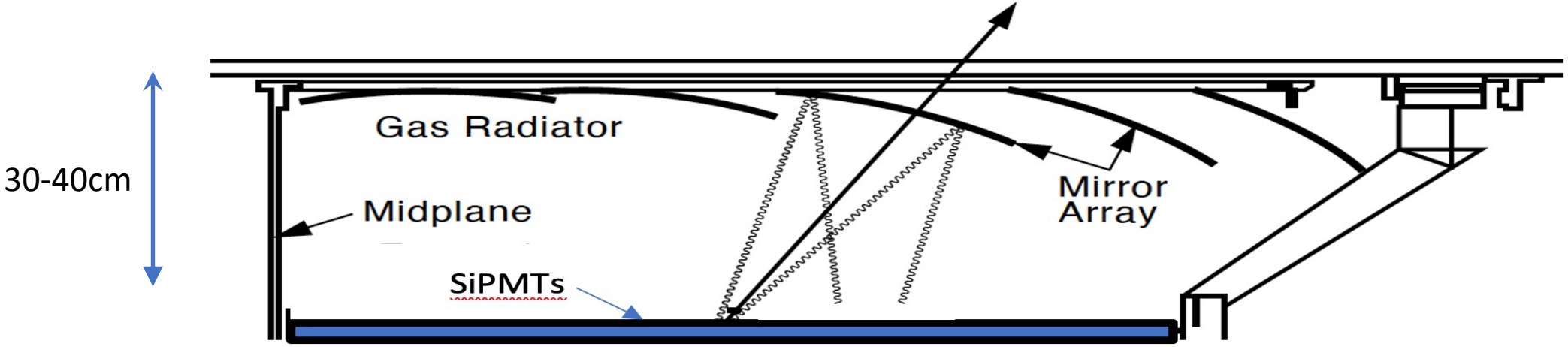
- At the Z^0 is from 3 experiments at LEP



- Gaseous RICH or large dE/dx TPCs are the only type of detectors capable of doing a good PID above 10 GeV/c

Gaseous RICH for SiD – are we dreaming ?

Jerry dreaming ?….



- Radiator problem: using pure C_5F_{12} at 1 bar requires a temperature of 40°C. Using SiPMTs for single photons requires cooling. So, there is a temperature problem.
- What is the allowed radial distance. 40 cm would be good, 30 cm could start hurting.
- Switching to less dense C_2F_6 gas for 40 cm path length may be marginal – I need to look at.
- **SiPMTs can do a rough TOF measurement at a level of 50-100ps, helping to clean up background; it could also eliminate a lot random noise background from SiPMTs. Could this eliminate a need to cool them ?**
- **Next: determine performance for various choices (N_{pe} = f(QE, length, gas, other design parameters)).**