Particle identification in ALICE with the High Momentum Particle Identification Detector (HMPID)

LIEKE GIJSEN MARCH 2024

ALICE (a Large Ion Collider Experiment)

Investigate the Quark Gluon Plasma (QGP)

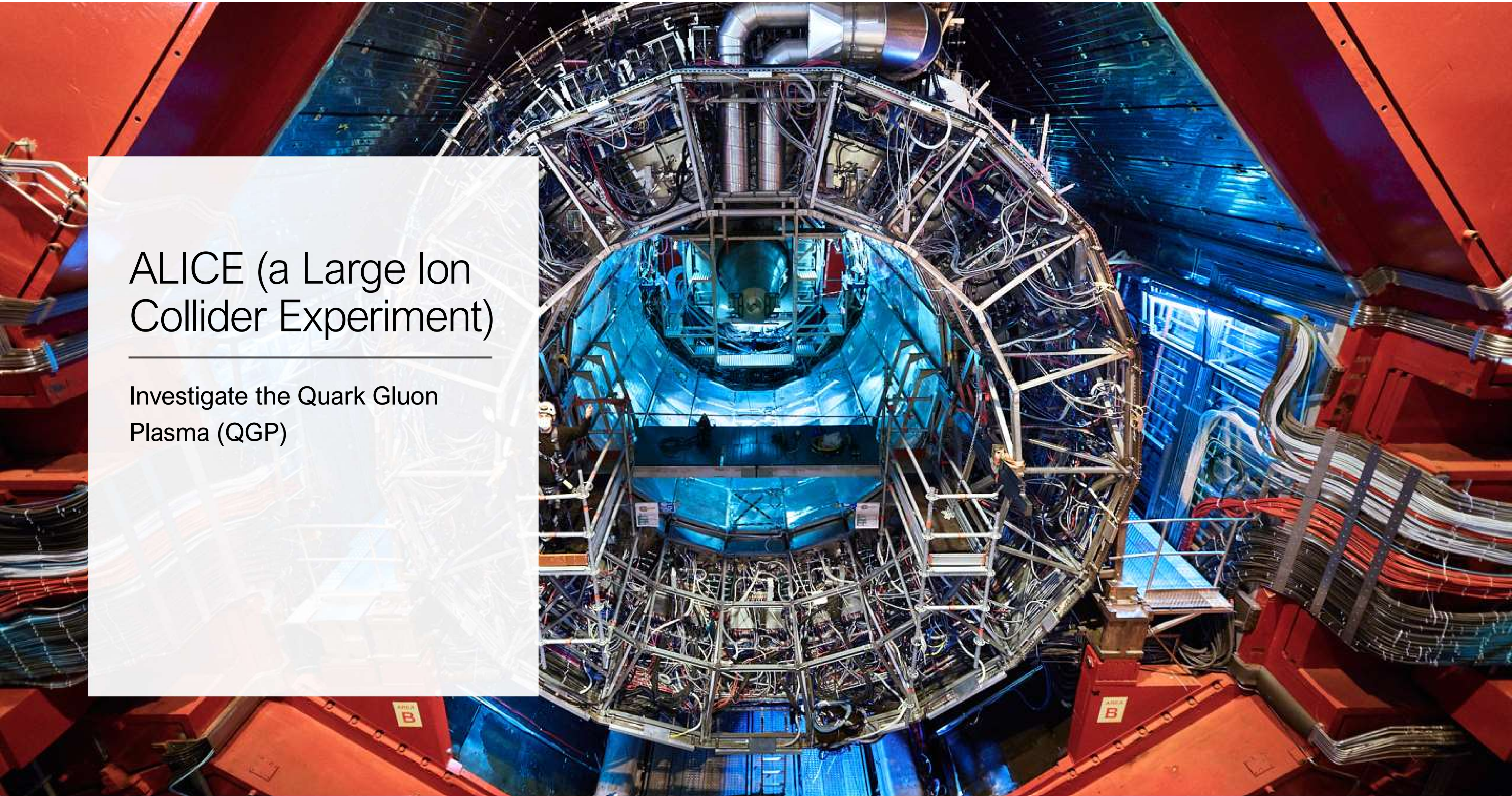


Figure: CERN Courier (2020) [1]

ALICE’s HMPID

Probe the QGP with high momentum ion measurements

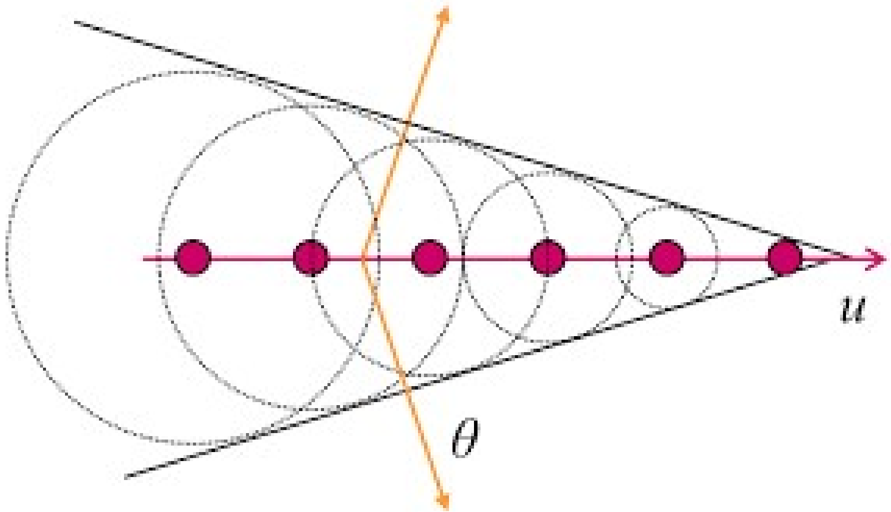
Test perturbative QCD

HE hadronisation

HMPID is a RICH detector

Cherenkov: charged particles faster than speed of light -> medium oscillations

$$\cos\theta_c = \frac{c/n}{\beta c} = \frac{1}{n\beta}$$



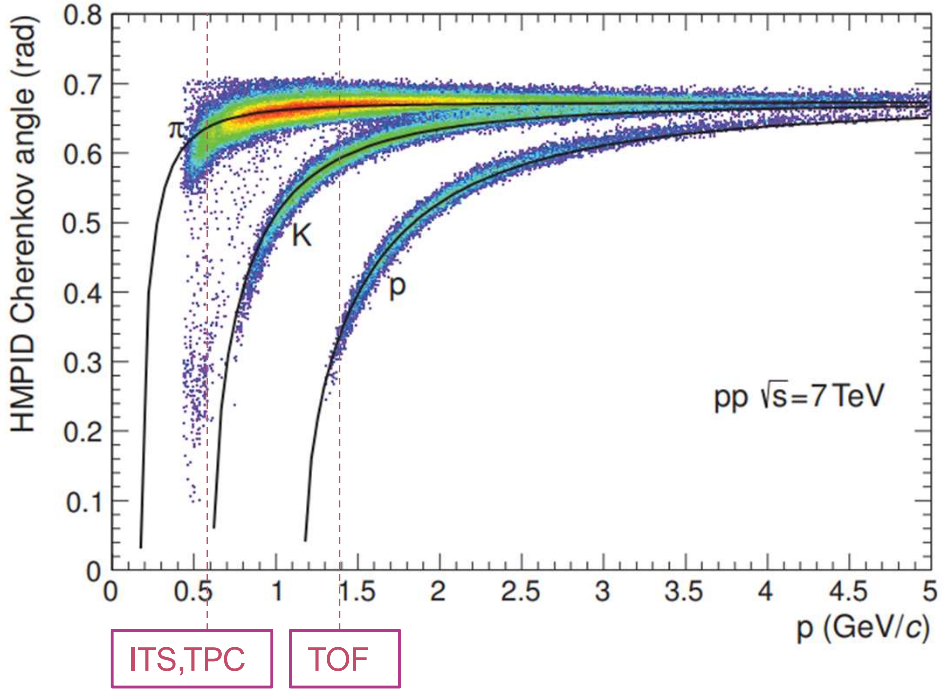
Charge from intensity

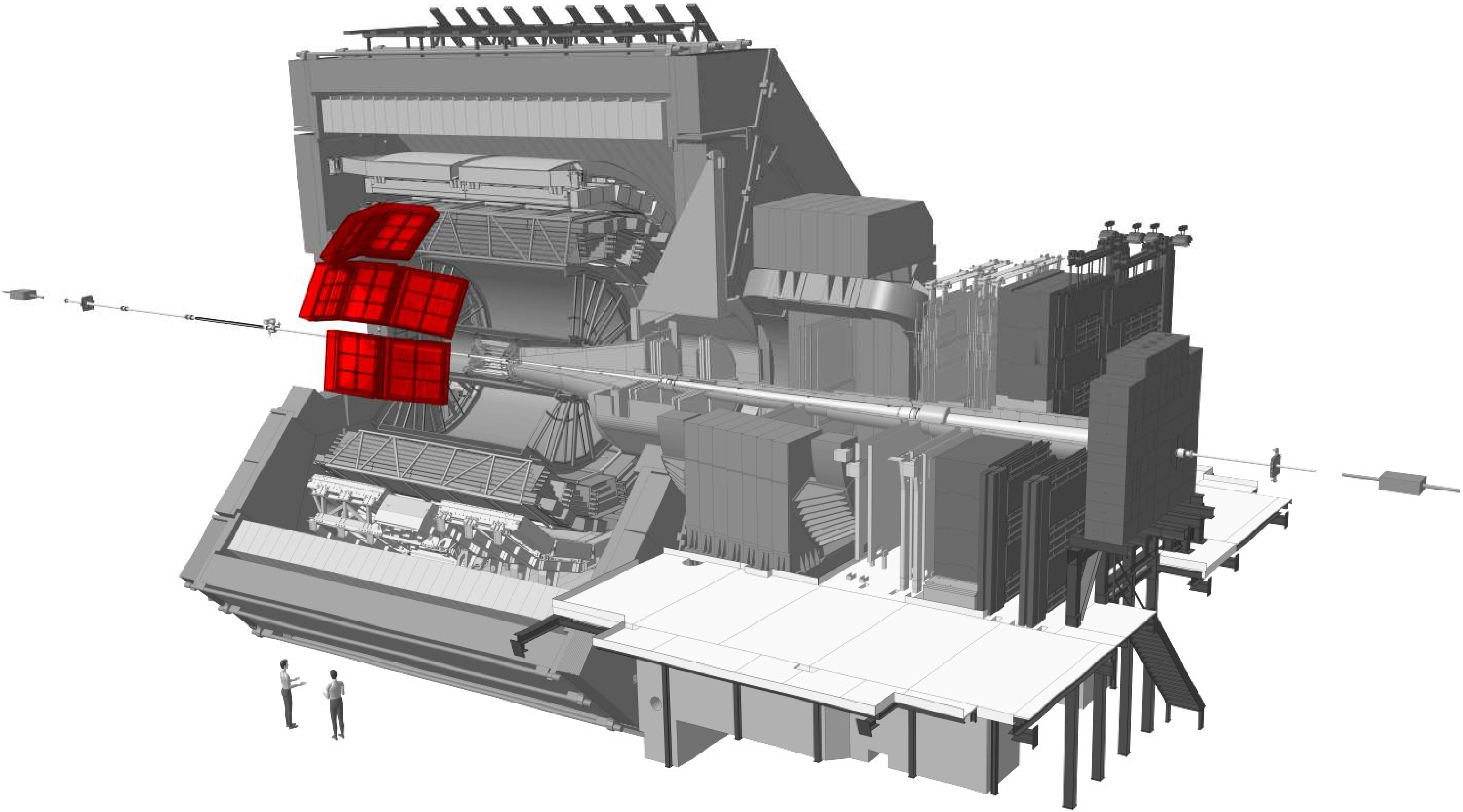
Mass in combination with tracking detectors

HMPID in the high momentum range

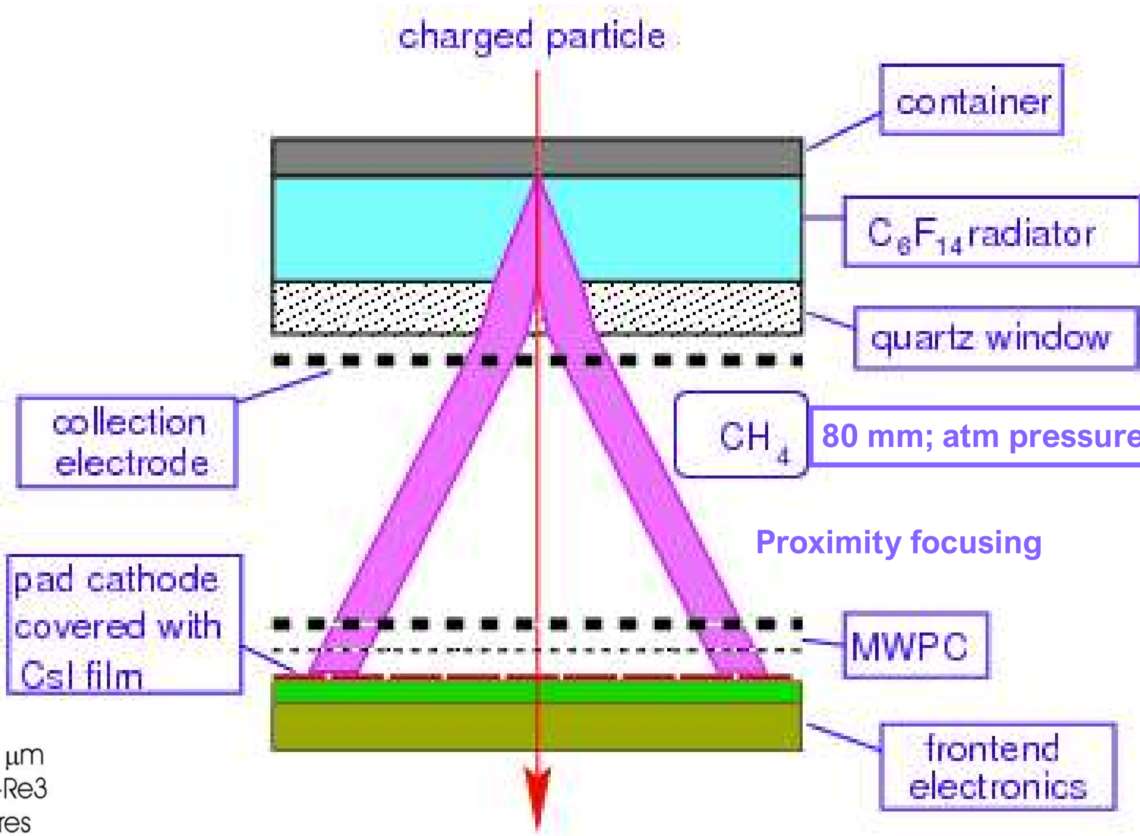
Cherenkov: charged particles faster than speed of light -> medium oscillations

$$\cos\theta_c = \frac{c/n}{\beta c} = \frac{1}{n\beta}$$





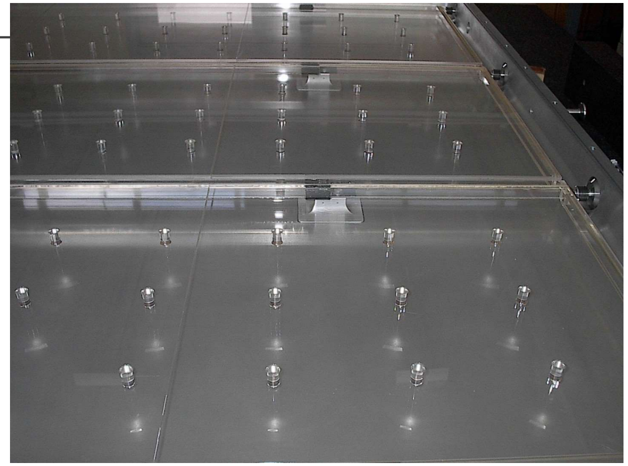
RICH

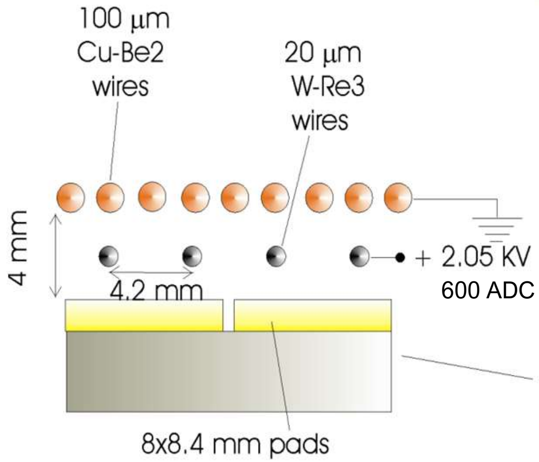


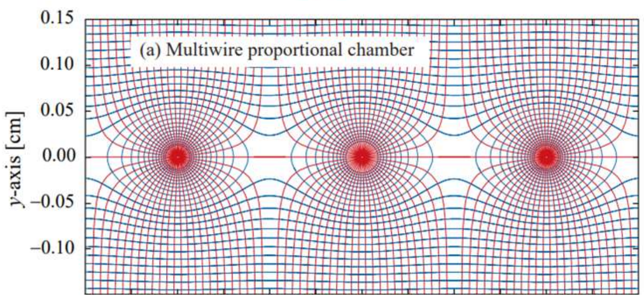
n ≈ 1.2989 at 175 nm, β_{th} = 0.77; 15 mm thick

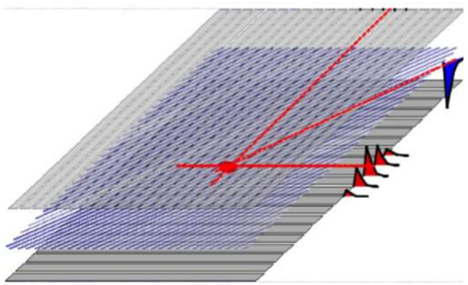
80 mm; atm pressure

Proximity focusing









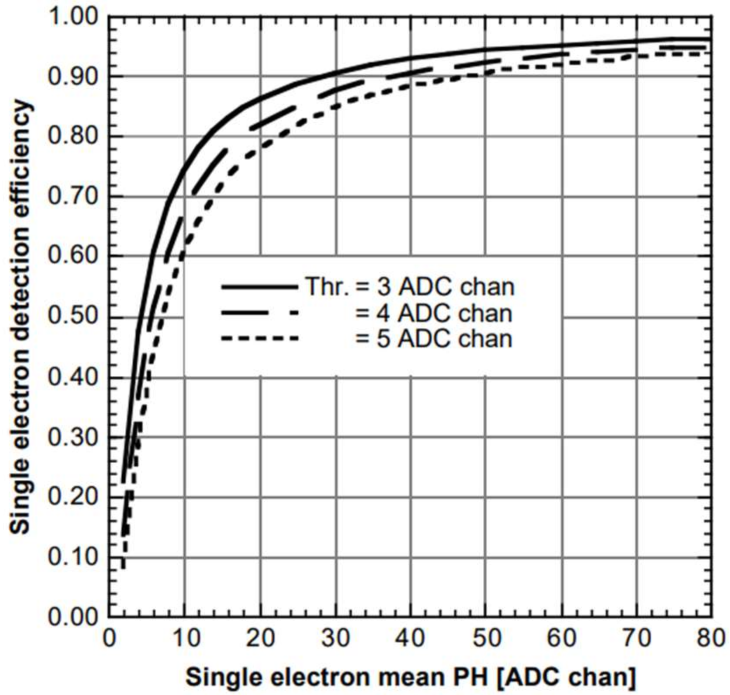
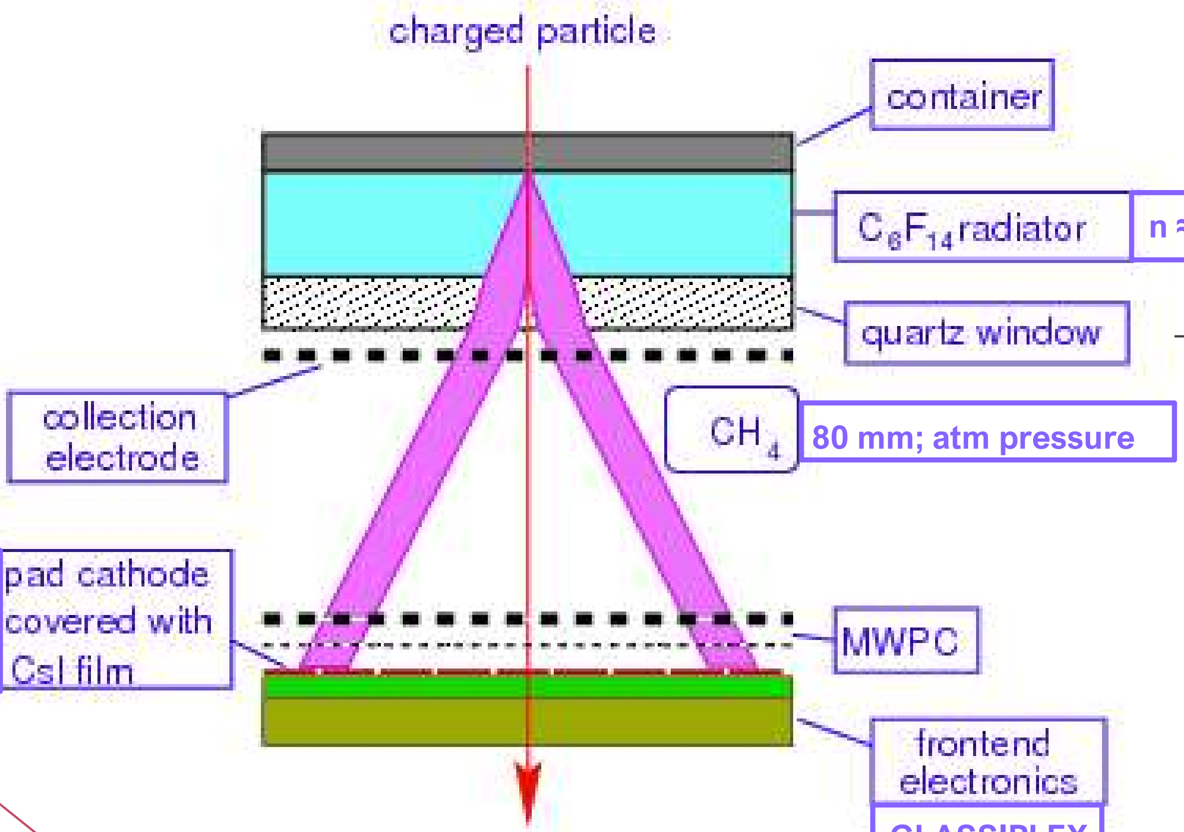


Figure 2.35: Single-electron detection efficiency as a function of the single-electron mean PH calculated at different experimental FEE thresholds.

RICH

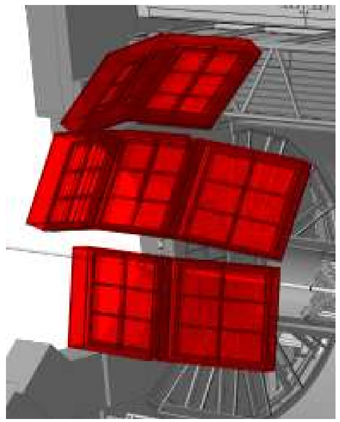


n ≈ 1.2989 at 175 nm, β_{th} = 0.77; 15 mm thick

80 mm; atm pressure

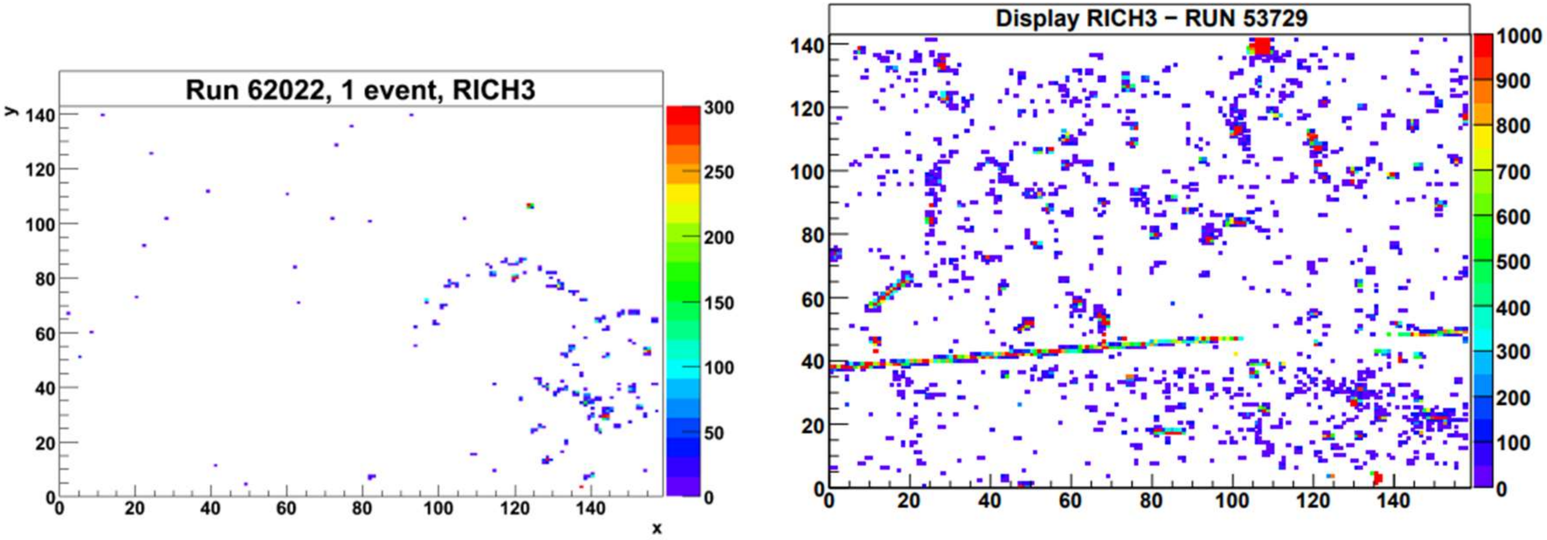
pad size 0.8x0.84 cm2; QE ≈ 25% at 175 nm

GLASSIPLEX (16 channels)



42 photo-cathodes → 3840 pads with individual readout
First such a detector of this size and high readout rate

Results from the experiment



2 mrad ring resolution dependent on ring radius: 7 mrad ~100 mm

Figure: Volpe, G. (2009) [11]

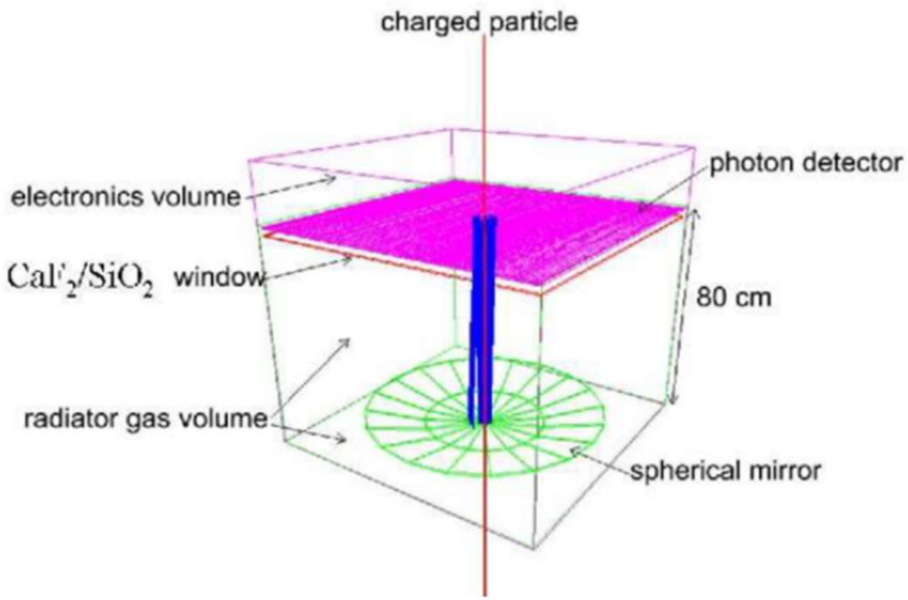
Future: Very High Momentum Particle Identification Detector (VHMPID)

Momentum p > 10 GeV/c → VHMPID

gas Cherenkov radiator (C_4F_{10}, n ≈ 1.0014)

-> higher energies needed for gas with low refractive index

Spherical mirrors



References

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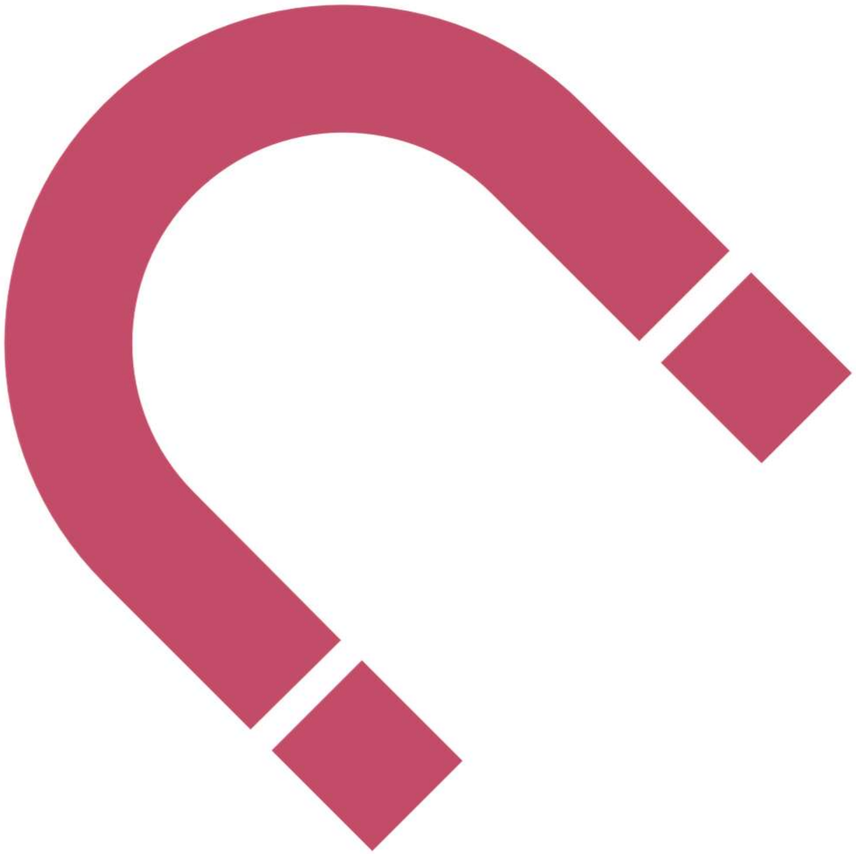

ALICE B-field: 0.5 T

Magnetic field parallel to the photocathodes does not affect the electron detection efficiency

Why CsI?

- Large QE
- Broad spectral response
- Low dark current
- Stable
- Can operate in vacuum

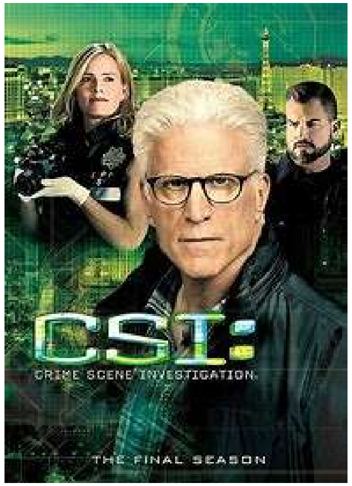

Figure: chemcraft.su (left) and arpardoy.exblog.jp (right)