Status of the LHCb silica aerogel Cherenkov radiator

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LHCb RICH Detectors

- Particle ID provided by Ring Imaging CHerenkov detectors covering the momentum range 1–100 GeV/c
- Essential to enhance the signal to background ratio in the selection of physical channels and provide an efficient kaon tag
- Three radiators: aerogel and C4F10 (RICH–1), CF4 (RICH–2)

Silica Aerogel

- Hygroscopic linked network of SiO2
- Density ρ ~ 0.15 g/cm³
- Clarity ~ 0.0050 μm³/cm, refractive index n ~ 1.03
- Produced by the Boreskov Institute of Catalysis, Novosibirsk
- LHCb equipped with 200×200×50 mm³ tiles, the largest size ever
- 16 tiles needed for RICH–1
- Good refractive index homogeneity σ(n-1)/(n-1)<1%
- Excellent π⁻/proton separation up to 10 GeV/c (~ 5 σ)

Ageing Effects

- Particle flux in the aerogel region ~ 3.5 × 10¹² particles/cm²/year
  Can this harm the performance?
- Hygroscopic sample exposed to humidity: degradation of its optical properties as expected, but in a reversible way!

Long Term Stability

- Aerogel radiator in contact with the gaseous C4F10 radiator
- Natural ageing to check the stability: 3 years of monitoring!

Refractive Index Issues

- A 500 MeV e⁻ beam to measure the refractive index variations
- Photographic film to collect photons
- Measurement of the chromatic dispersion
  \[ n² - 1 = \frac{a_0 \lambda²}{\lambda² - \lambda_0²} \]
  \[ a_0 = 0.05613 ± 0.00009 \]
  \[ \lambda_0 = 88.71 ± 2.11 \]
- One–pole Sellmeier curve
- Agreement with pure fused silica model in the range 200 – 700 nm

Poster presented at the 10th Topical Seminar on Innovative Particle and Radiation Detectors – Siena (I)