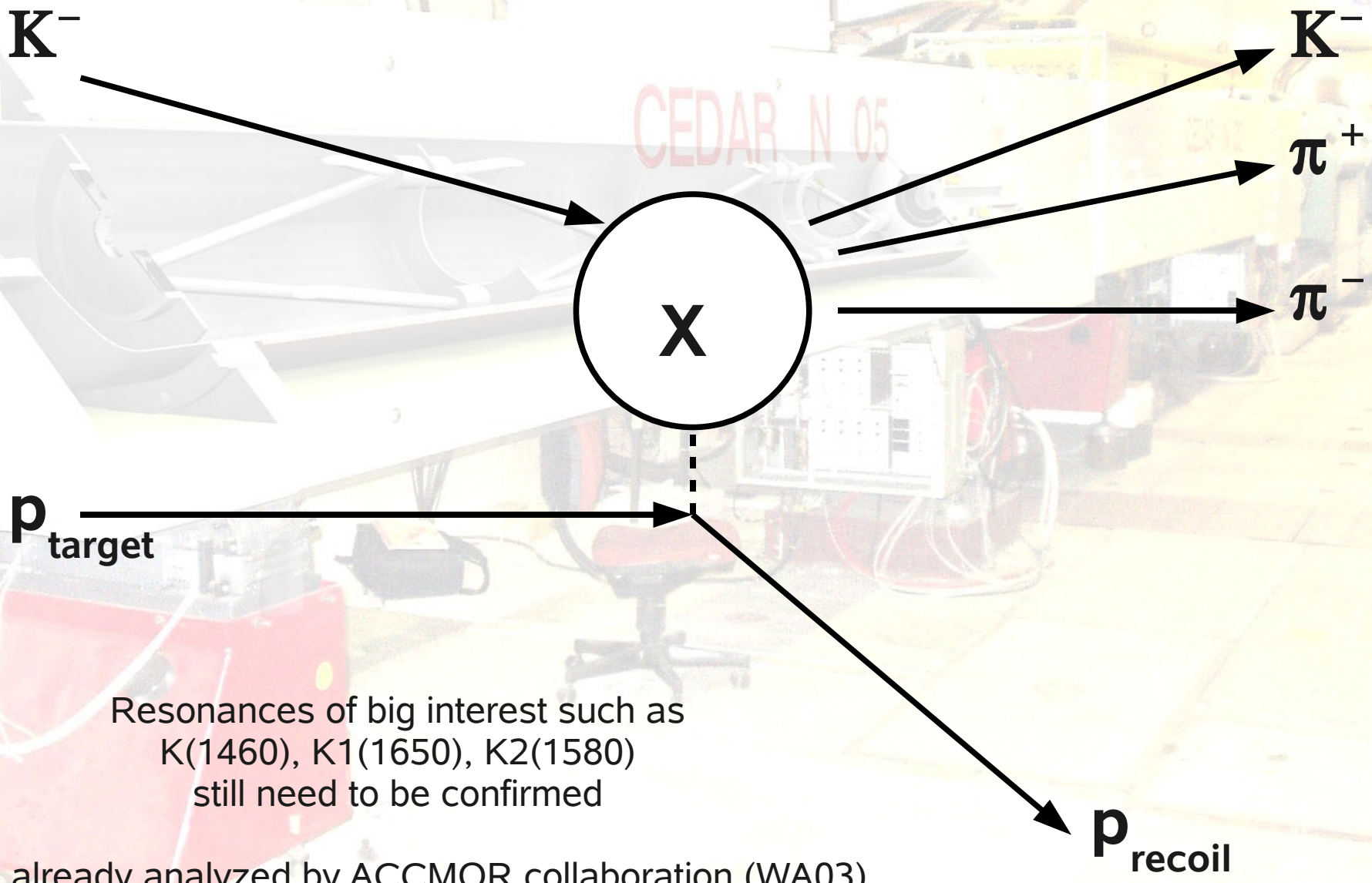
Selection of incoming Kaons in the high energetic hadron beam of the COMPASS-experiment

Spin Praha 2009
Prometeusz Jasinski
for the
COMPASS-collaboration

Diffractive scattering of Kaons on protons



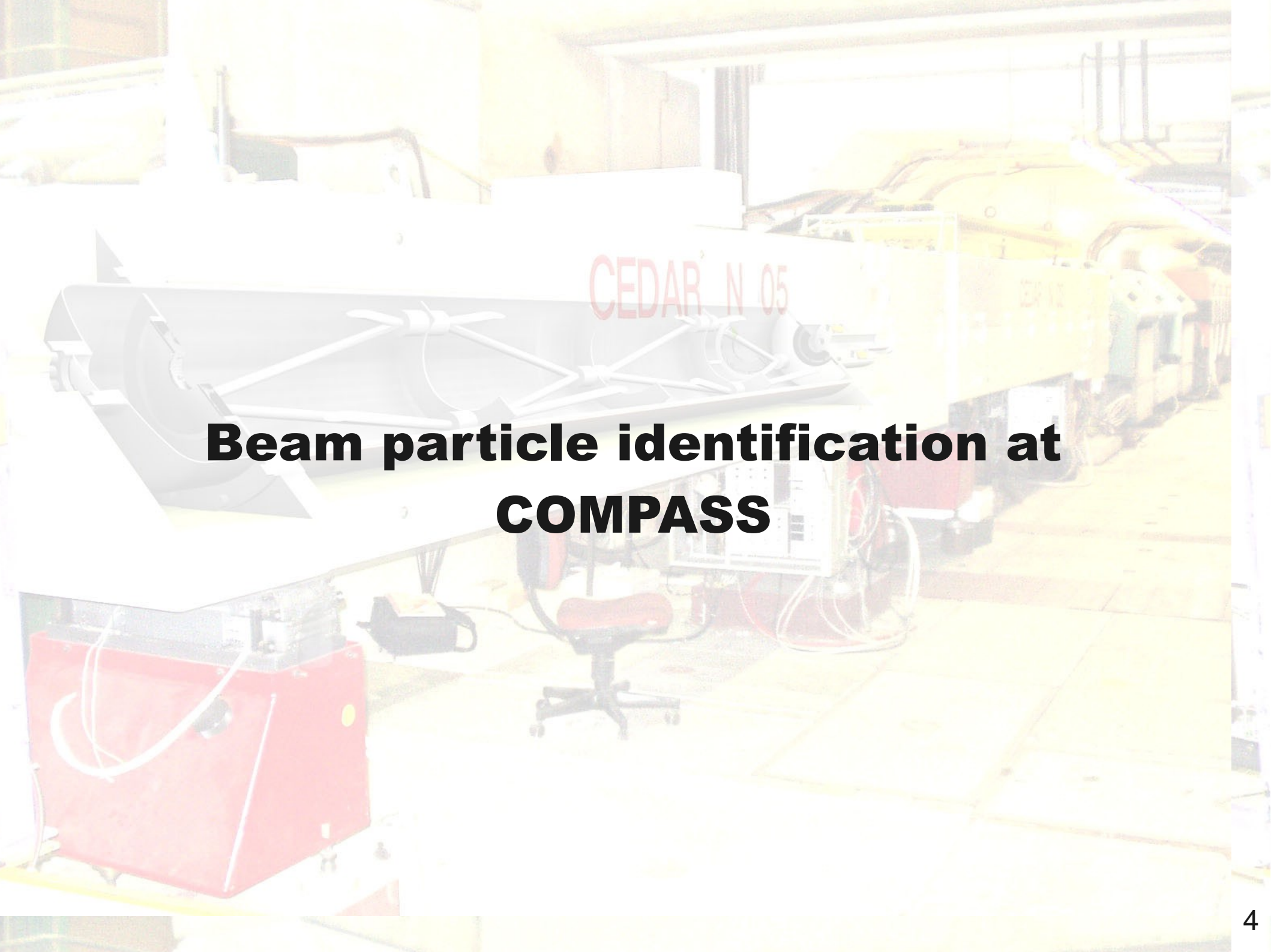
Resonances of big interest such as
K(1460), K1(1650), K2(1580)
still need to be confirmed

Was already analyzed by ACCMOR collaboration (WA03)

topics

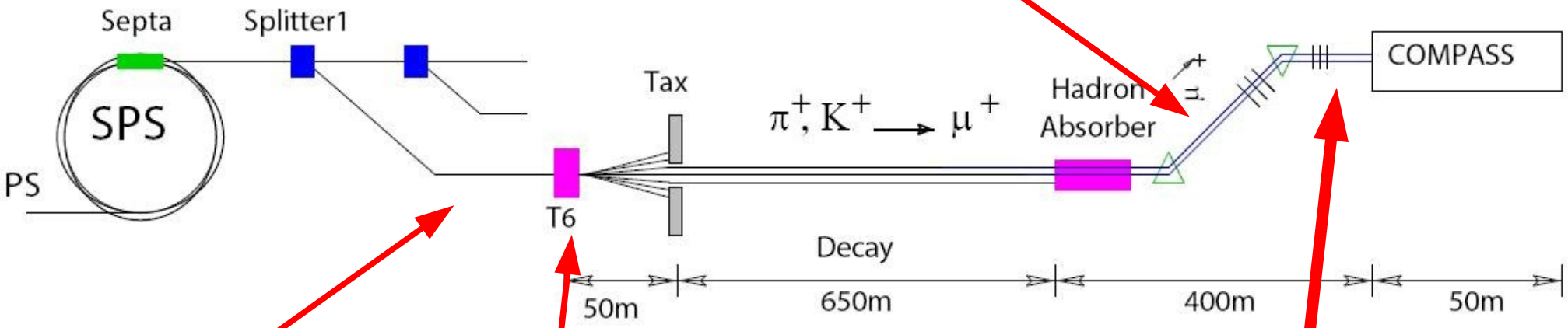
1. Beam particle identification at COMPASS

2. Analysis of a channel with strageness



Beam particle identification at COMPASS

Production of the secondary hadron beam for COMPASS: the M2 beamline



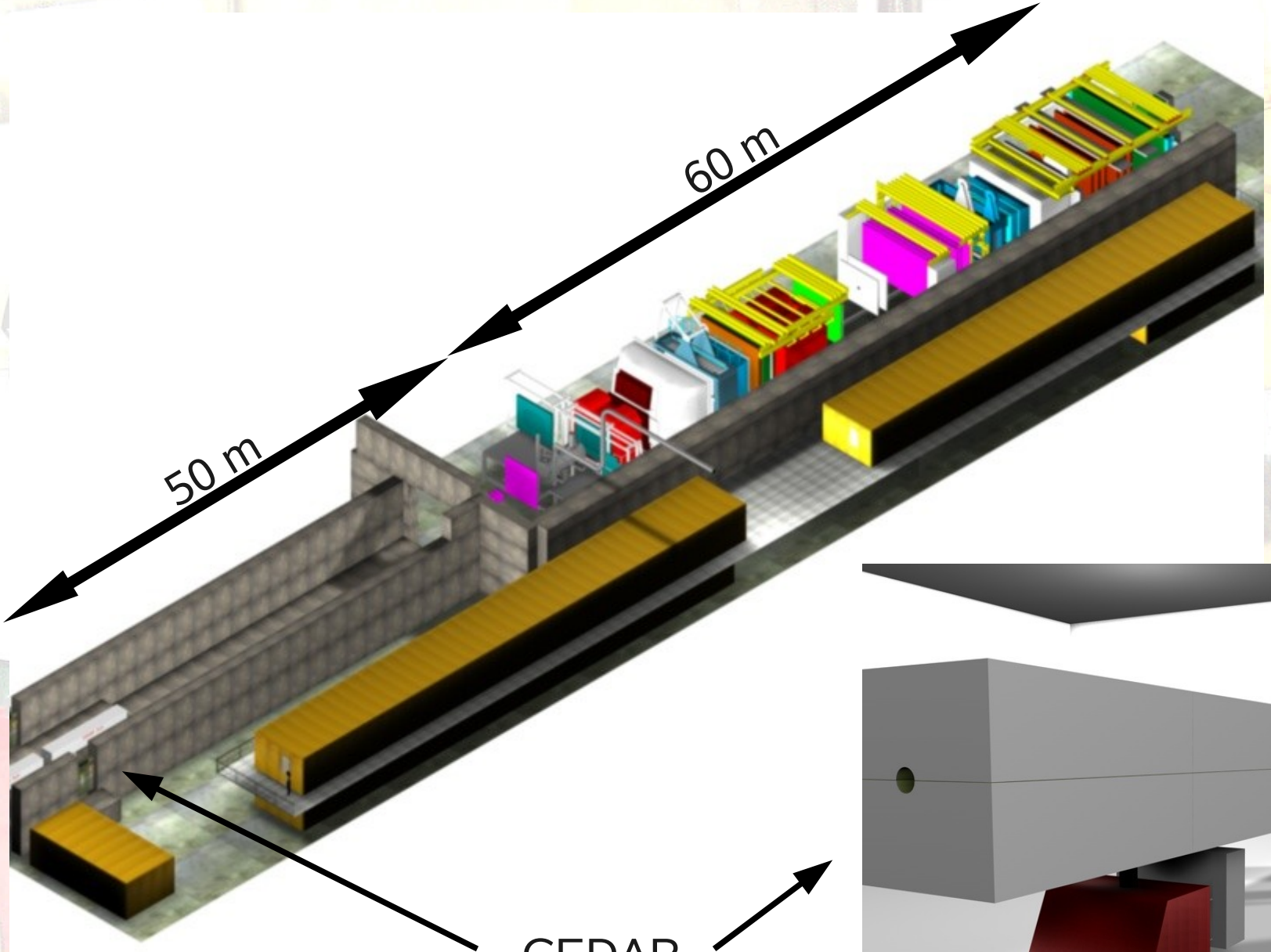
400 GeV/c
primary proton beam

beryllium target

beam composition for
190GeV/c at the COMPASS target:

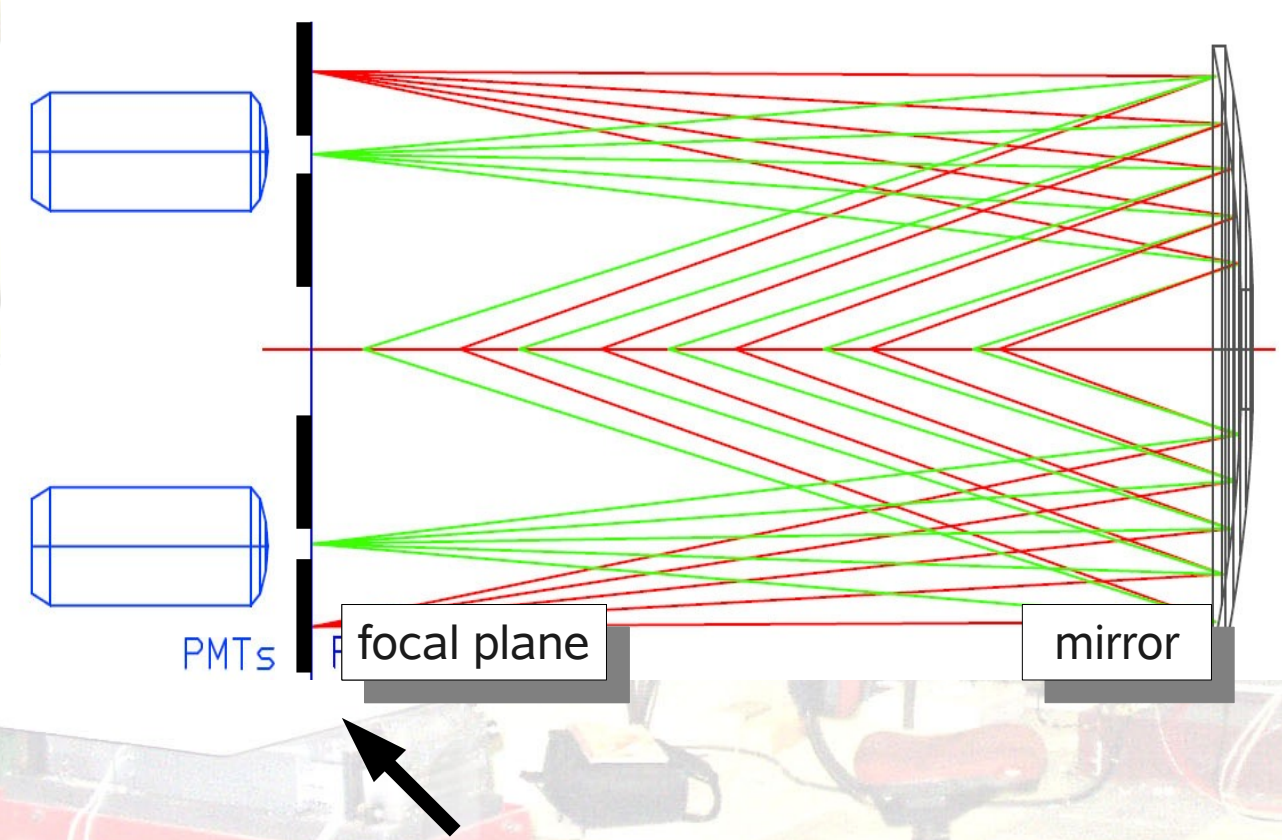
particle	Prob.(%)
π^-	93
K^-	2.5
μ^-	3
p^-	0.6
e^-	0.1

Beam particle identification at COMPASS



CEDAR, how does it work?

ChErenkov Differential counter with Achromatic Ring focus



$$R = \Theta \cdot f$$

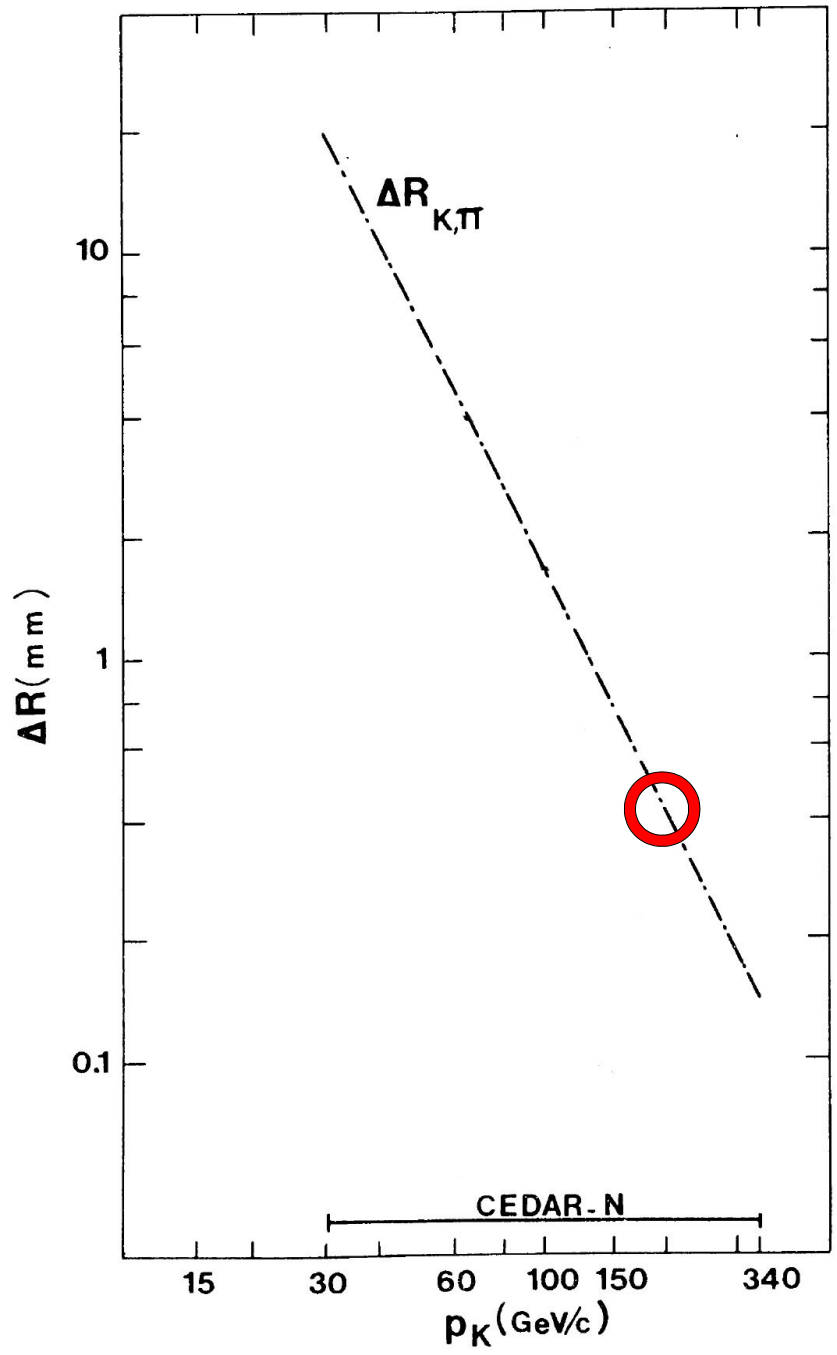
$$\cos\Theta = \frac{1}{n\beta}$$

$$\beta = \left[1 + \left(\frac{m_0 c}{p}\right)^2\right]^{-\frac{1}{2}}$$

diaphragm in the focal plane to separate particles of different masses

$$\Delta R = R_\pi - R_K \approx \frac{f}{\Theta}\left(m_\pi^2 - m_K^2\right)c^2 \frac{1}{2p^2}$$

Ring radius difference over beam momentum

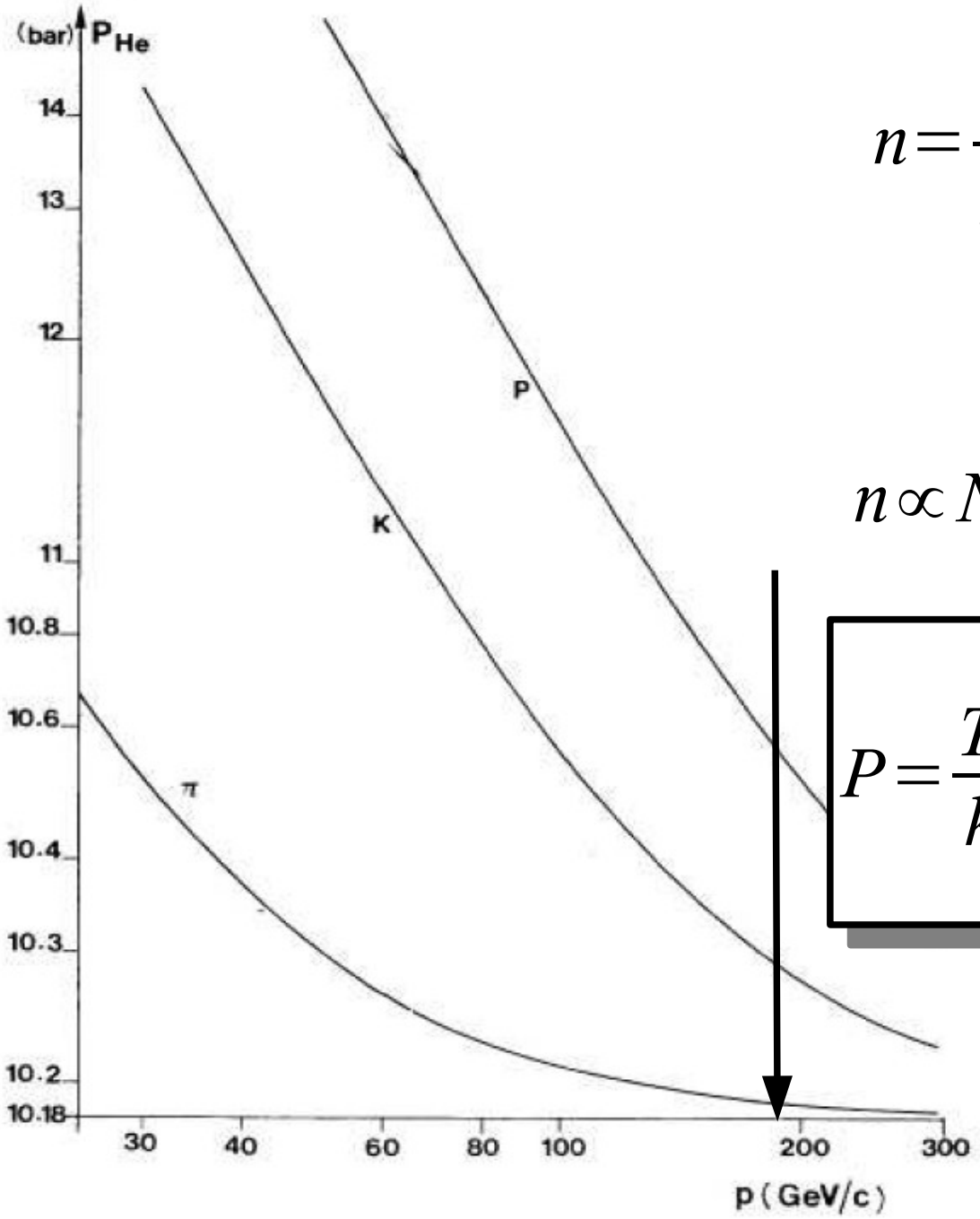


$$\Delta R = R_\pi - R_K \approx \frac{f}{\Theta}\left(m_\pi^2 - m_K^2\right)c^2 \frac{1}{2p^2}$$

Radiator gas	helium
Focal length	4.6 m
Angular acceptance Θ	25 mrad
ΔR	~ $1/p^2$
ΔR @ 190 GeV/c	0.4 mm

Radius must match the angular acceptance.
Only free parameter is the refractive index!

pressure for the fixed accepted Cherenkov angle



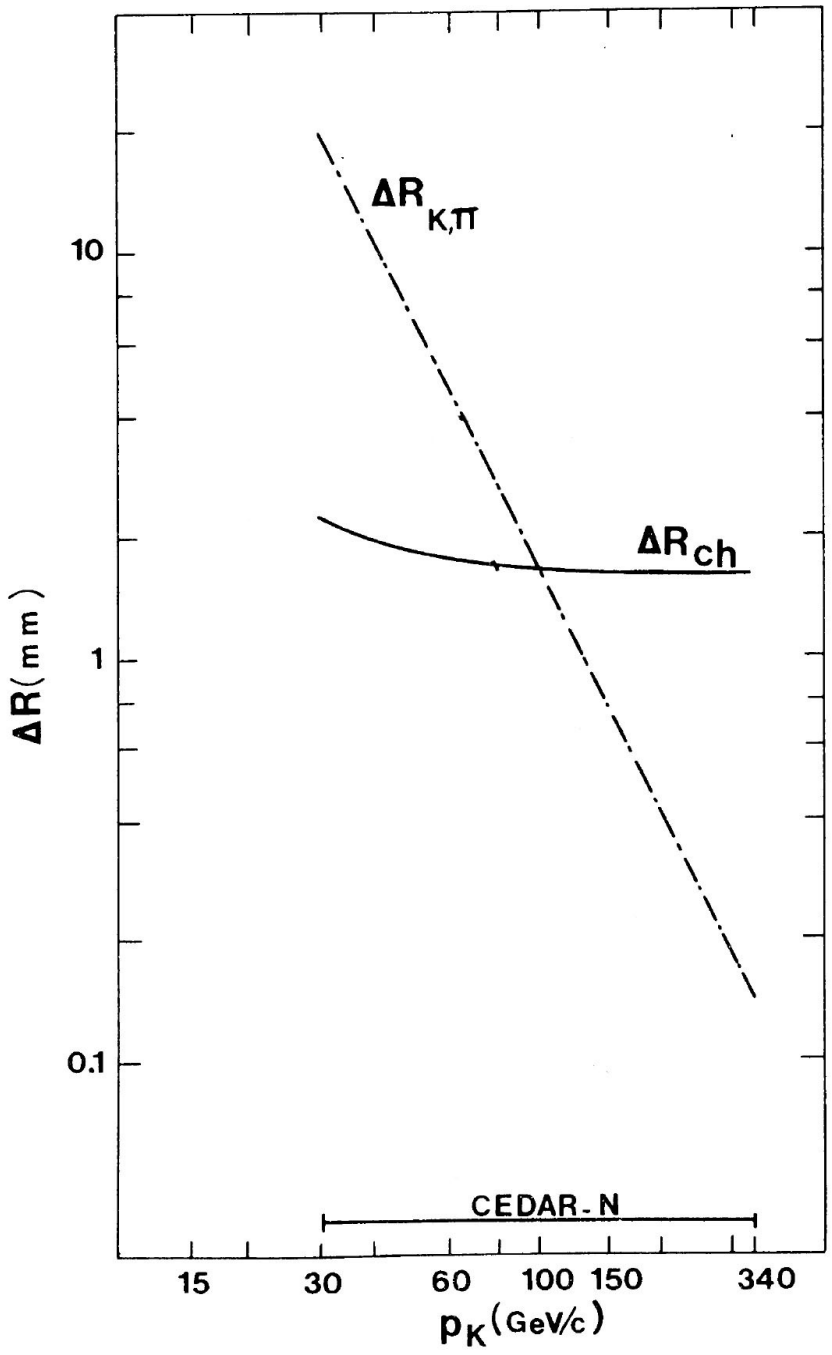
$$n=\frac{1}{\beta\cos\Theta}=\left[1+\left(\frac{m}{p}\right)^2\right]^{\frac{1}{2}}\frac{1}{\cos\Theta}$$

Ideal gas equation:

$$n\propto N\,;V=const\Rightarrow n-1=k\frac{P}{T}\Rightarrow$$

$$P=\frac{T}{k}\left[-1+\left[1+\left(\frac{m}{p}\right)^2\right]^{-\frac{1}{2}}\right]\frac{1}{\cos\Theta}$$

impact of the natural dispersion on the ring focus



$$R(\lambda) = f \cdot \Theta(\lambda) = \arccos\left(\frac{1}{n(\lambda)\beta}\right)$$

spectral range of PMTs:

$$\Rightarrow \Delta R_{ch} = R(500\text{nm}) - R(200\text{nm})$$

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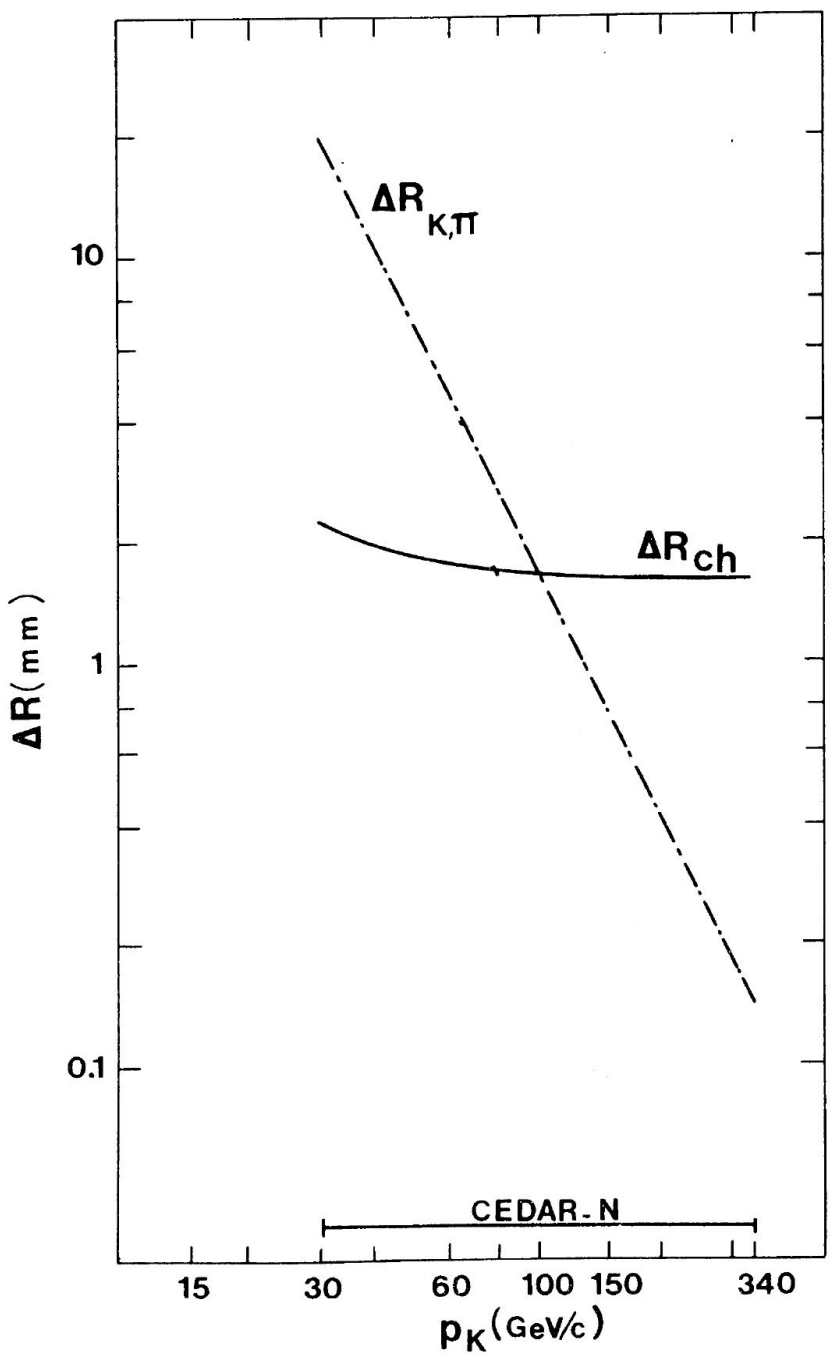

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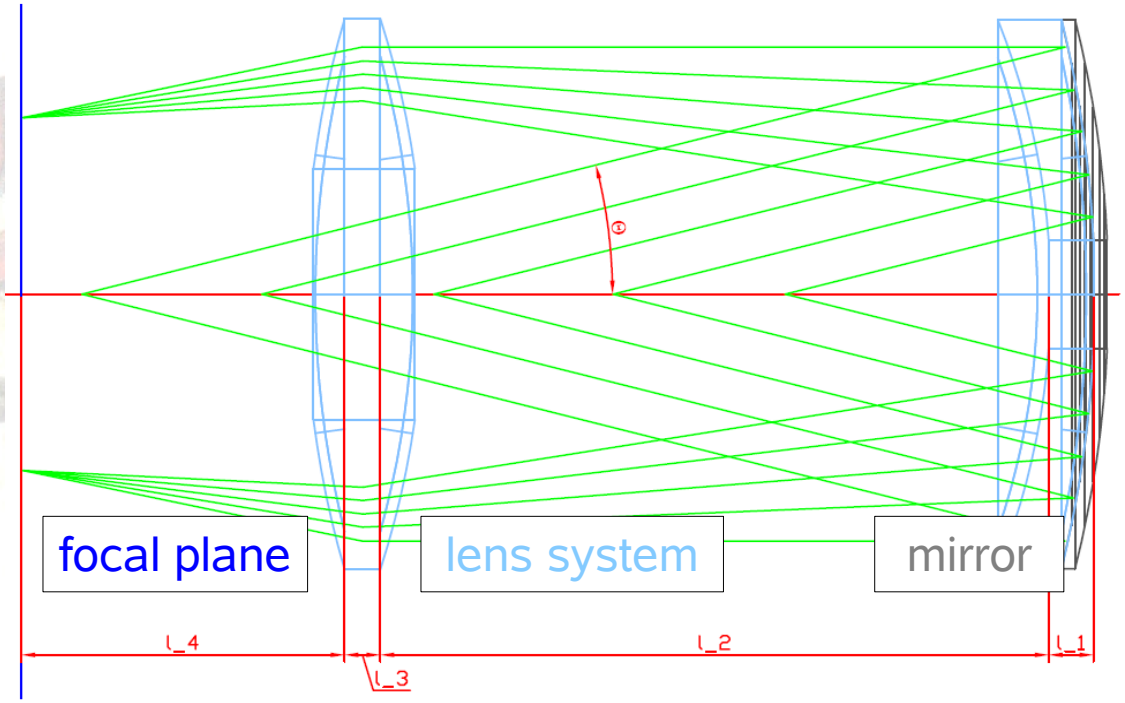

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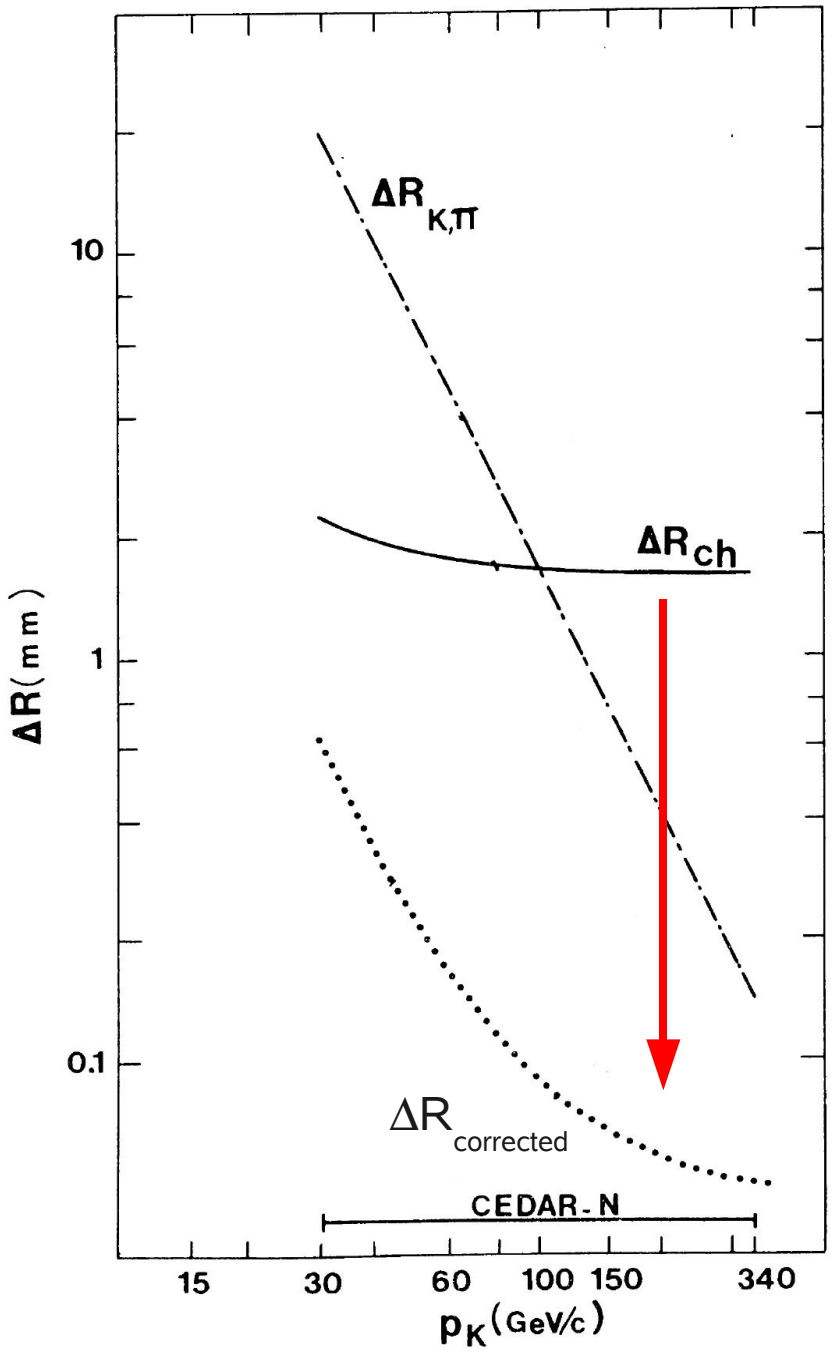

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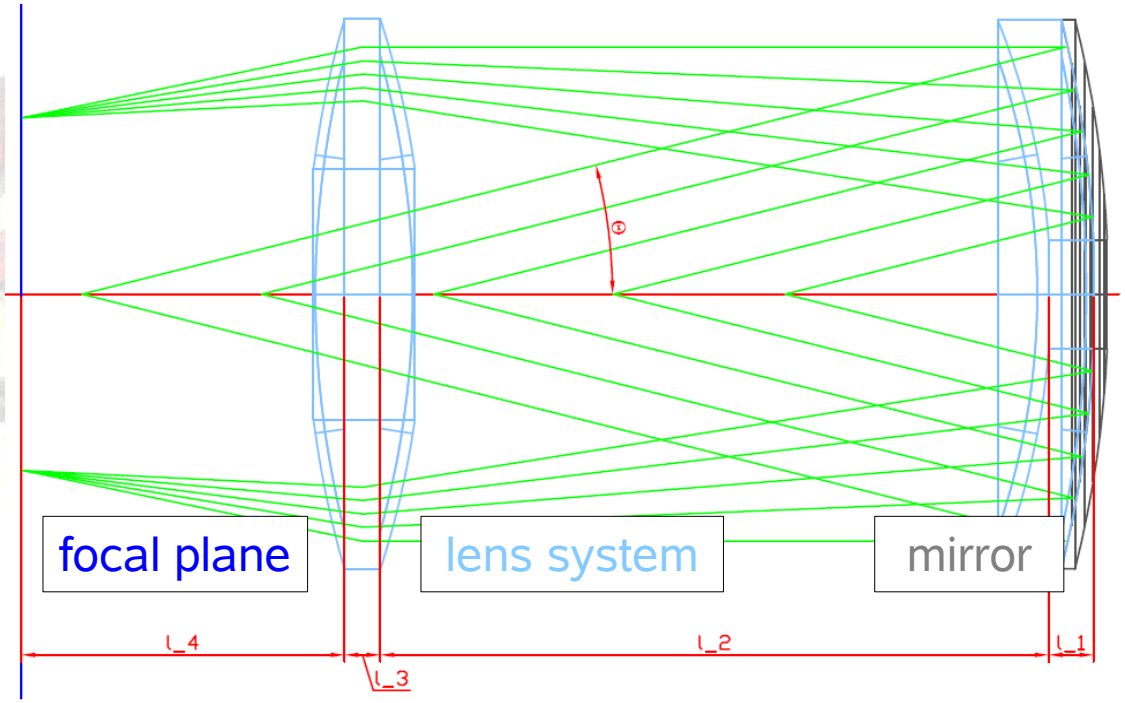
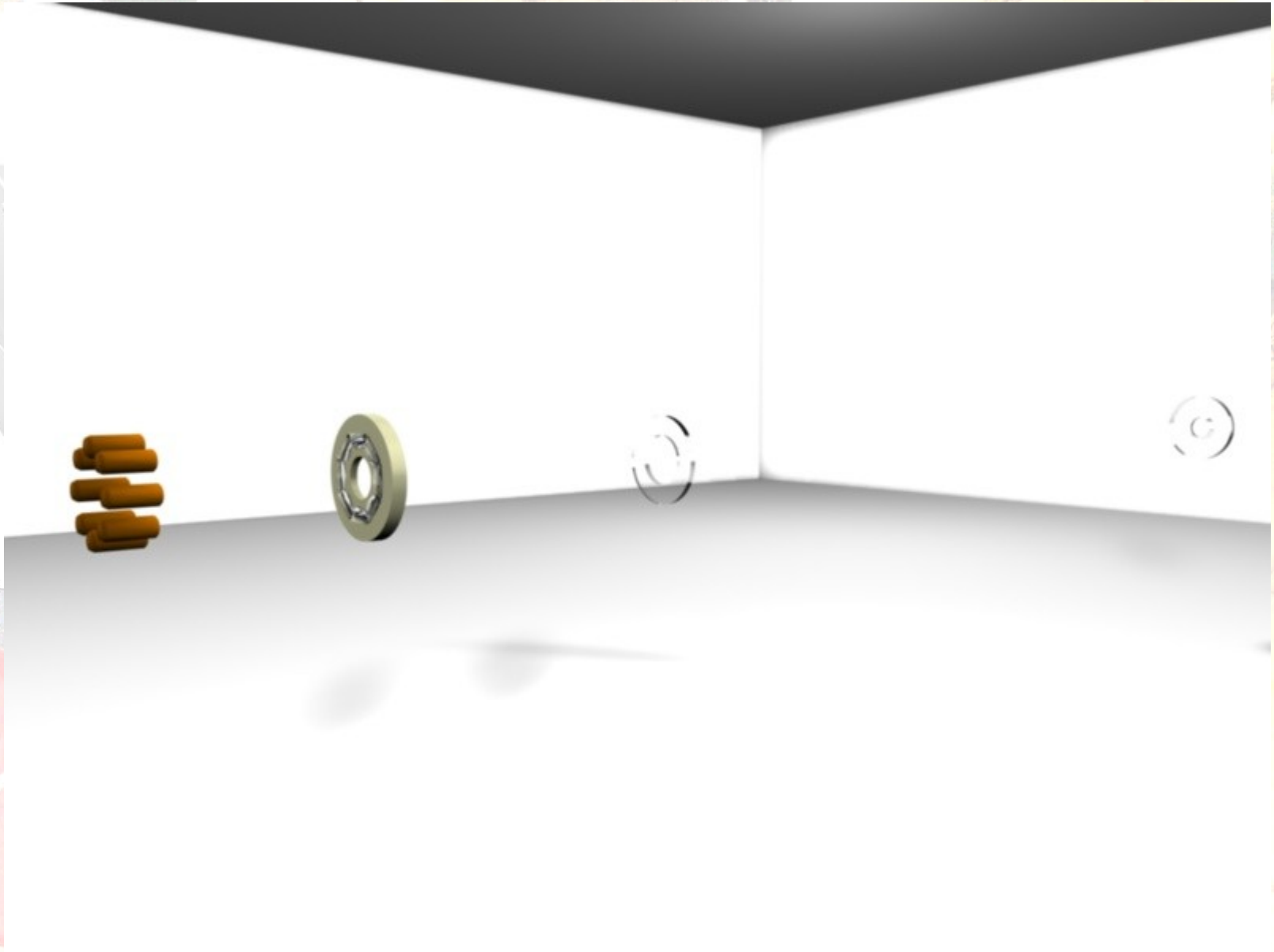


mechanical layout of the CEDAR



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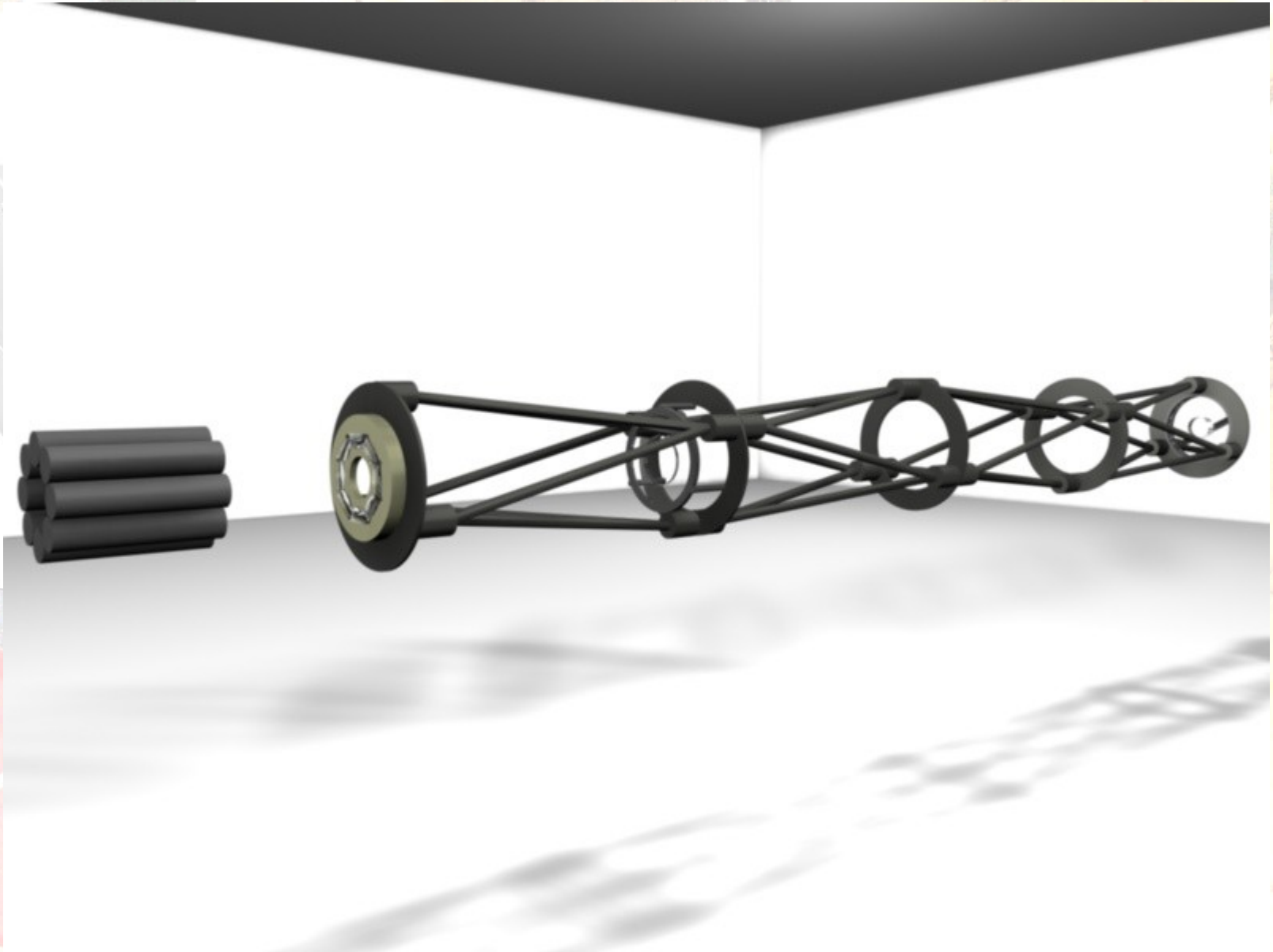

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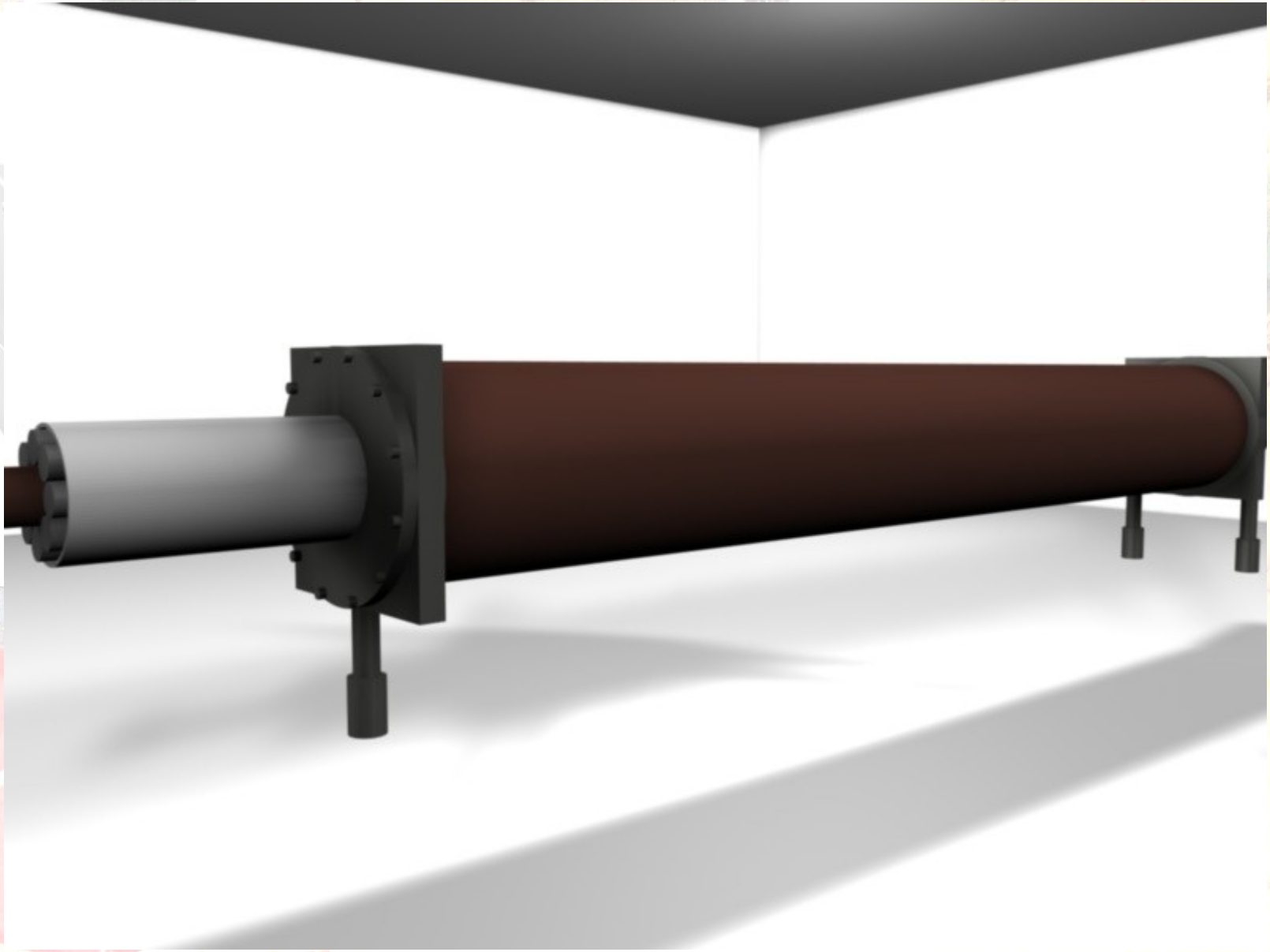

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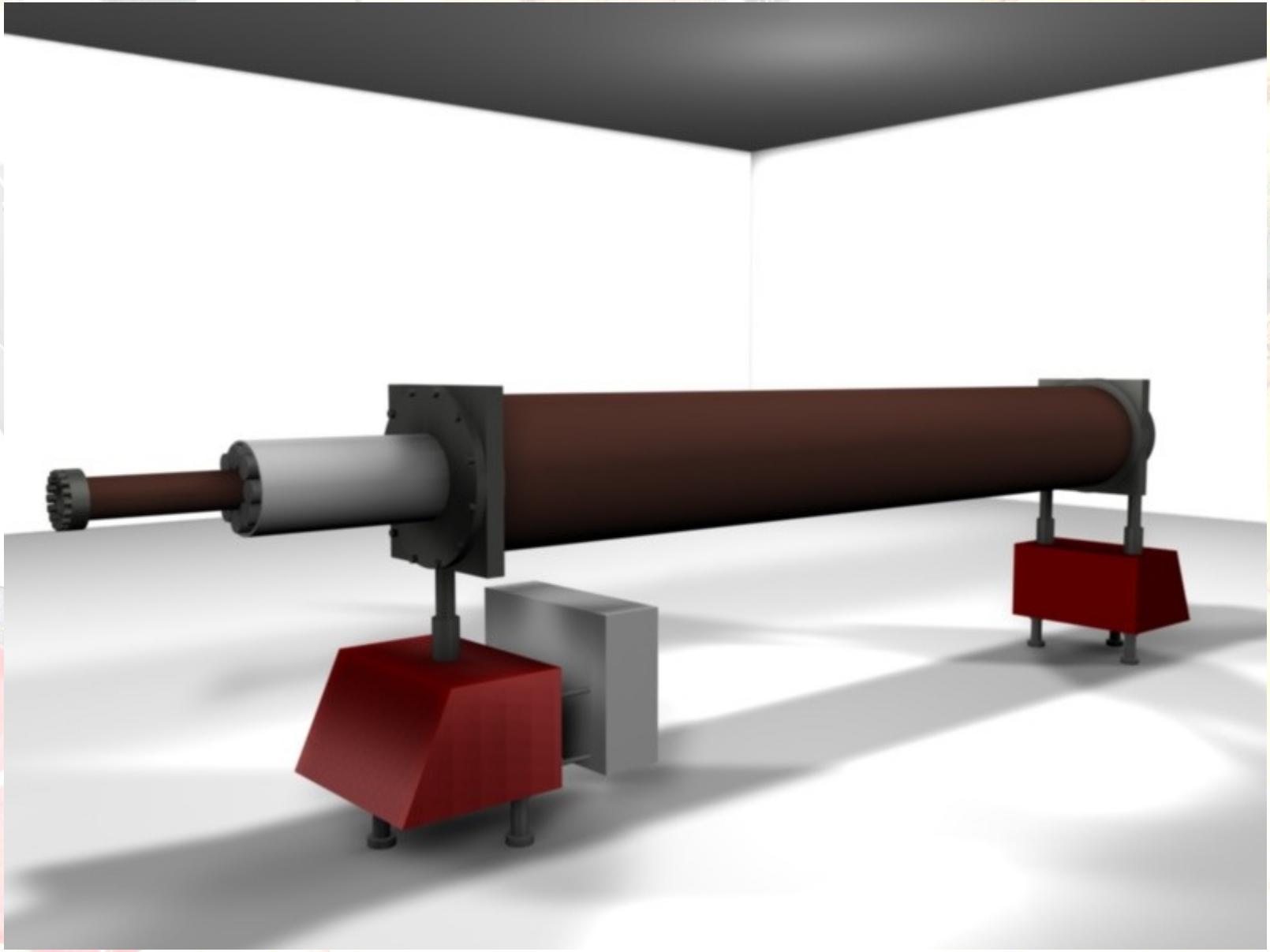
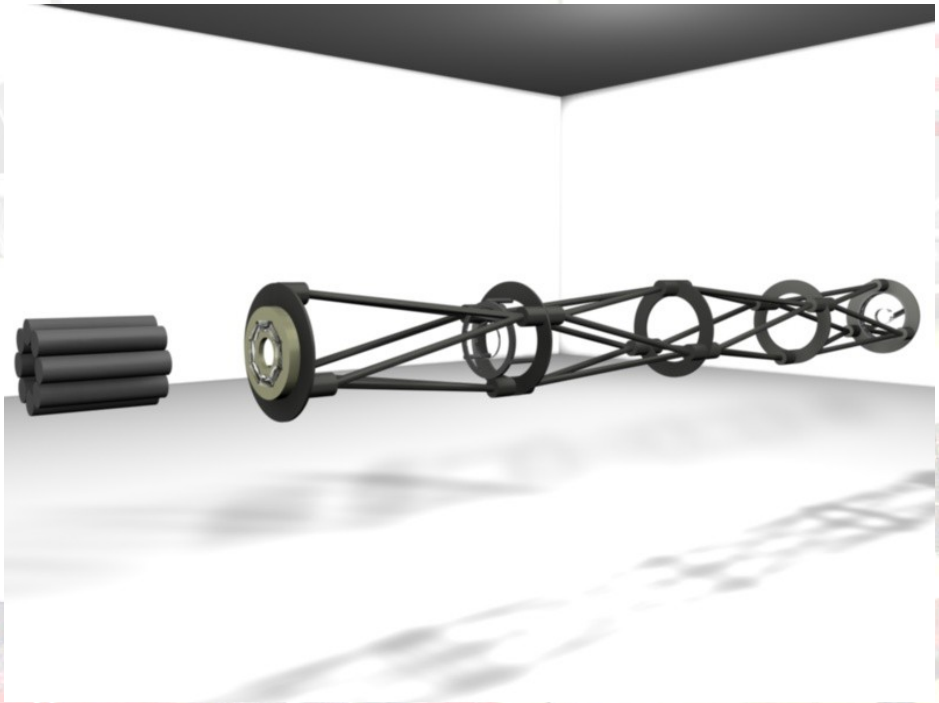


mechanical layout of the CEDAR

CEDAR detector setup in the hadron run 2008



Light detection with 8 PMTs

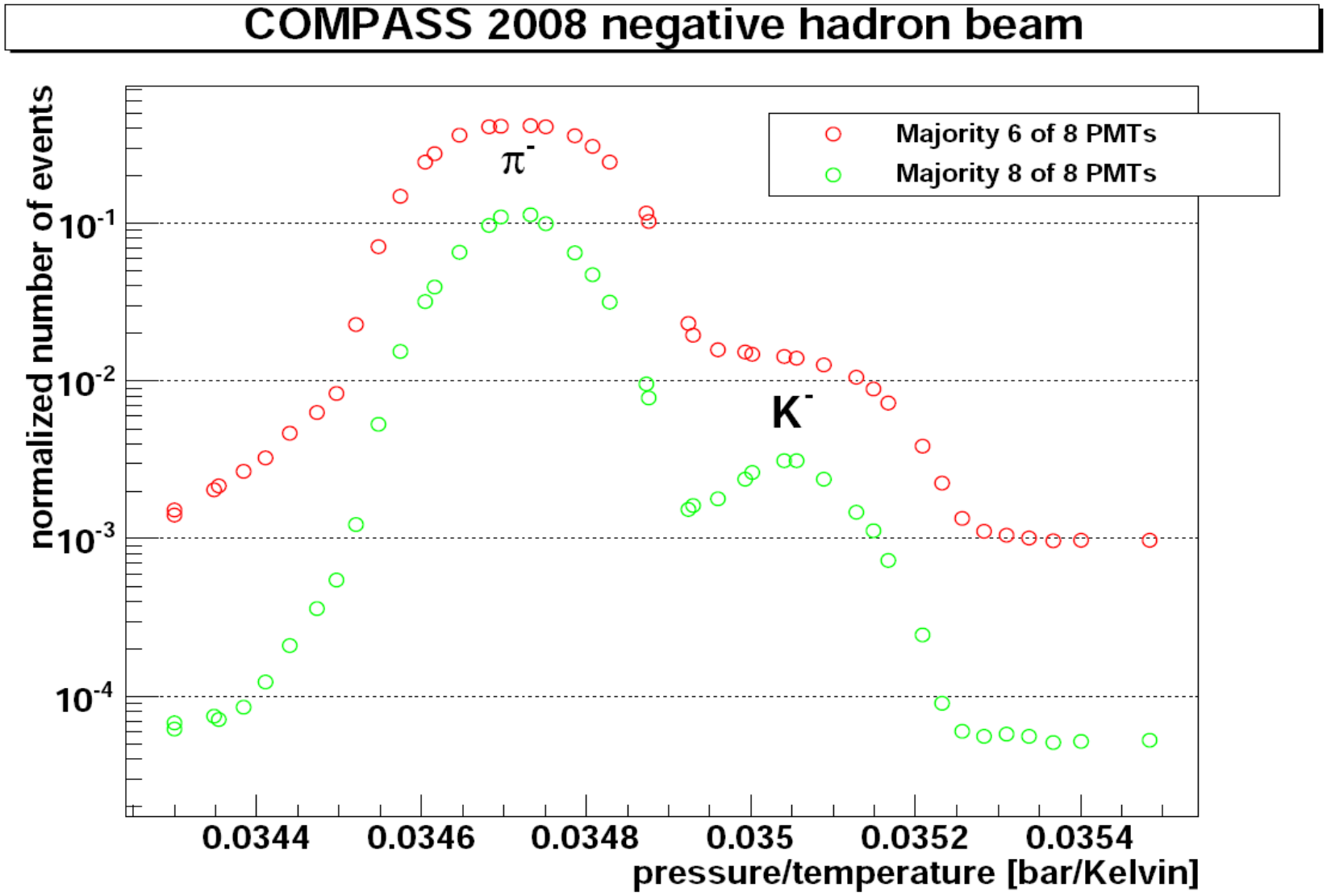
Most of the beam time set on Kaons

About 10 cherenkov photons per PMT equal 3-4 mean photoelectrons

All PMT hits recorded for offline analysis

Trigger: majority of 6 PMTs in one CEDAR and
CEDAR 1 && CEDAR 2

Setting the pressure: pressure scans



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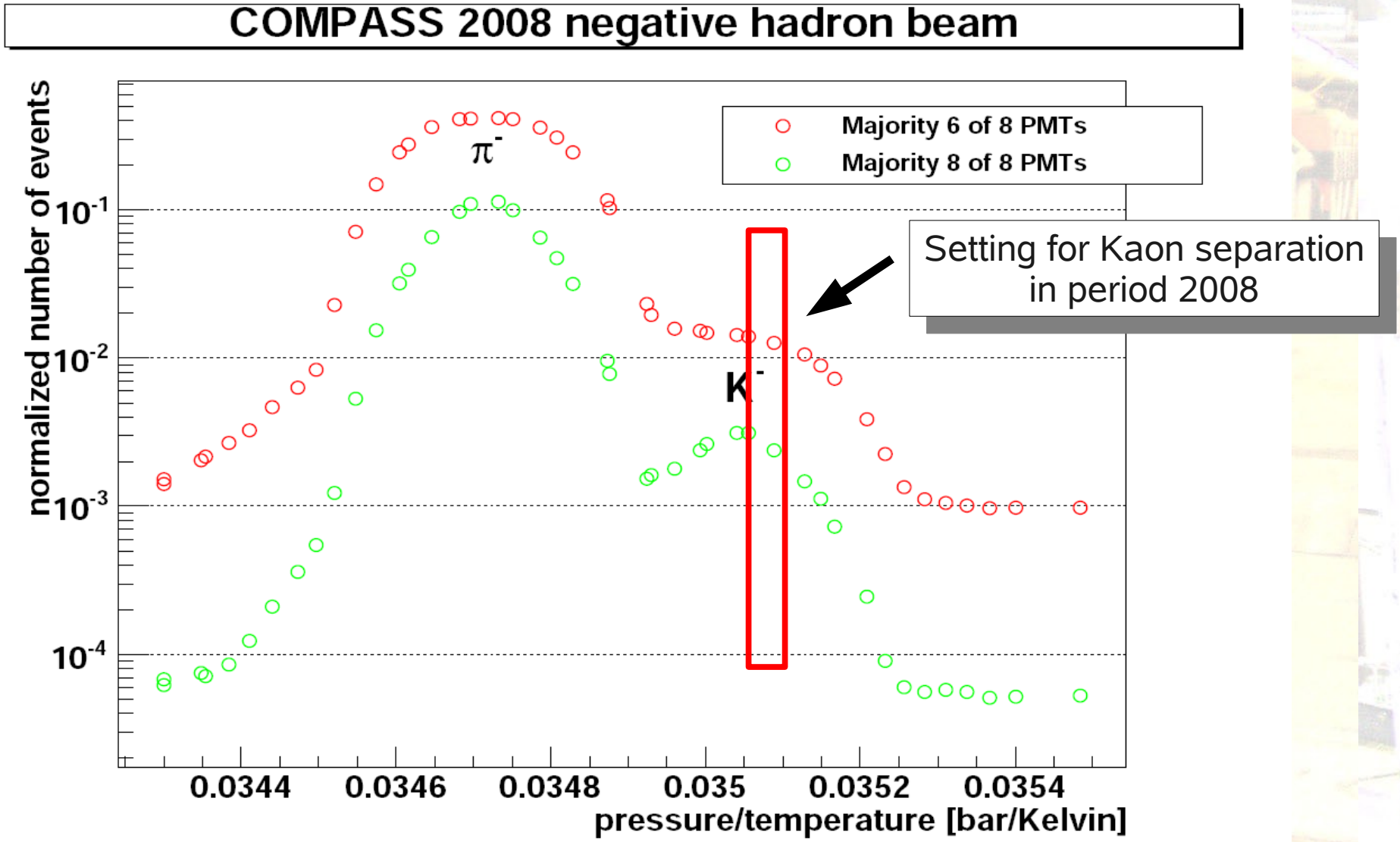
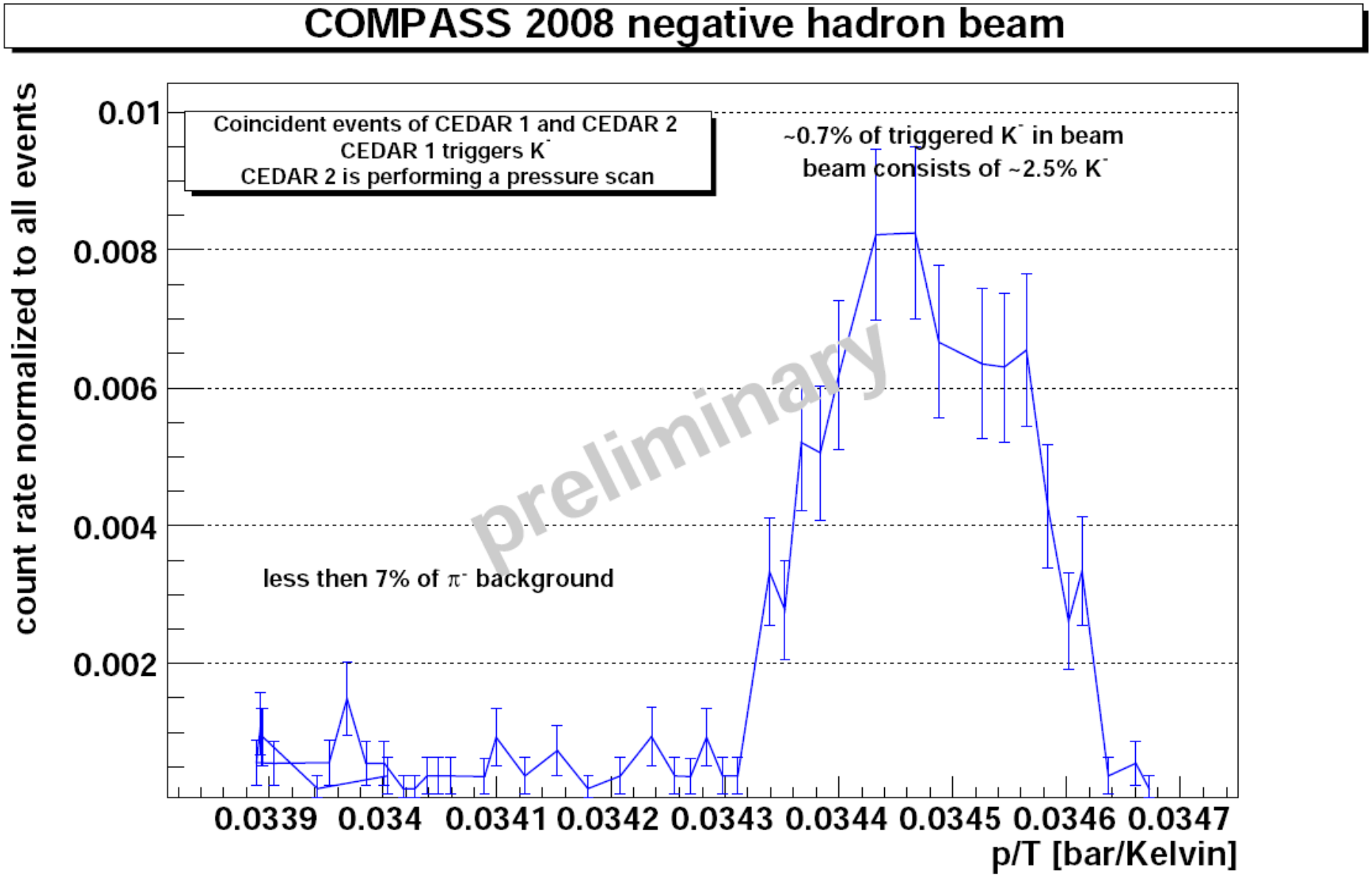
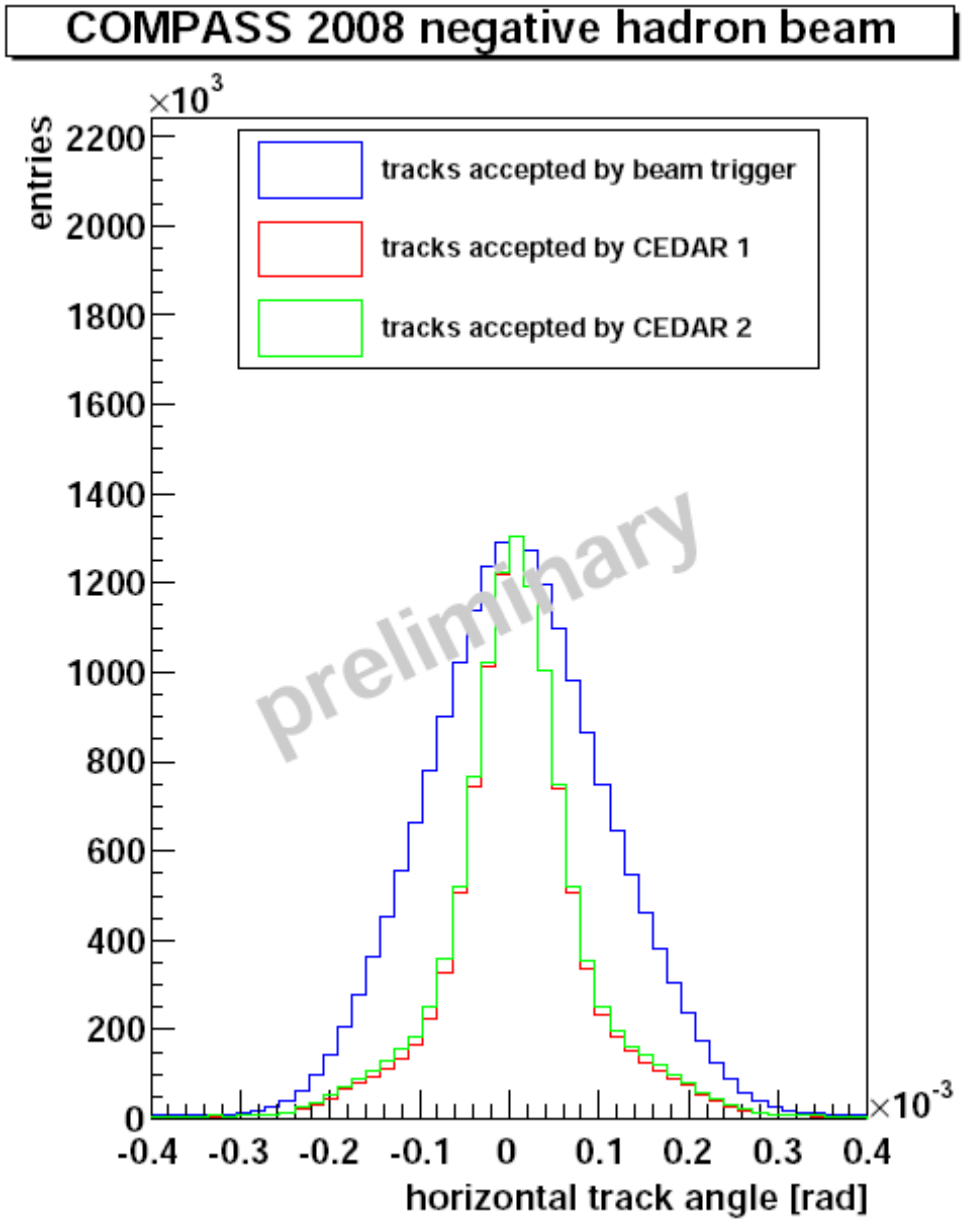
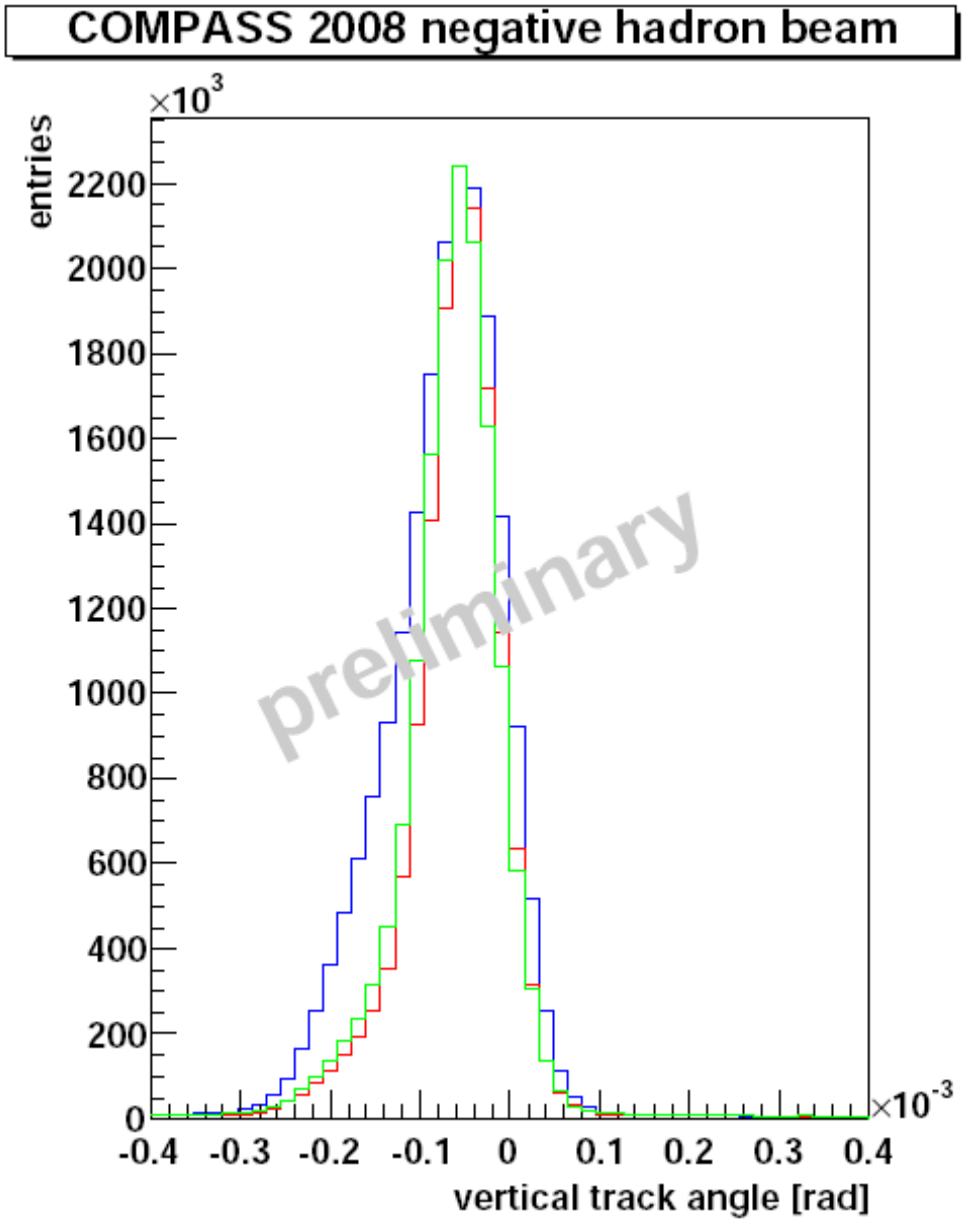


Offline purity and efficiency analysis



Study of beam divergence

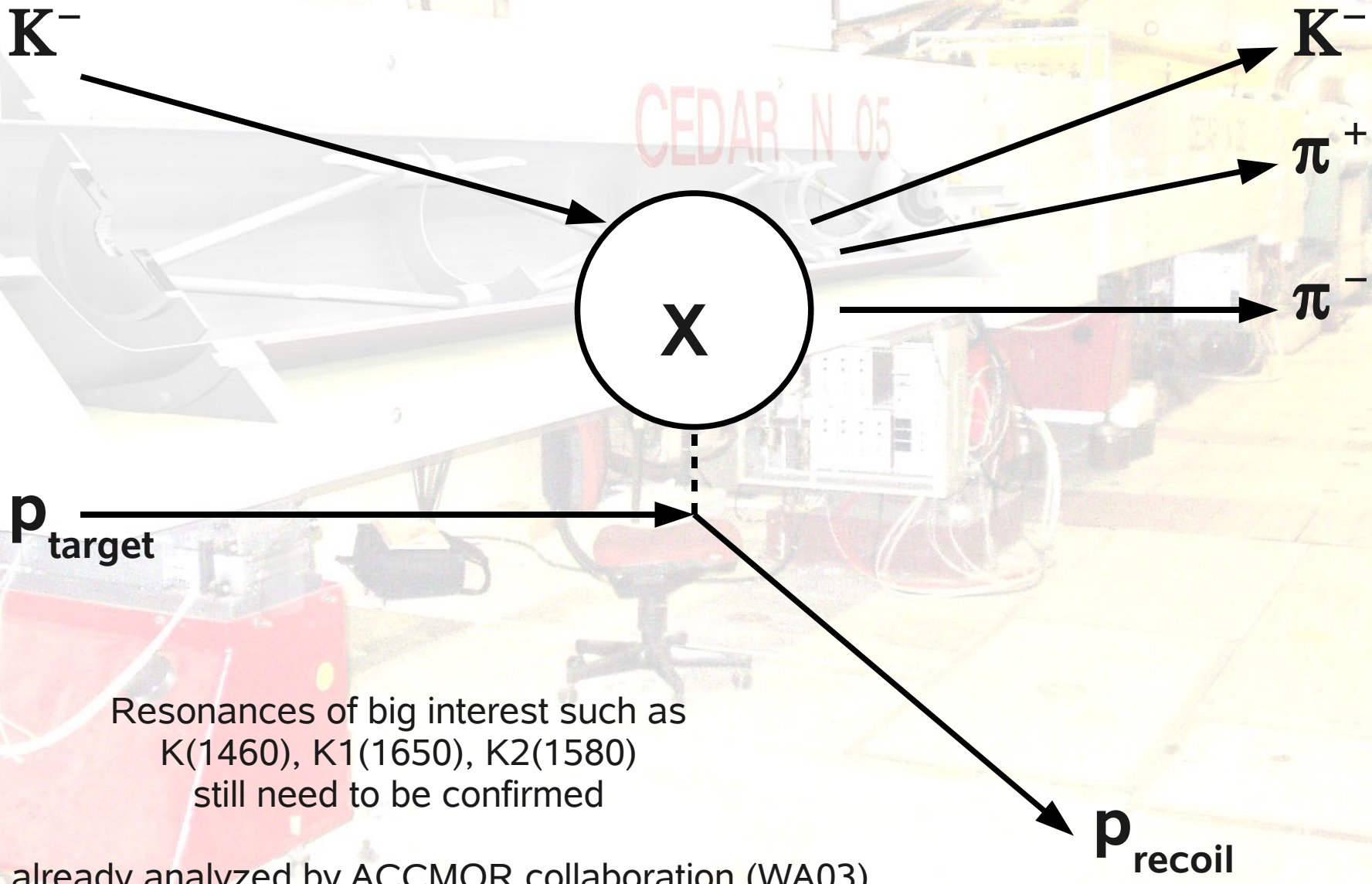




beam tracks with a large divergence are not accepted by the CEDARs.

Analysis of a channel with strageness

Diffractive scattering of Kaons on protons



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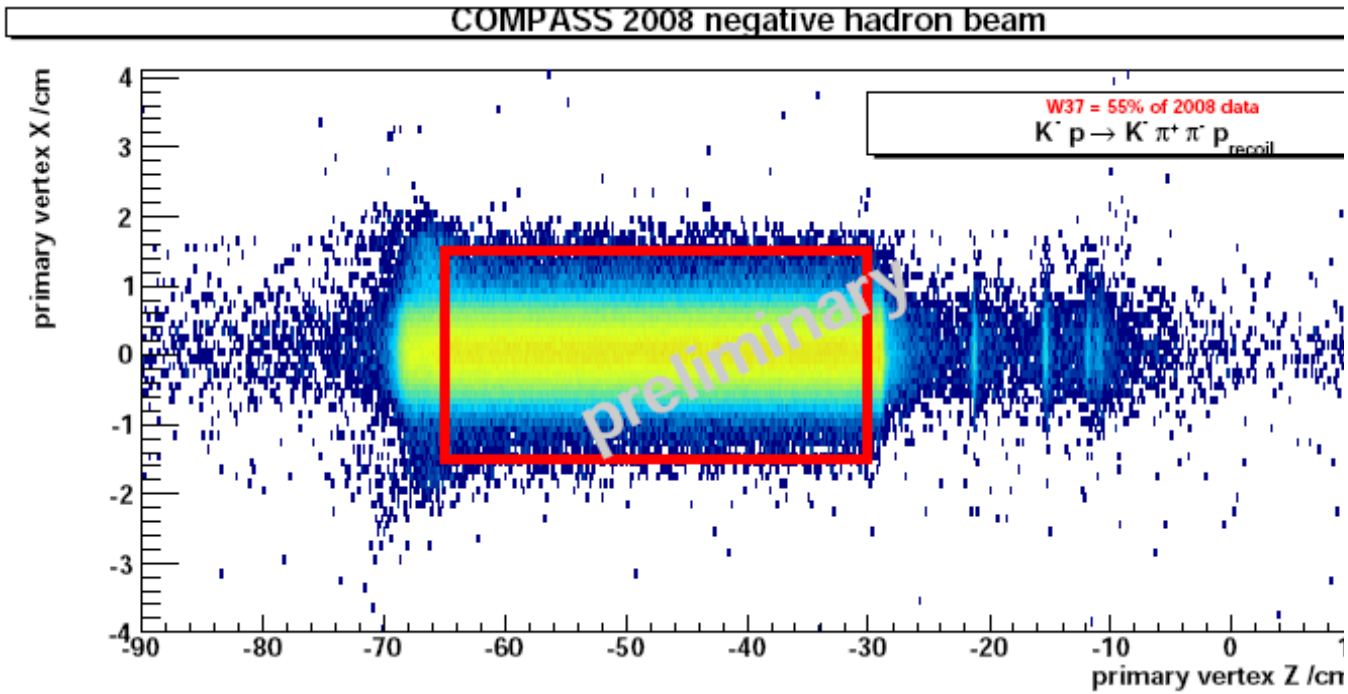
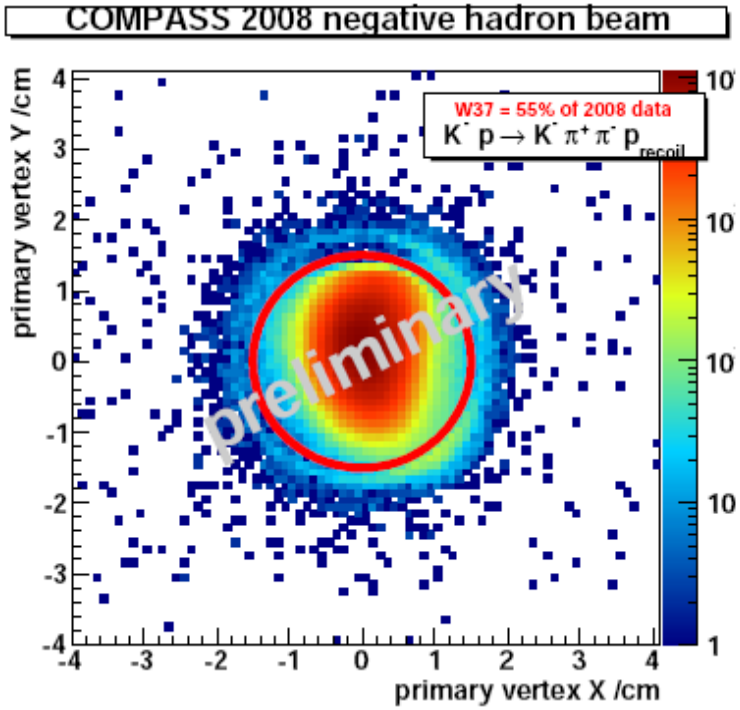
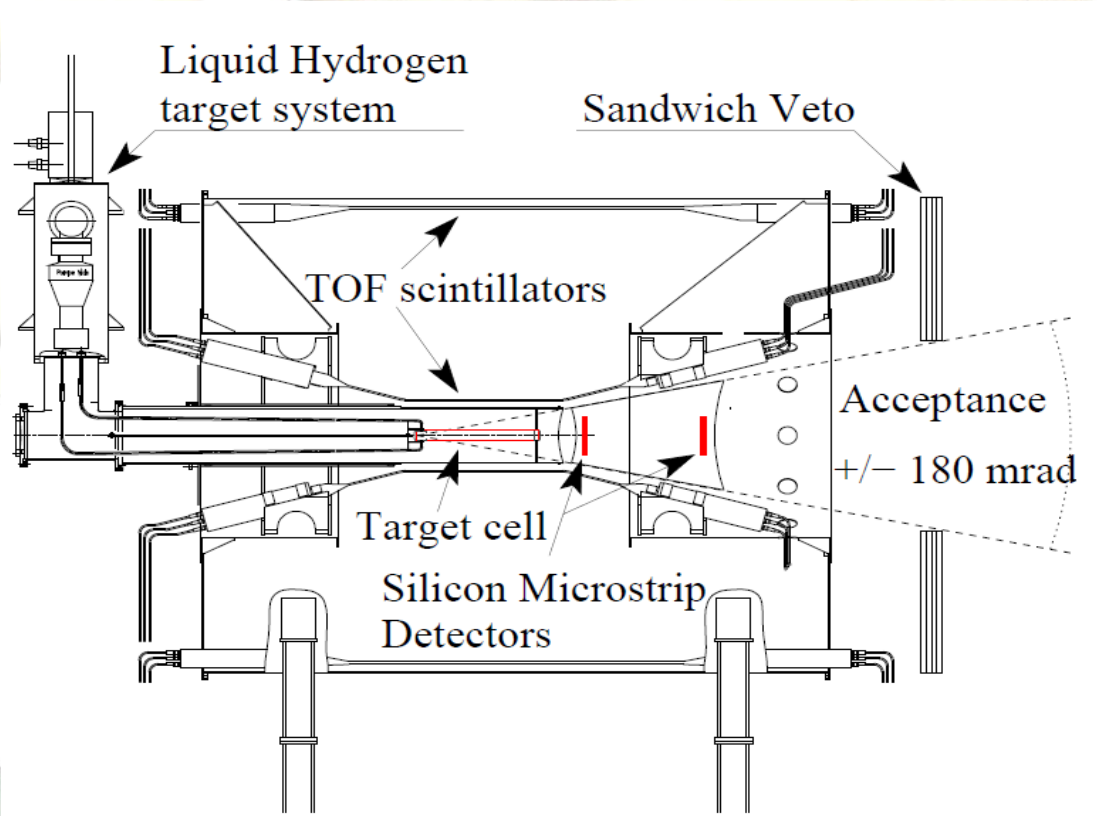
Vertices with 3 outgoing charged particles





A cut is applied to select the target region

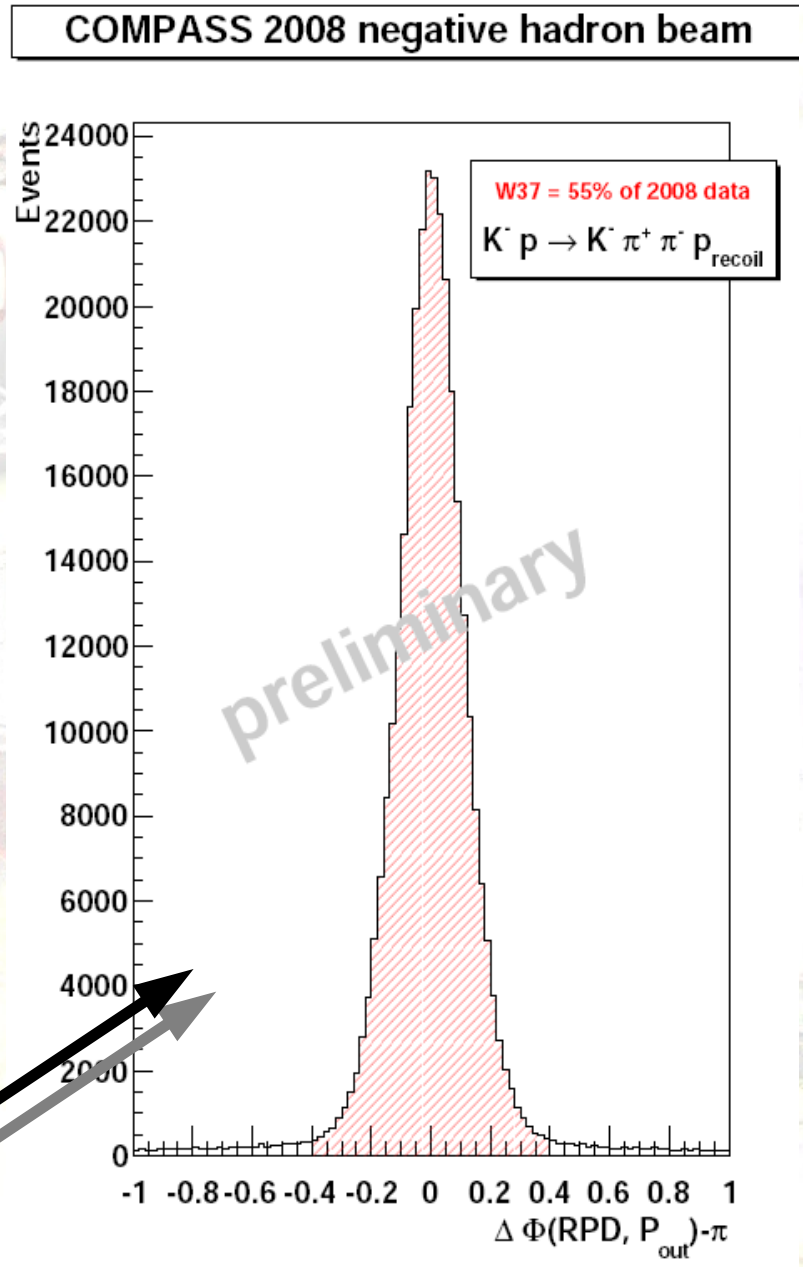
event coplanarity



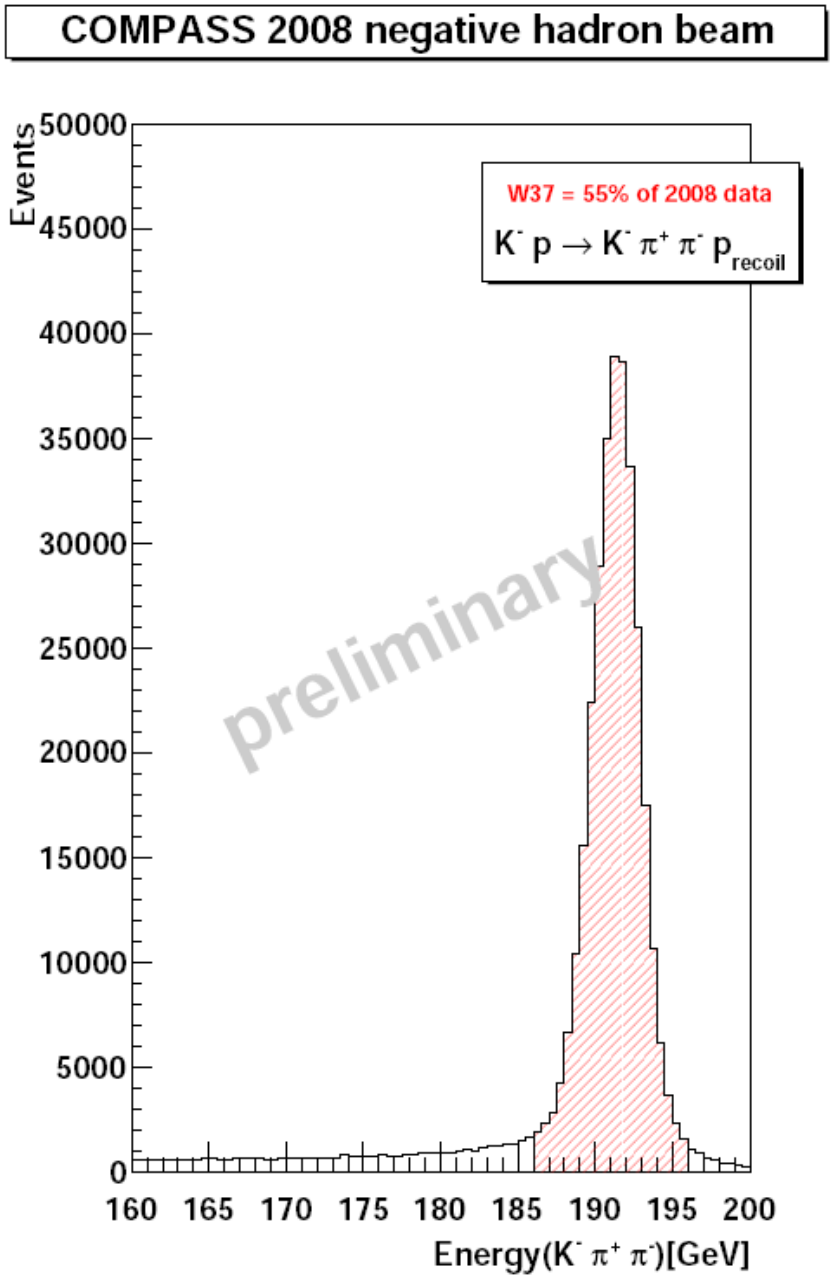
The recoil proton is detected by the RPD

Check of coplanarity of
reconstructed 3-particle Lorentz vector
and
reconstructed recoil proton.

$|\Delta \Phi - \pi| < 0.4$



Searching for exclusive events

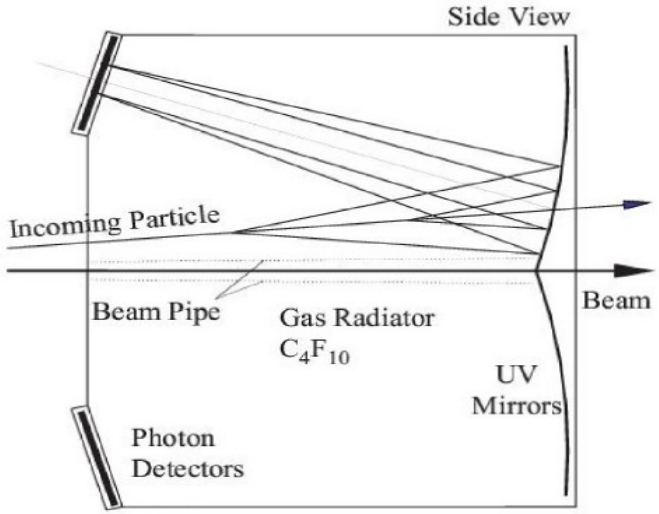


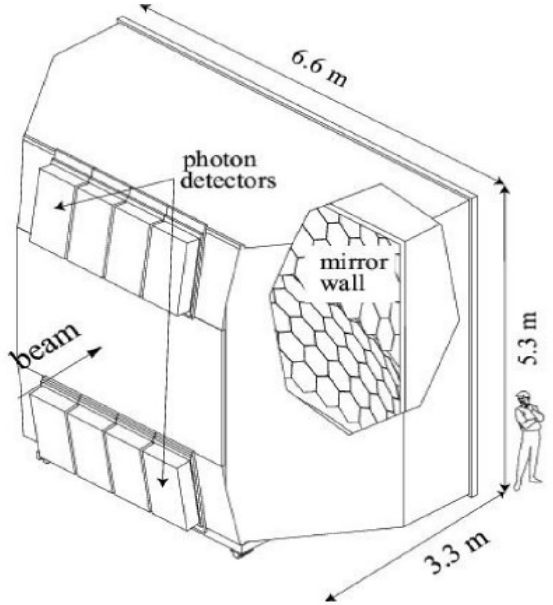
The incoming beam momentum is not measured!

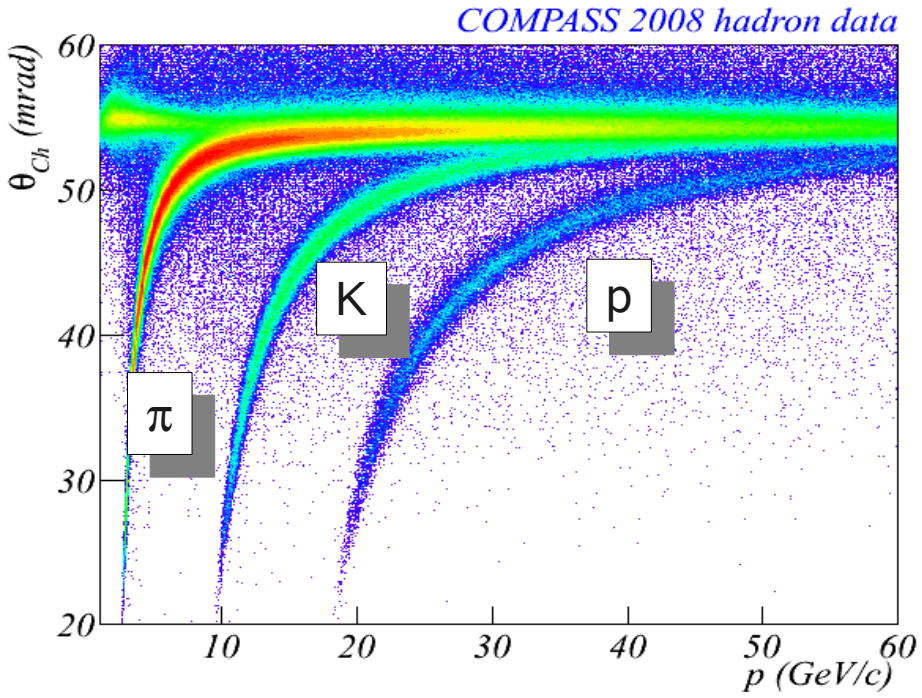
The exclusivity of the event is given by a cut on the total energy of the reconstructed tracks

Reduction of combinatorial background

Particle identification by using the RICH





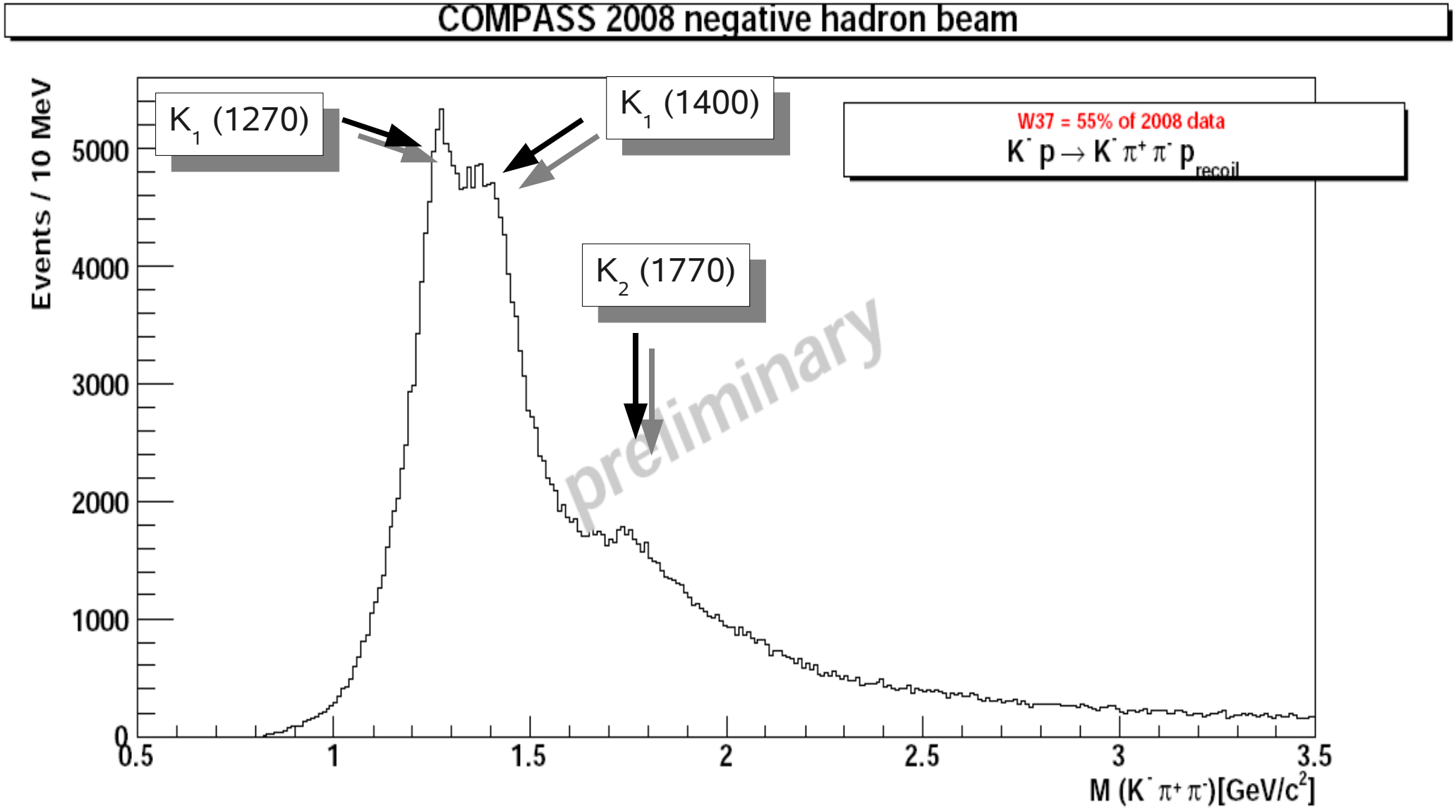


K/π seperation up to ~55 GeV particle momentum

RICH is used as a VETO

~1/2 of all wrong particle combinations are rejected

Invariant mass distributions for diffractively produced $K^- \pi^- \pi^+$ 3-body systems



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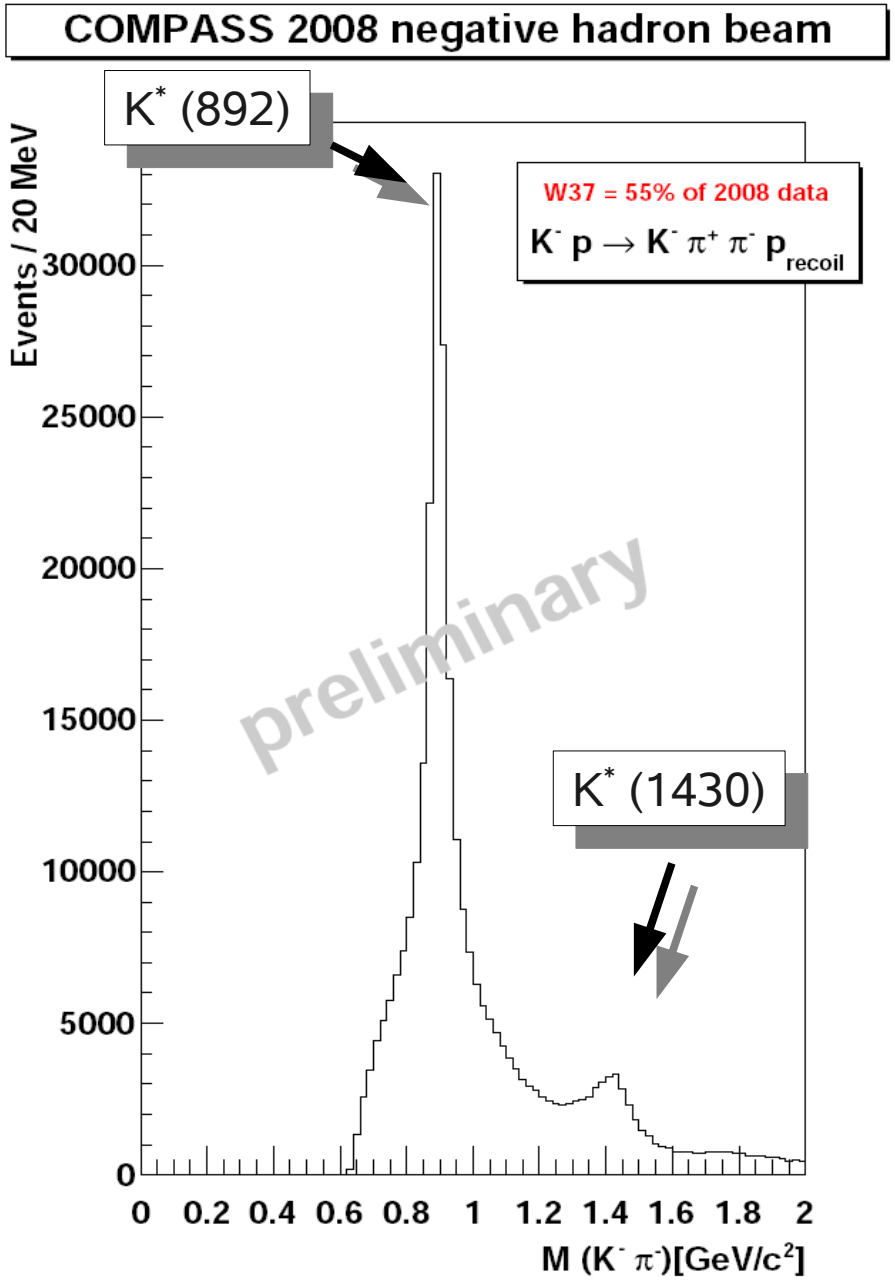

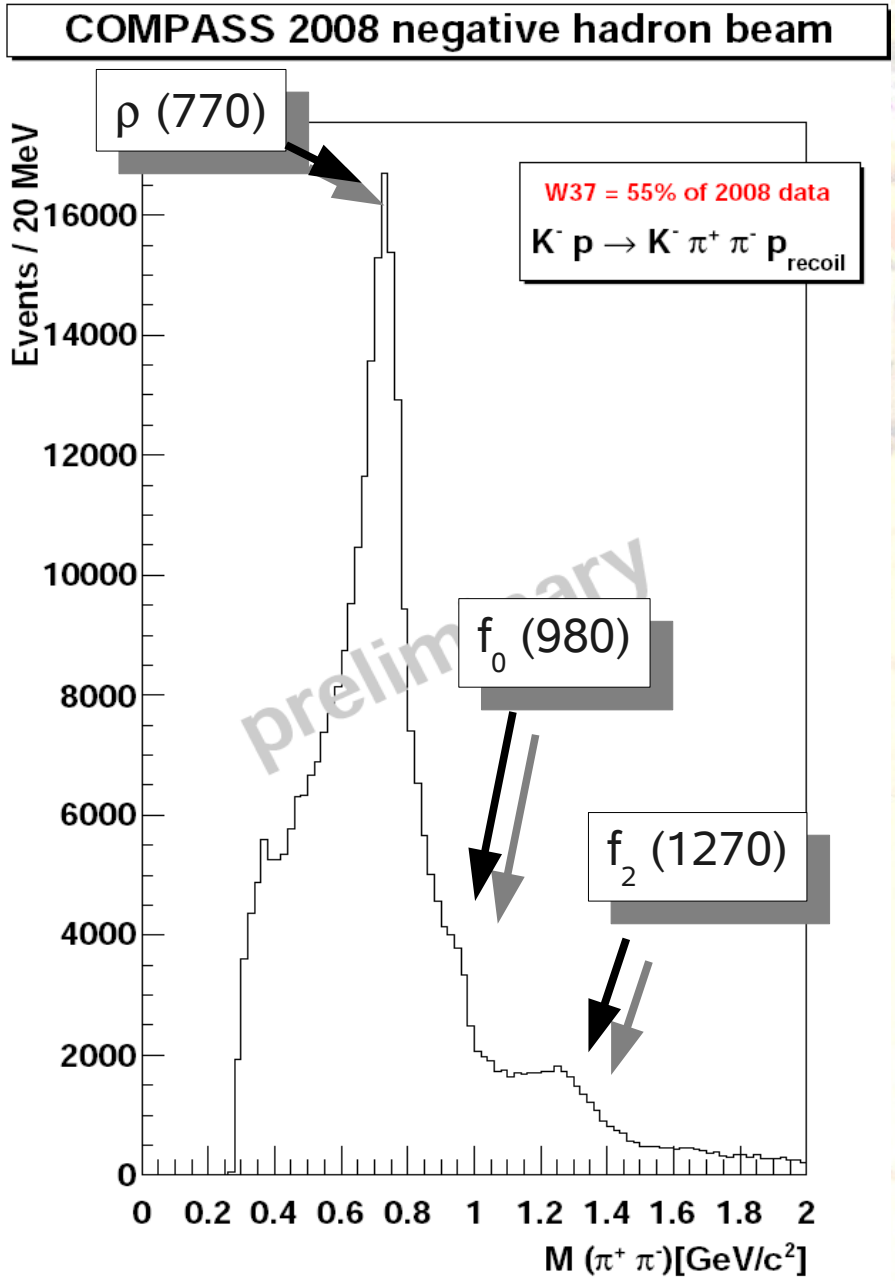

Summary and outlook

A CEDAR is a very good detector to trigger one kind of beam particles

The 30 years old CEDAR devices had been successfully used in the 2008 run on the CERN M2 beamline

The K p -> K p π π channel was investigated. Only 55% of 2008 data were analyzed. More to come.

A full PWA will be performed in the near future.

Thank you for your attention!

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

bmb+f - Förderschwerpunkt COMPASS Großgeräte der physikalischen Grundlagenforschung