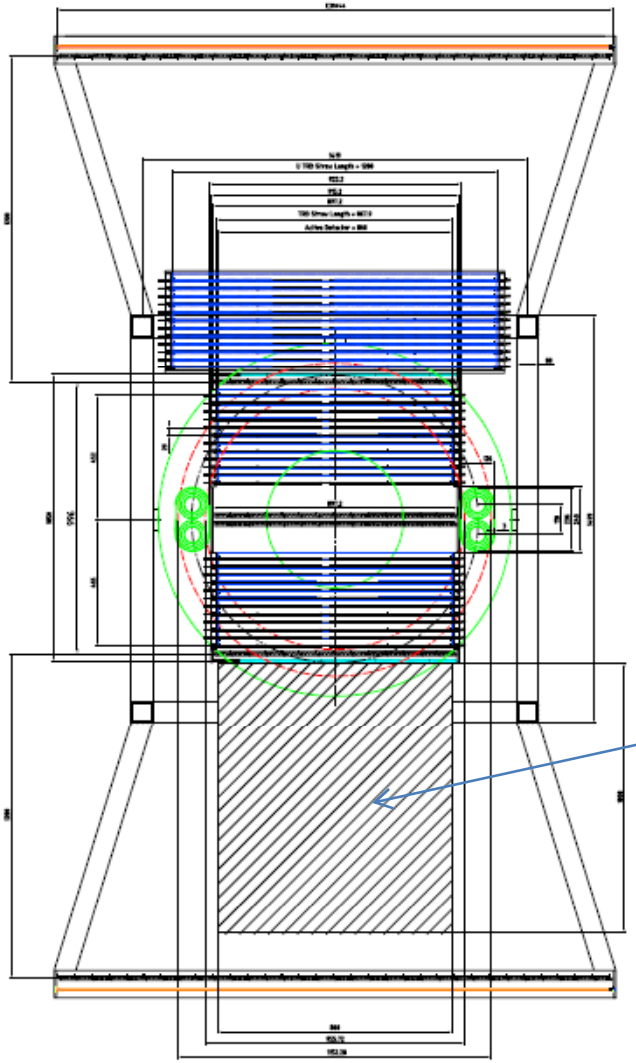
RICH detector

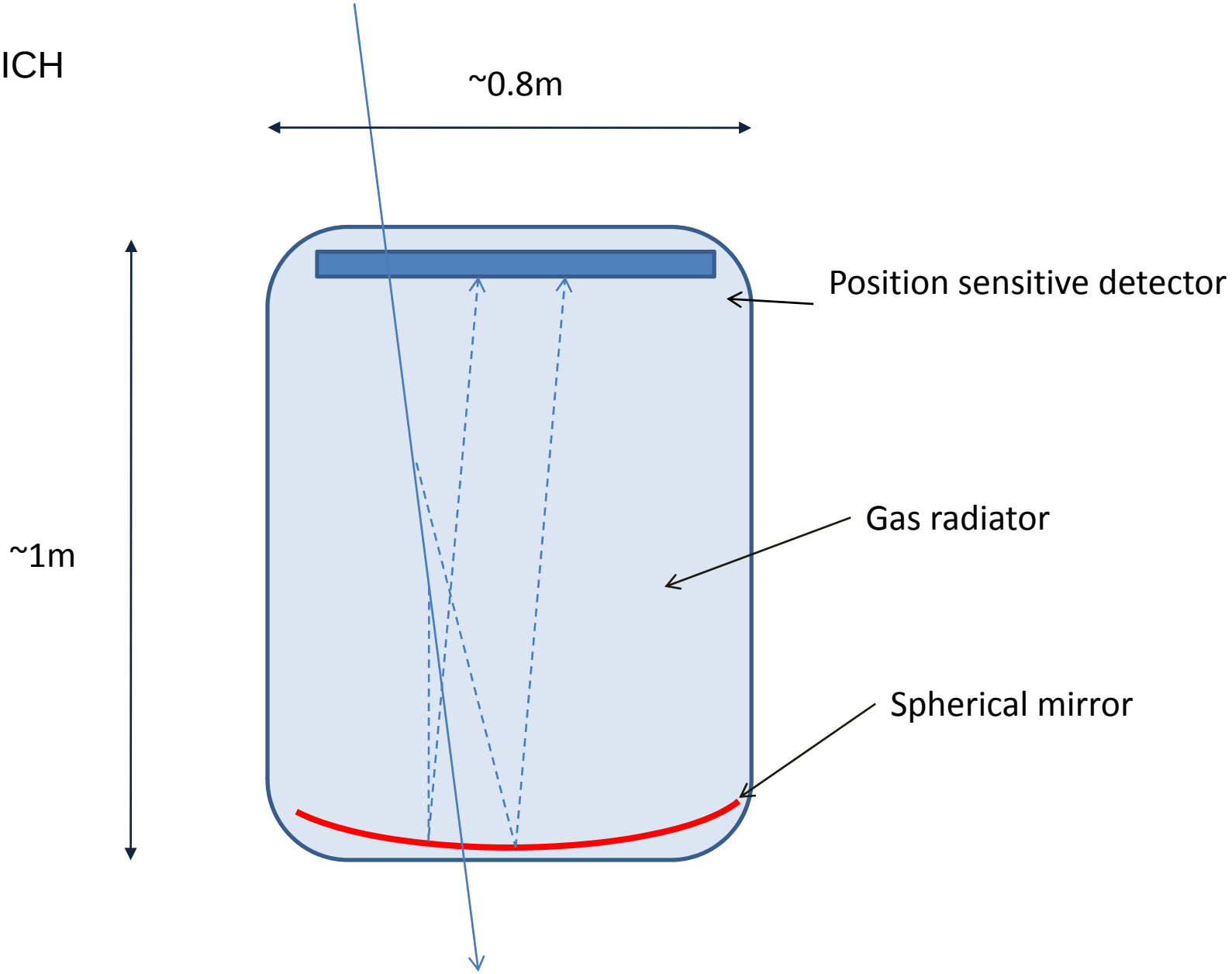
Simon Swordy - PEBS meeting Jan 2009, CERN

Purpose: to provide mass resolution at high rigidity (>10GV)

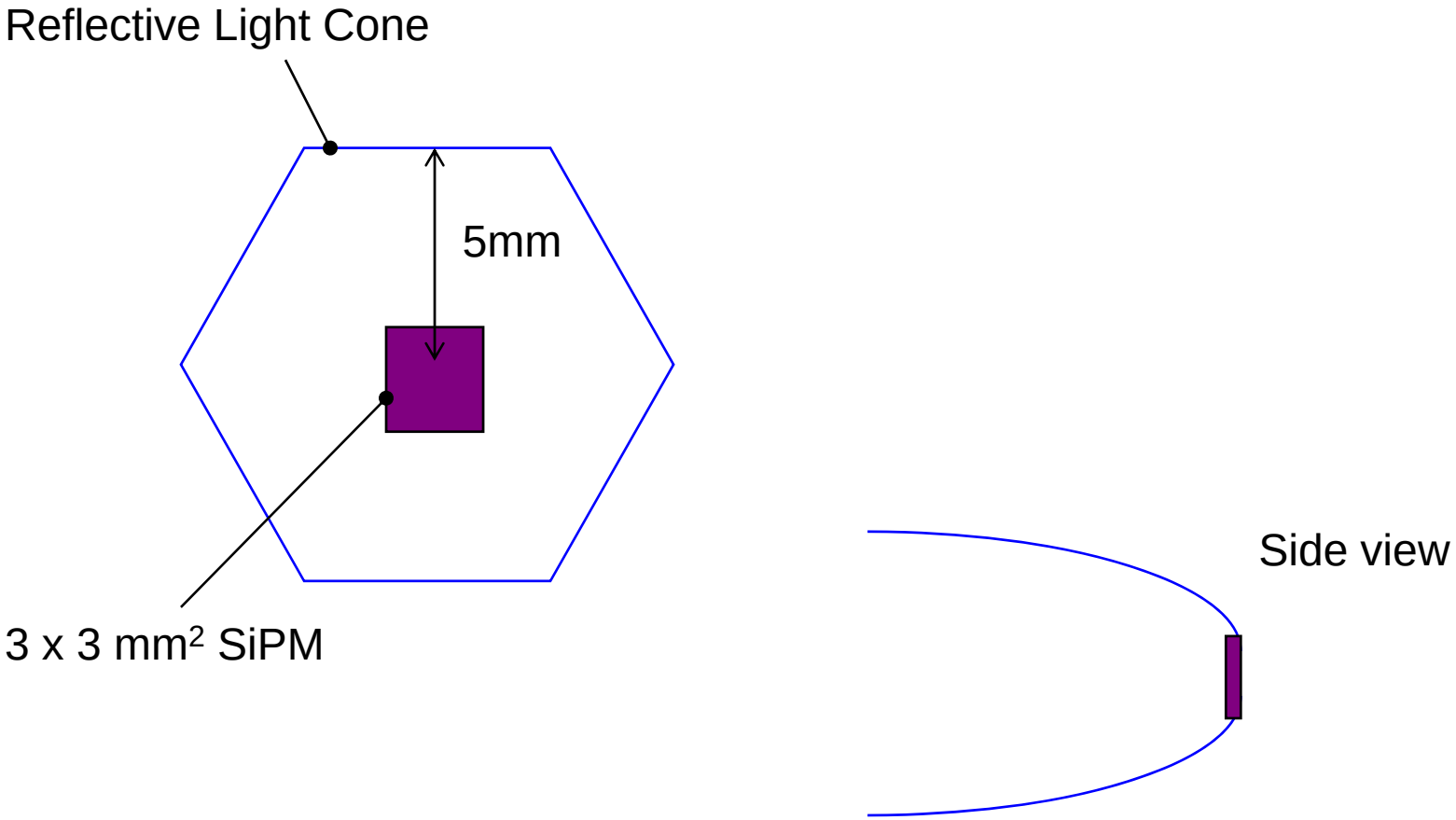


RICH volume

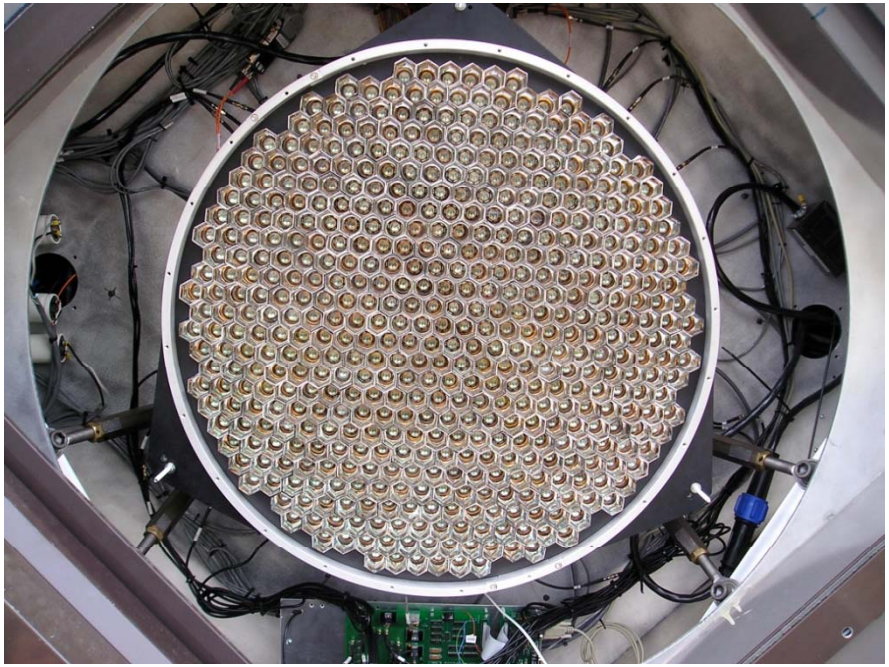
Gas RICH


~0.8m
~1m
Position sensitive detector
Gas radiator
Spherical mirror

Conceptual design of focal plane



VERITAS light cones (~3cm diameter)

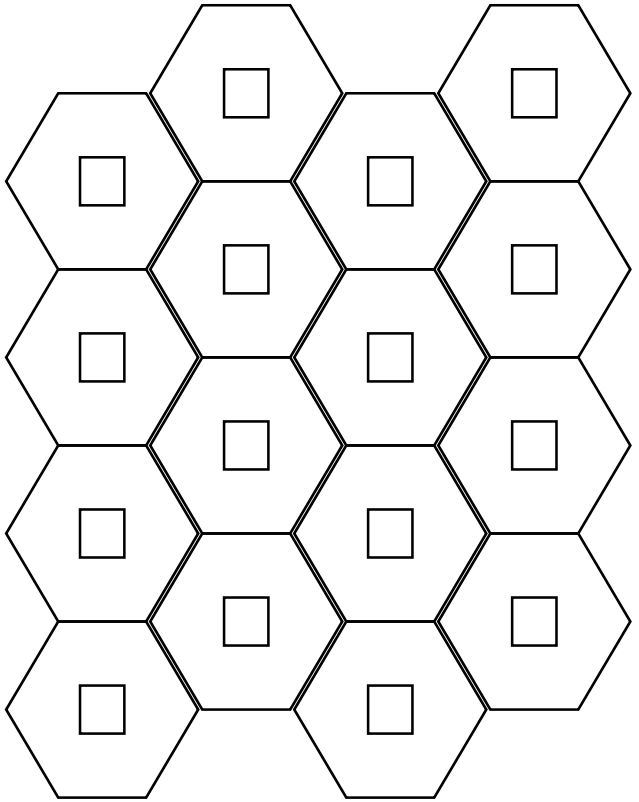


These cones ~30% efficient
normalized by area

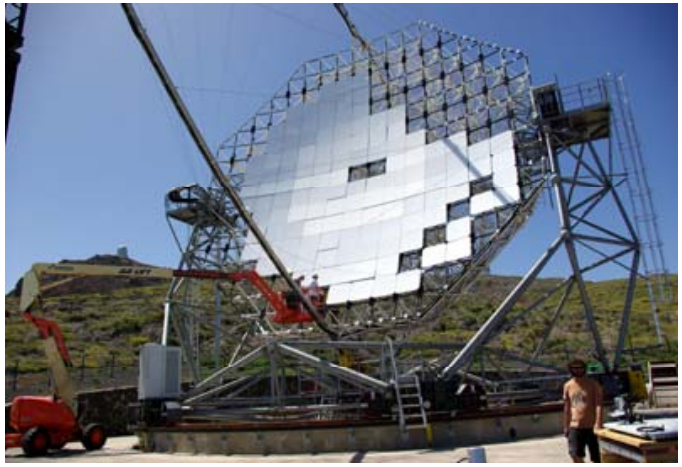
~5,000-10,000 elements for RICH
~3mm rms photon location
~300-600 module units

PEBS focal plane cones

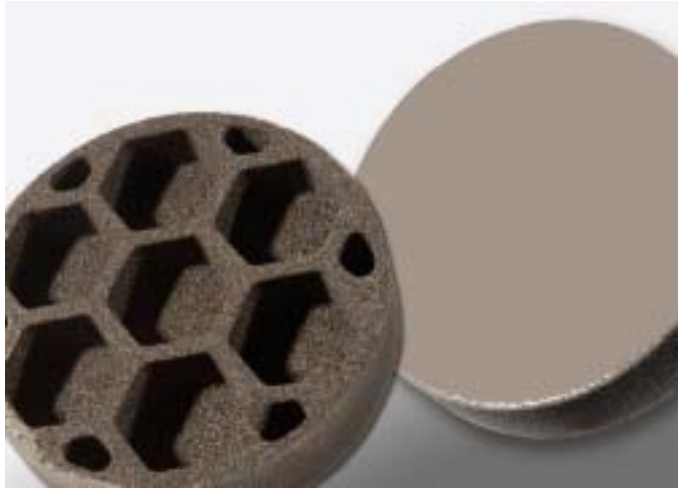
Injection molded 16ch unit



Mirror options

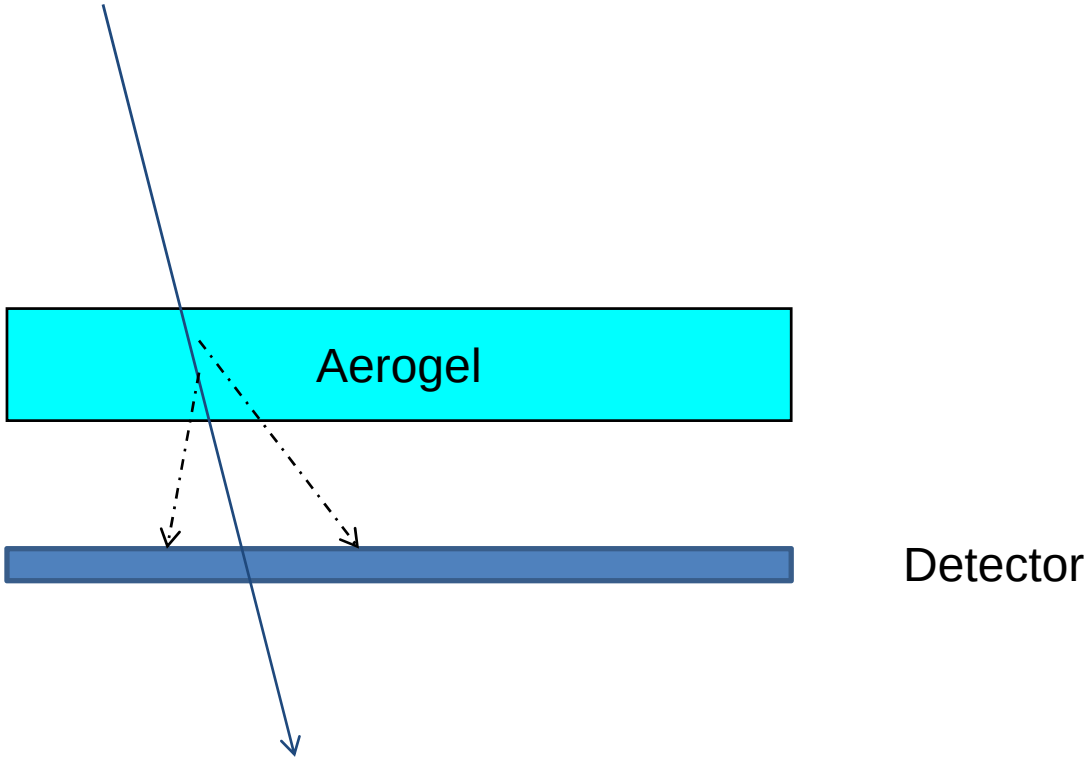


MAGIC telescope diamond cut metal mirrors



Carbon foam base mirrors

Also glass foam base cold slump mirrors,
Can be made of astronomical quality



Proximity focused Aerogel RICH

Cerenkov quality factor N0

$N=N0 \times L(length) \times \sin^2\theta$

N0 => integration over wavelength of detector QE, reflectivity, etc

Best RICHs get N0~120

With these cones we lose light -> x 0.3 (ouch!)

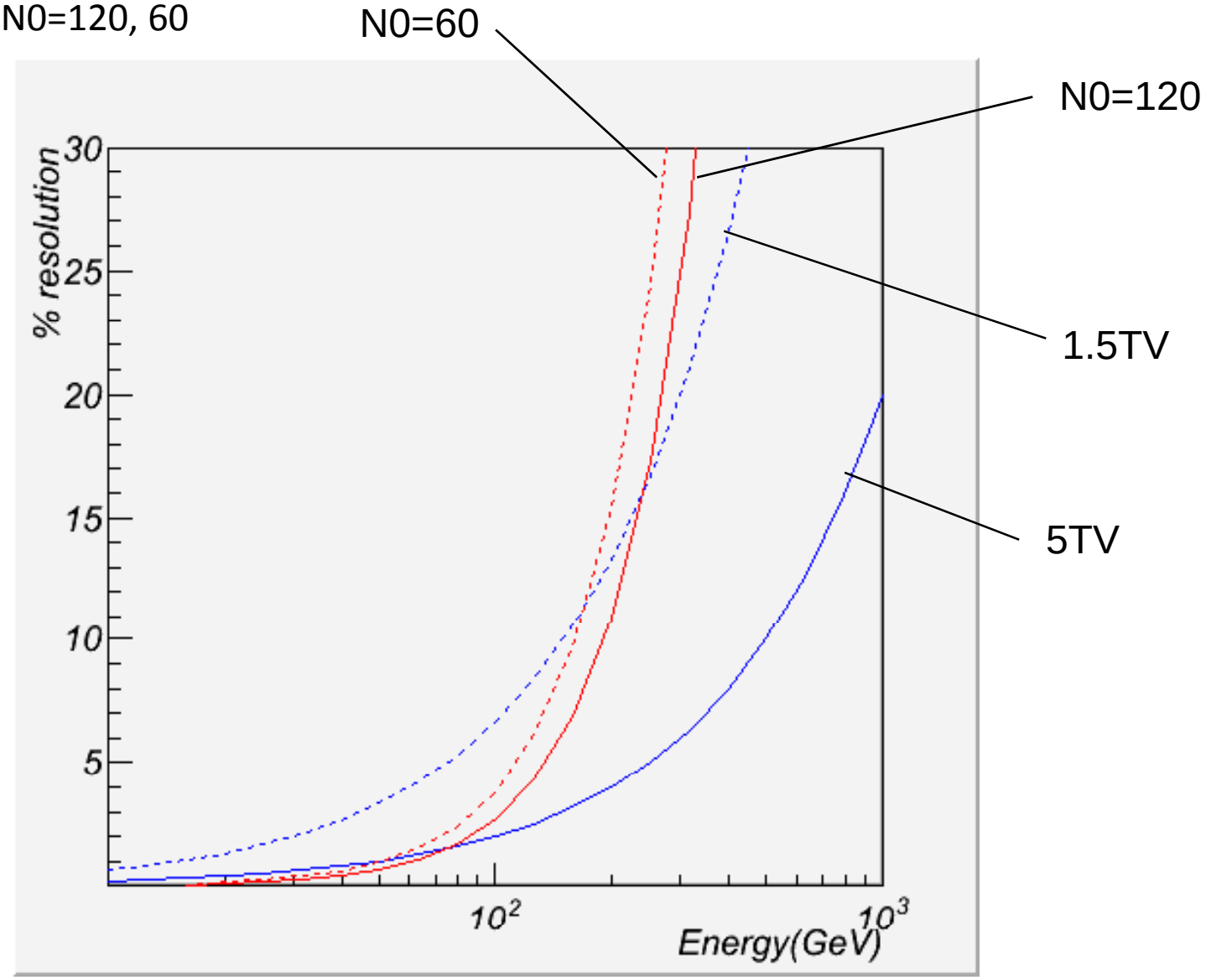
But SiPM QE is larger than typical PMT -> x 1.5

So possibly N0 for Z=1 ~60

But, for Z=2, N0 ~240 (~60 pe for gamma threshold of ~18)

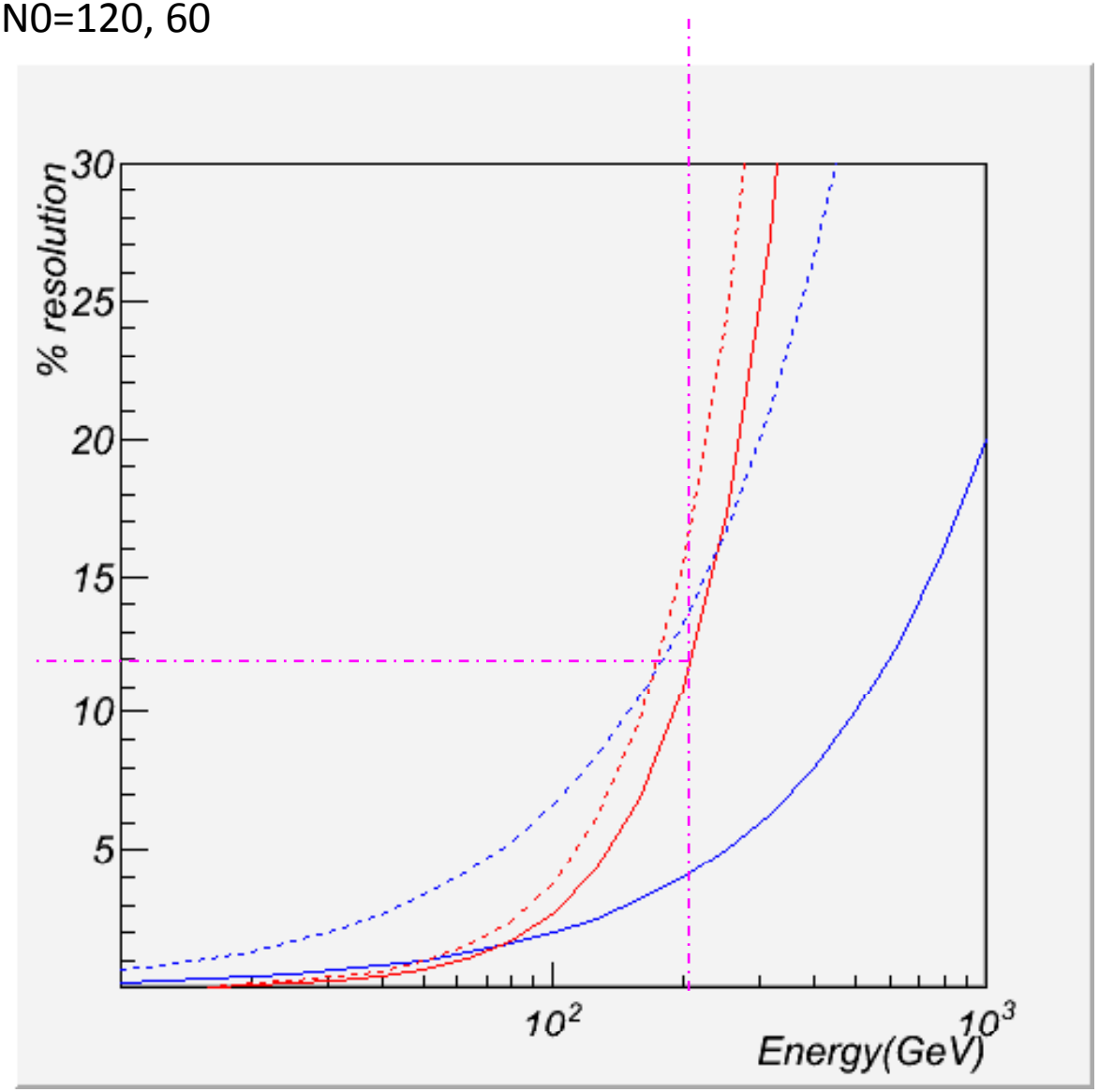
Rigidity resolution (blue) and RICH gamma resolution (red)

1.5TV, 5TV MDR
(3mm res), N0=120, 60

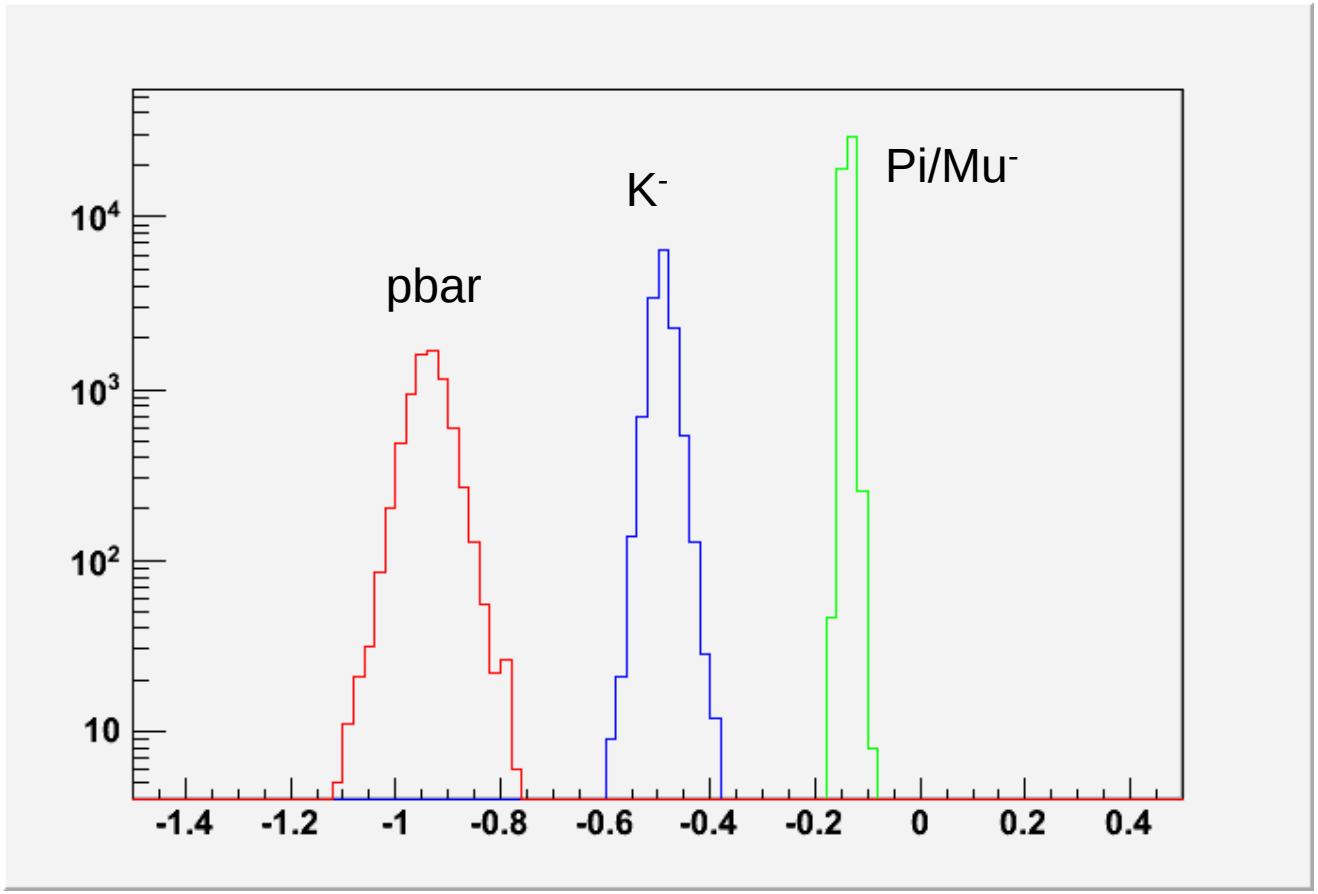


Assume radiator gas C_4F_{10} $\gamma_{threshold}$ ~18

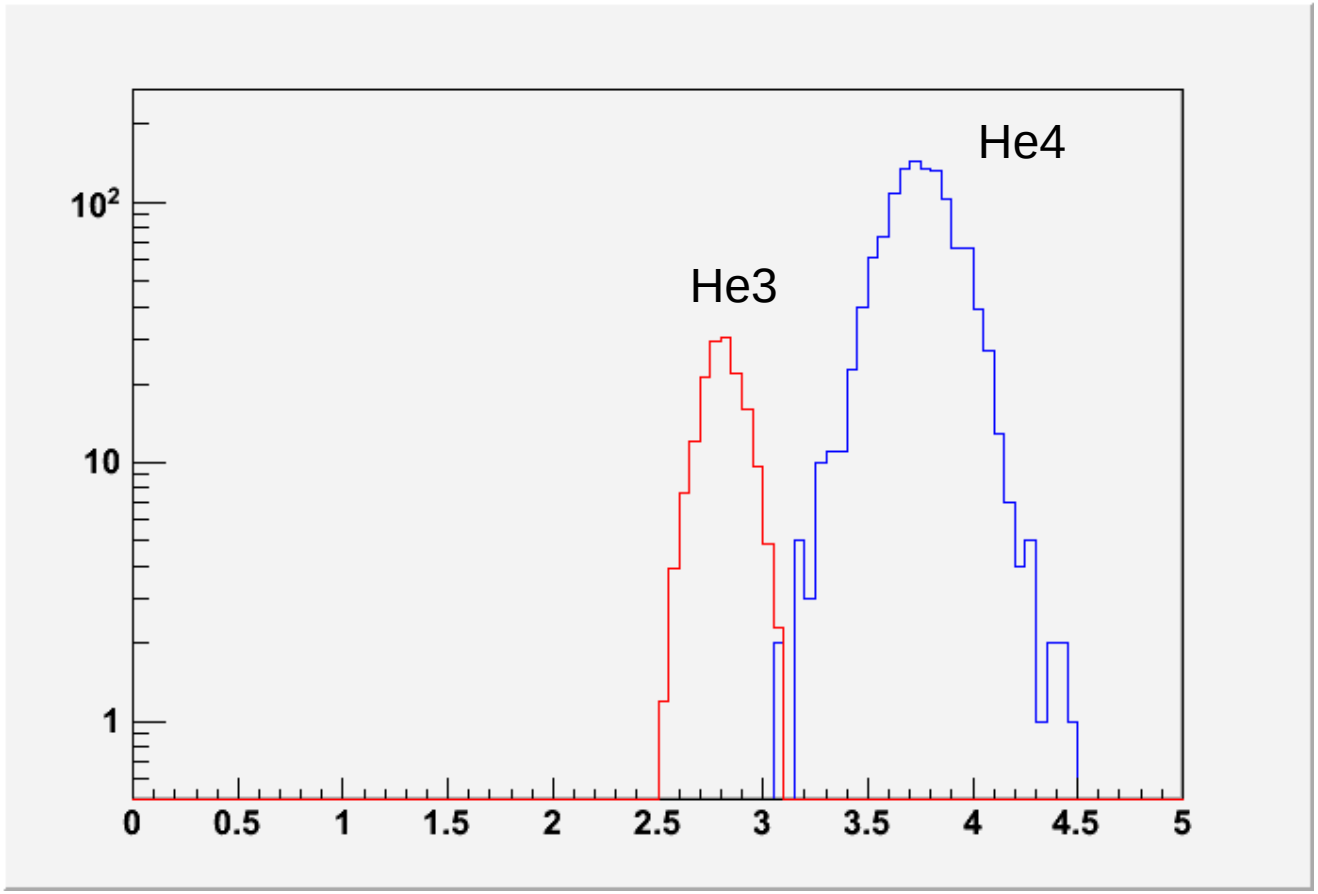
1.5TV, 5TV MDR
(3mm res), N0=120, 60



PEBS pbar mass resolution, MDR=5TV, N0=30, rms=3mm
@ 80 ± 10 GeV



Separation He3/4 at 40±5 GeV/n
N0 = 120, MDR=5TV, rms 3mm



Next steps:

- Work with 3x3mm^2 SiPMTs
- Develop light cone geometry
- Test manufacture cones, measure collection improvement
- Electronics options

+ 2010

- Mirror design
- Vessel design