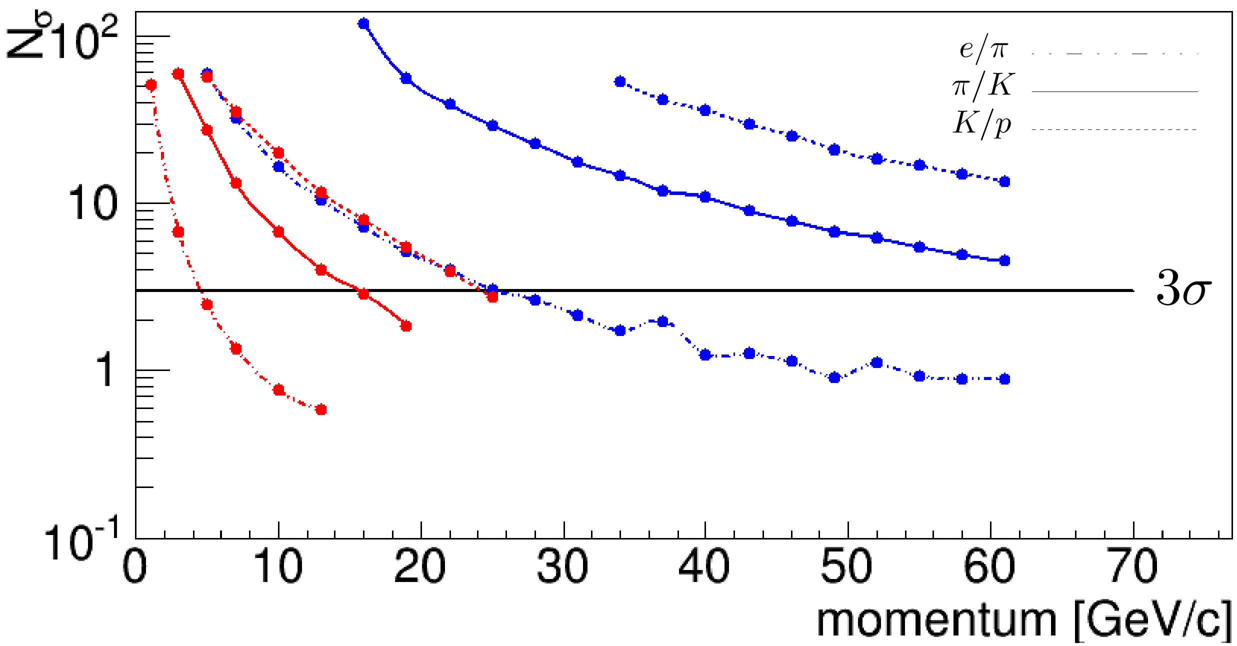
Dual-radiator RICH: update

Alessio Del Dotto for the EIC PID/RICH collaboration
April 25, 2016

Particles separation power

$Aerogerl \mid e_{th}(GeV/c) = 0.002542 \mid \pi_{th}(GeV/c) = 0.67 \mid K_{th}(GeV/c) = 2.46 \mid p_{th}(GeV/c) = 4.89$

$CF_4 \mid e_{th}(GeV/c) = 0.016457 \mid \pi_{th}(GeV/c) = 4.35 \mid K_{th}(GeV/c) = 15.94 \mid p_{th}(GeV/c) = 31.66$



Polar angle = 12.5°

Some regions covered by threshold with CF⁴:

- only *e* up to 4.3
- only *e* and *pi* up to 16
  --> pi/K region [10,16] covered in redundancy with Aerogel

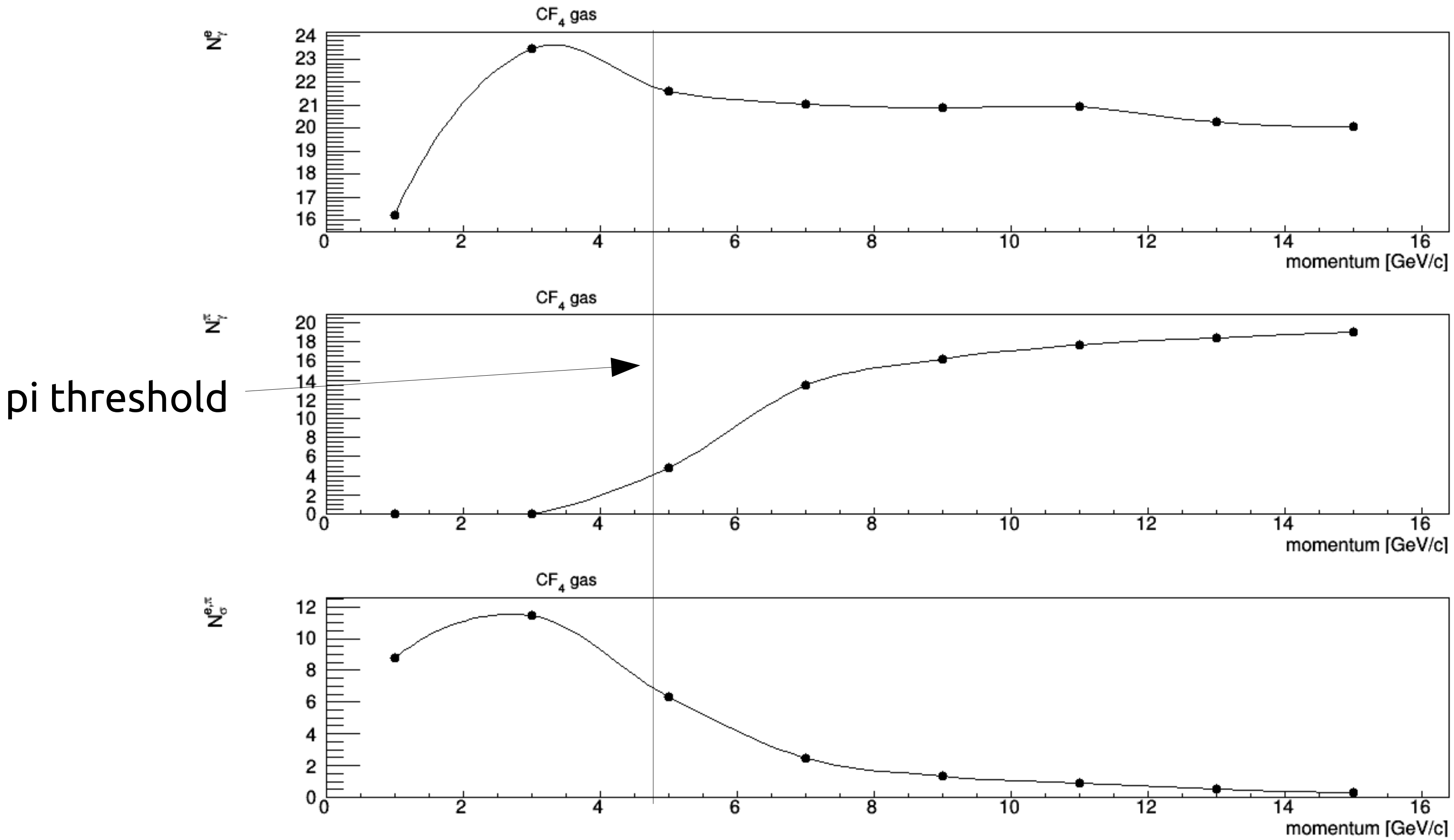
$$N_\sigma = \frac{(<\theta_{p2}> - <\theta_{p1}>)\sqrt{N_\gamma}}{\sigma_\theta^{tot(1p.e.)}}$$

$$N_\gamma = (N_\gamma^{p1} + N_\gamma^{p2})/2$$

$$\sigma_\theta^{tot(1p.e.)} = (\sigma_\theta^{p1} + \sigma_\theta^{p2})/2$$

QE -->H12700 maPMT

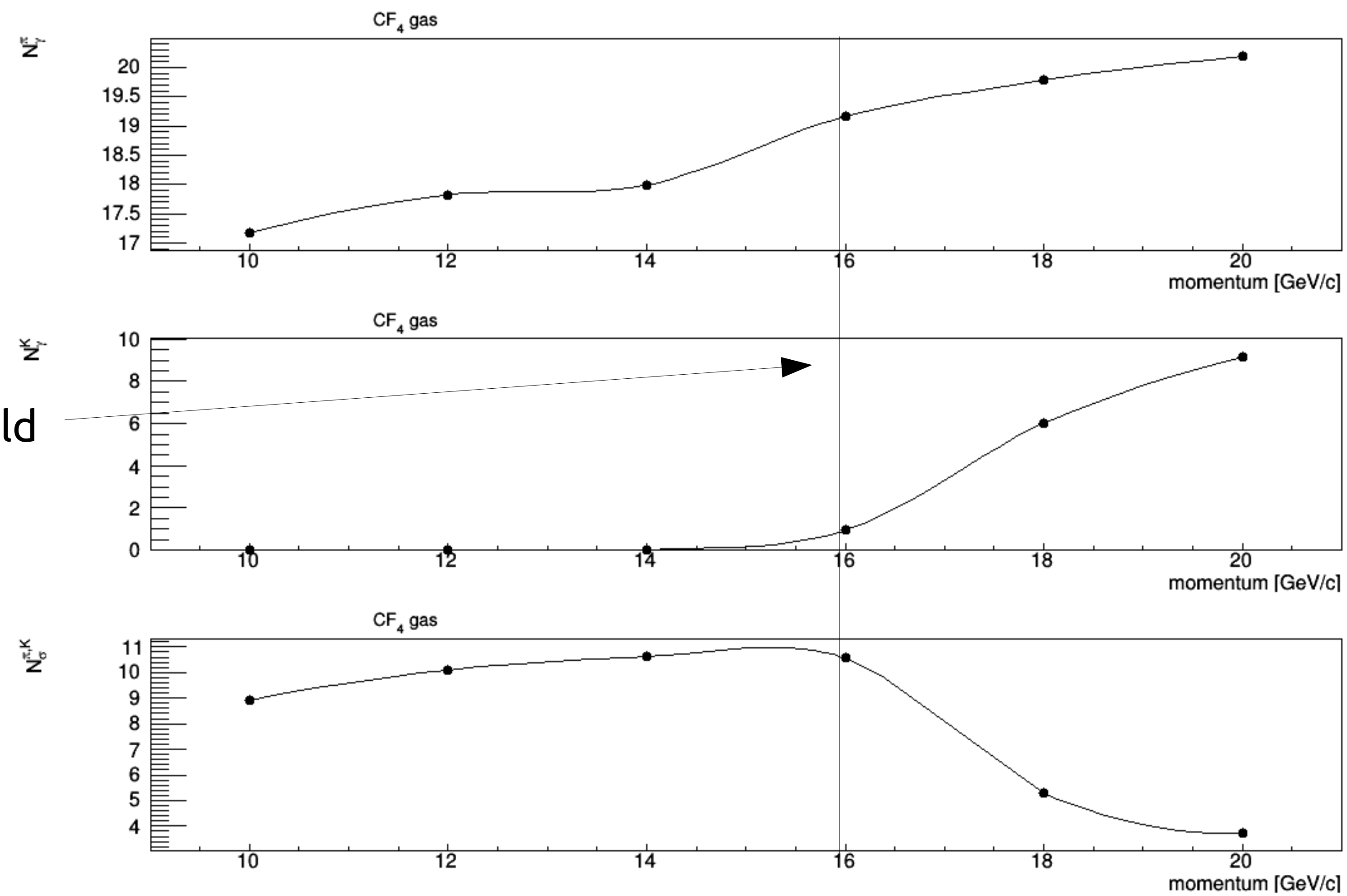
Threshold CF_4 - e/pi



$$N_\sigma^{e,\pi} = \frac{(< N_\gamma^e > - < N_\gamma^\pi >)}{\sigma_{N_\gamma}}$$

Threshold CF_4 - pi/K

K threshold



$$N_{\sigma}^{\pi,K} = \frac{(< N_{\gamma}^{\pi} > - < N_{\gamma}^{K} >)}{\sigma_{N_{\gamma}}}$$

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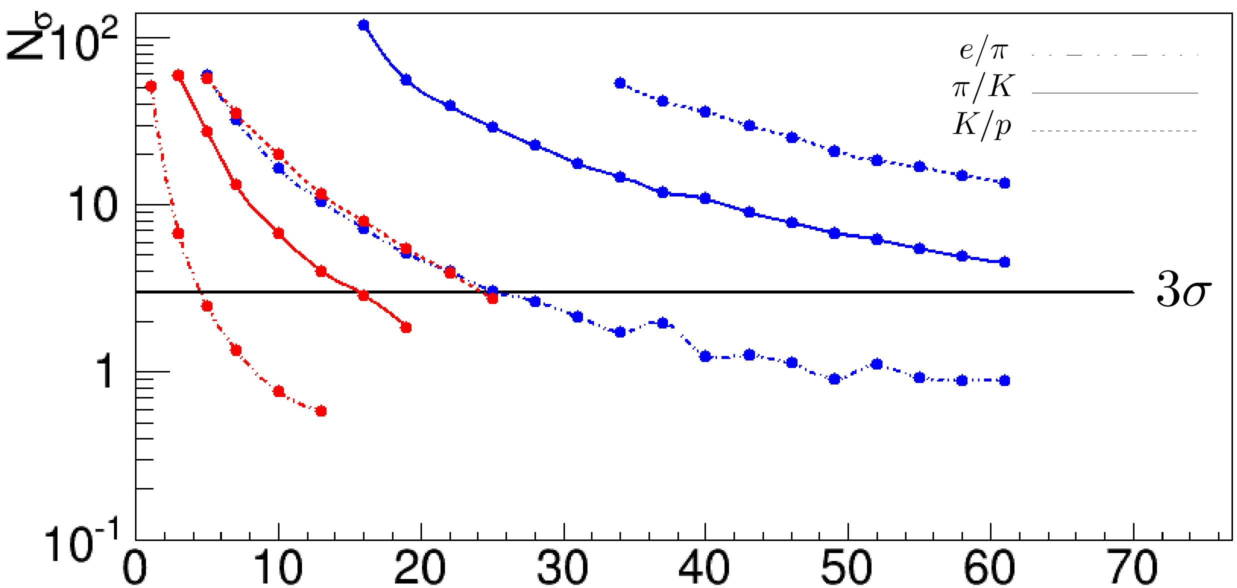
RICH

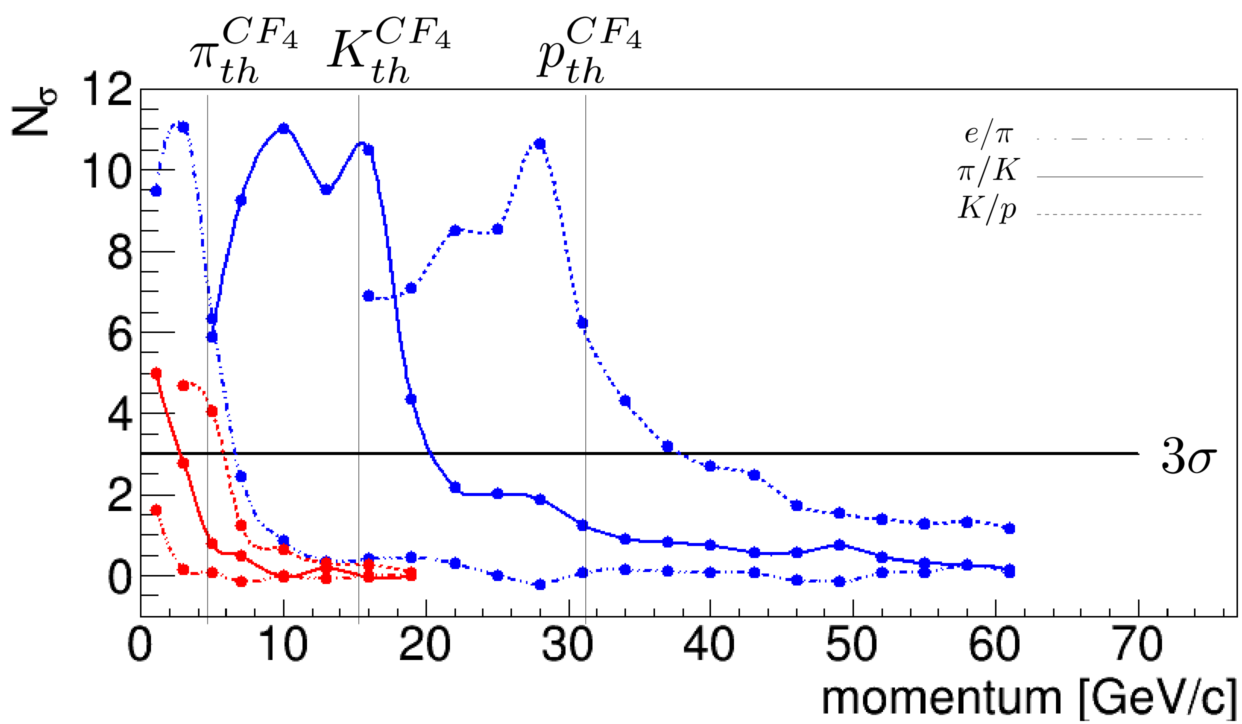


Polar angle = 12.5°

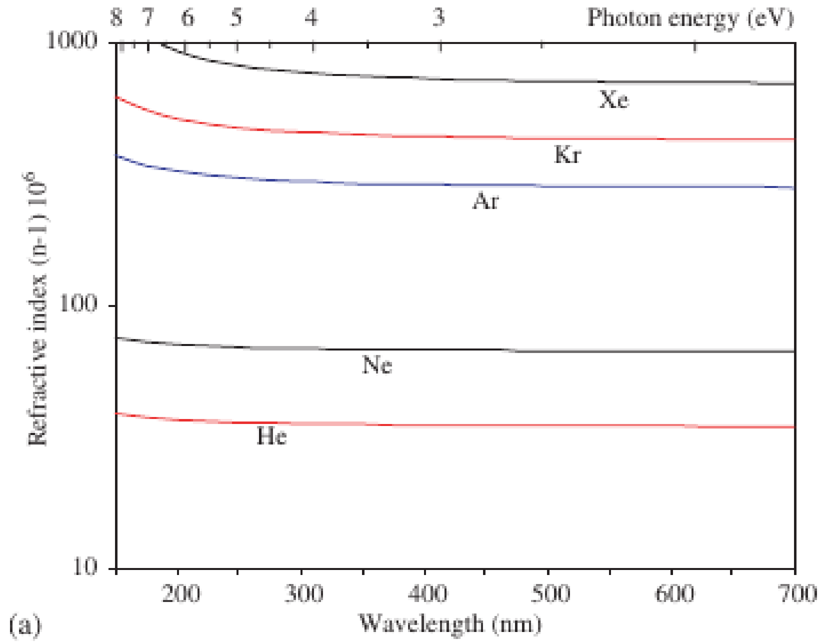
$n_{Aerogel} = 1.02$

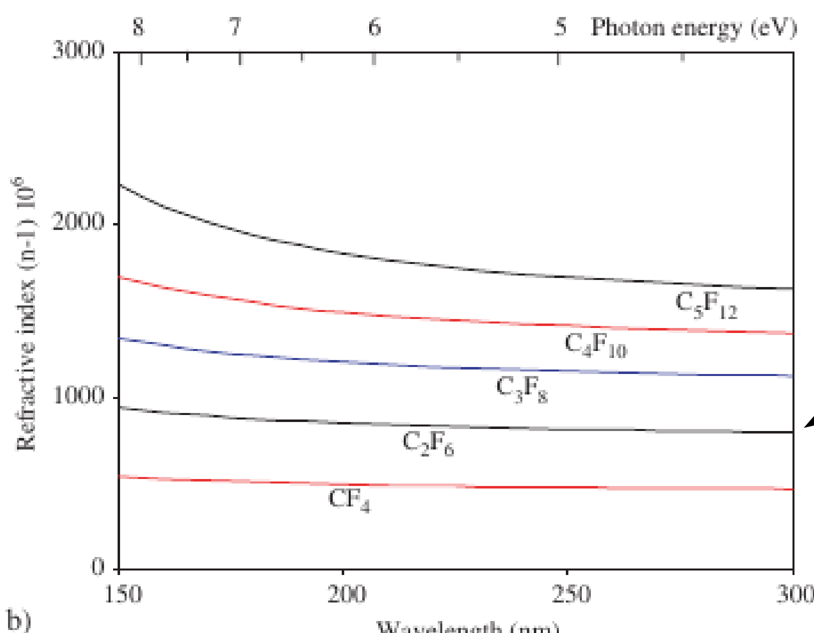
$n_{CF_4} = 1.000482$

Threshold Cherencov



Gaseous radiators





Ullaland, O. "Fluid systems for RICH detectors." NIMA 553.1 (2005): 107-1

There are two options in
In between of CF^4 and $C4F^{10}$

$$n^{C_2F_6} \simeq 1.0008$$

$$e^{th} \simeq 0.012\ GeV/c$$
$$\pi^{th} \simeq 3.48\ GeV/c$$
$$K^{th} \simeq 12.3\ GeV/c$$
$$p^{th} \simeq 23.4\ GeV/c$$

Important quantities in gas radiators

- The wavelength where the absorption starts to have a significant role: <u>not play a significant role in gas radiators.</u>

$$\lambda^{alkanes}_{cut-off} = 181 - \frac{226}{2+N}$$

$$\lambda^{fluorocarbons}_{cut-off} = 2 \cdot N + 110$$

- The Rayleigh scattering might play a role --> resultant opacity:

$$\kappa = \frac{32\pi^3}{3}\frac{(n-1)^2}{\lambda^4}\frac{6+3\delta}{6-7\delta}\frac{t}{N_0}$$

Rayleigh for gas not present at the moment in GEMC simulation!

- Transmittance:

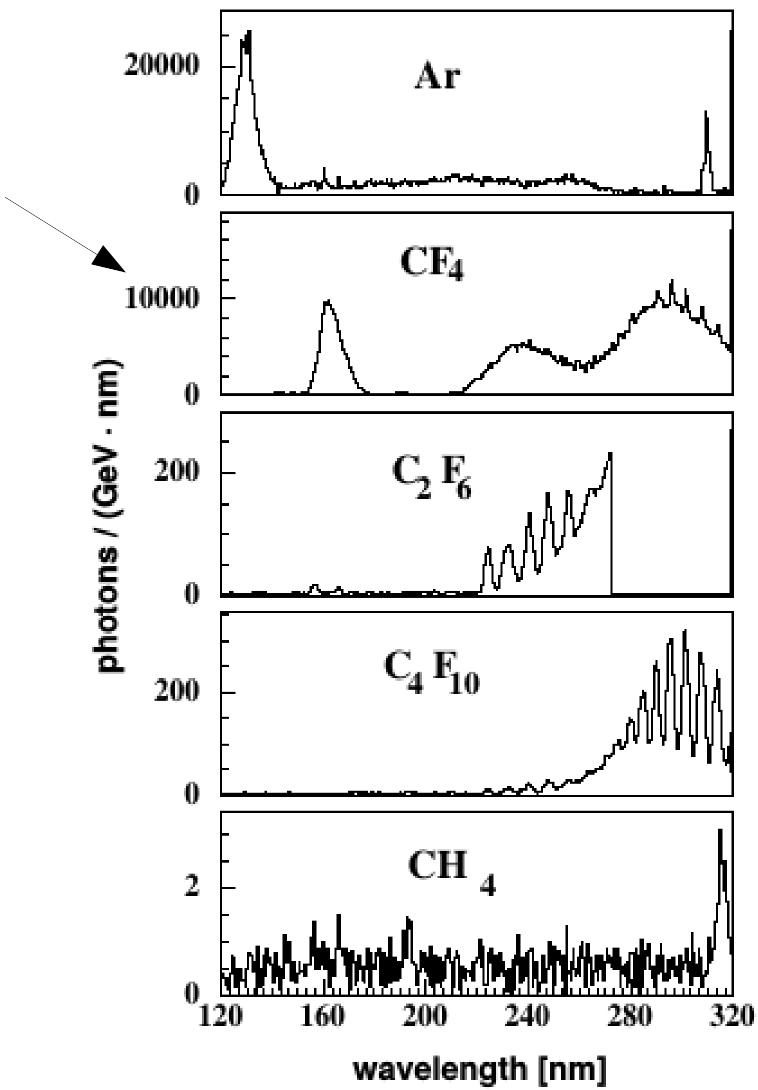
$$T = \exp(-\kappa)$$

<u>Usually Rayleigh scattering becomes to be important below about 190 nm</u>

Ullaland, O. "Fluid systems for RICH detectors." NIMA 553.1 (2005): 107-1

Scintilation in gases

R. Gernhauser et al., NIM A371(1996)300



- CF_4 scintillation near 240-300 nm is a problem. LHCb is adding CO_2 to quench the CF_4 scintillation. This sensibly reduce the problem.
- The level of scintillation in C_4F_{10} and C_2F_6 is acceptable.

To do next

- Test performances of CF_4 at different polar angles [5,25] deg
- Try different gas radiators
- Study of the background, in particular from Aerogel