A RICH Detector for CLAS12

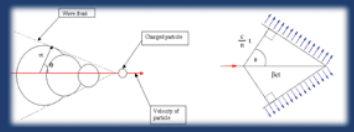
Ring-Imaging CHerenkov (RICH)

Particle detector used to **identify charged particles** by determining its velocity, **v**

RICH detector works by measuring emission of Cherenkov radiation: **a cone of light** produced when a particle traverses a medium with a **velocity greater than the speed of light in that medium:**

$$v = \beta c > c/n$$

n = refractive index of the medium
β = particle velocity as a fraction of the speed of light in vacuum, c



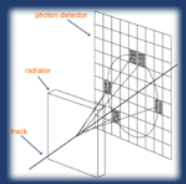
This phenomenon can be compared to the sonic boom produced by an aircraft breaking the sound barrier (the velocity of the aircraft is greater than the velocity of the sound in air)

The Cherenkov emission angle, ϑ_c , of the light is given by:

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

If the momentum of the particle is measured independent and the angle of Cherenkov light emission is also reconstructed, then it is possible to derive the mass of the particle

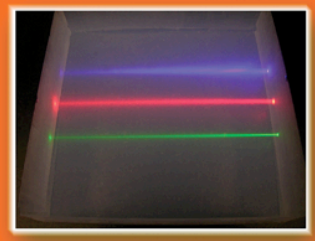
A RICH detector consists of a radiator, an expansion volume, which allows the photons to separate and a photon detector. Often the light is focused with mirrors

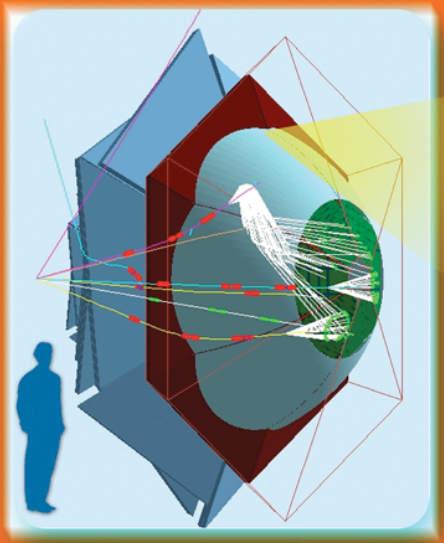


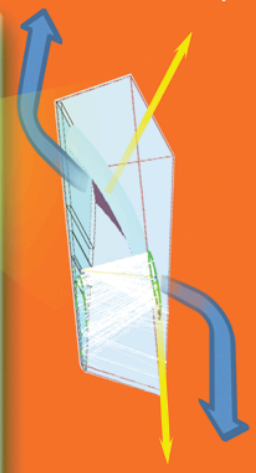
In a RICH detector the POSITION and DIRECTION of the impact point of each photon on the detector surface is detected with high resolution in order to reconstruct with hight precision the Cherenkov emission angle, ϑ_c

Aerogel

Invented in 1931 but first applications in particle physics in 1980
Is the world's lightest solid (SiO_2),
weighing only three times that of air
and is 1,000 times less dense than glass.
Variable refractive index close to 1





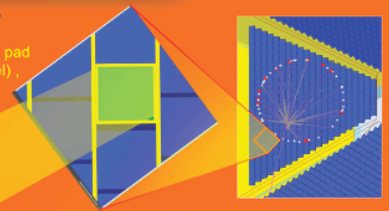


Cerenkov radiator plane

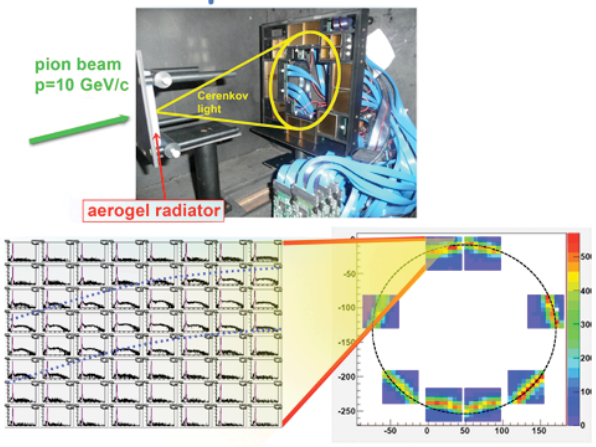
Photon Detector Plane

Multi Anode PMT

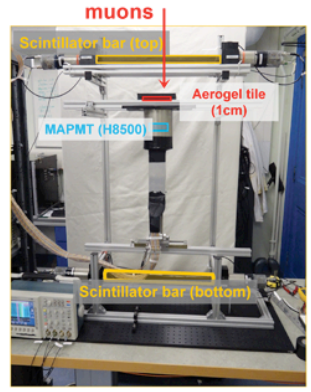
Hamamatsu H8500: compact,small pad size (5x5 cm^2 with 6x6 mm^2 pixel) , detection of visible light in single photon regime

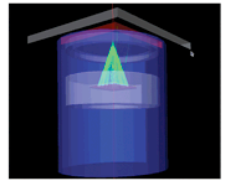


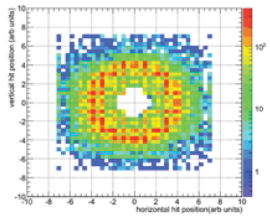
Test with pion beam at CERN



Test with cosmic muons at Glasgow







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