A Double radiator configuration approach for the RICH detector

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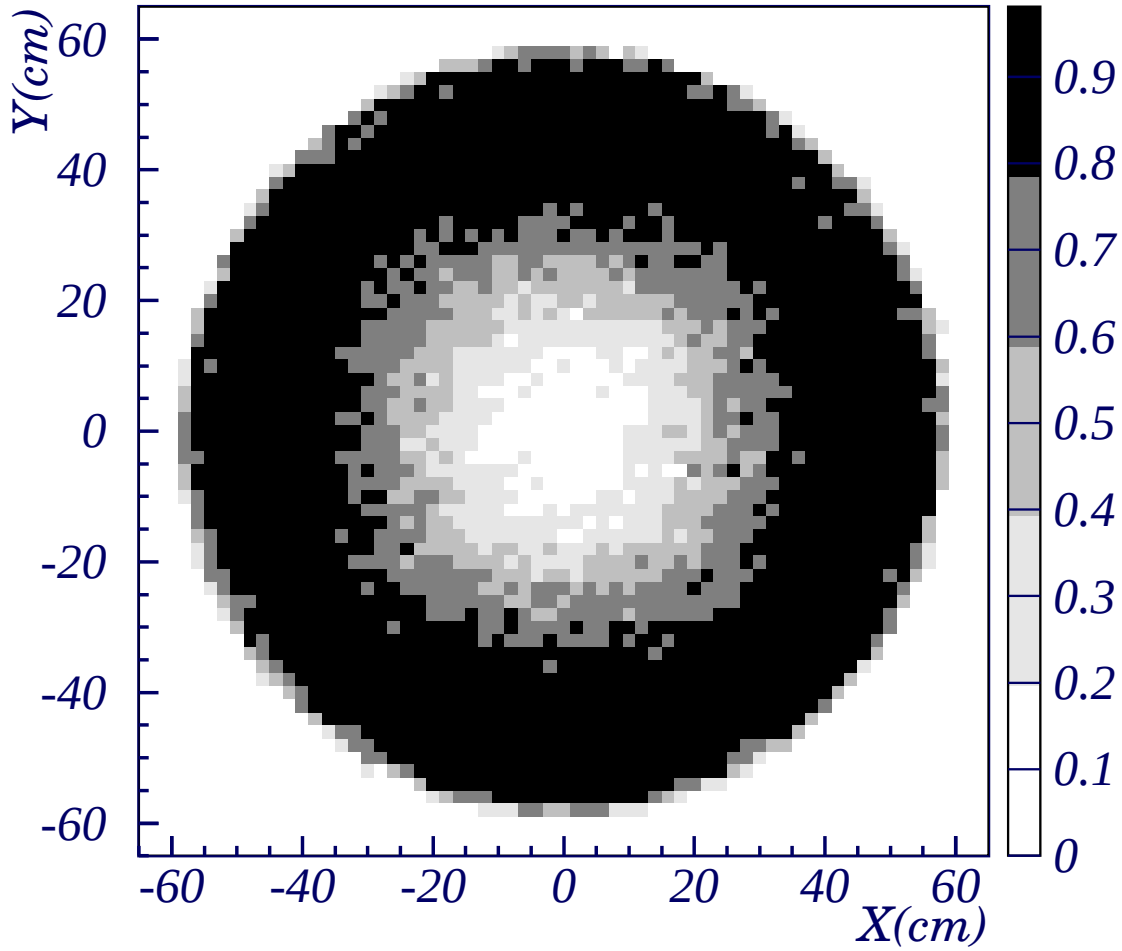
Event geometrical acceptances with Aerogel

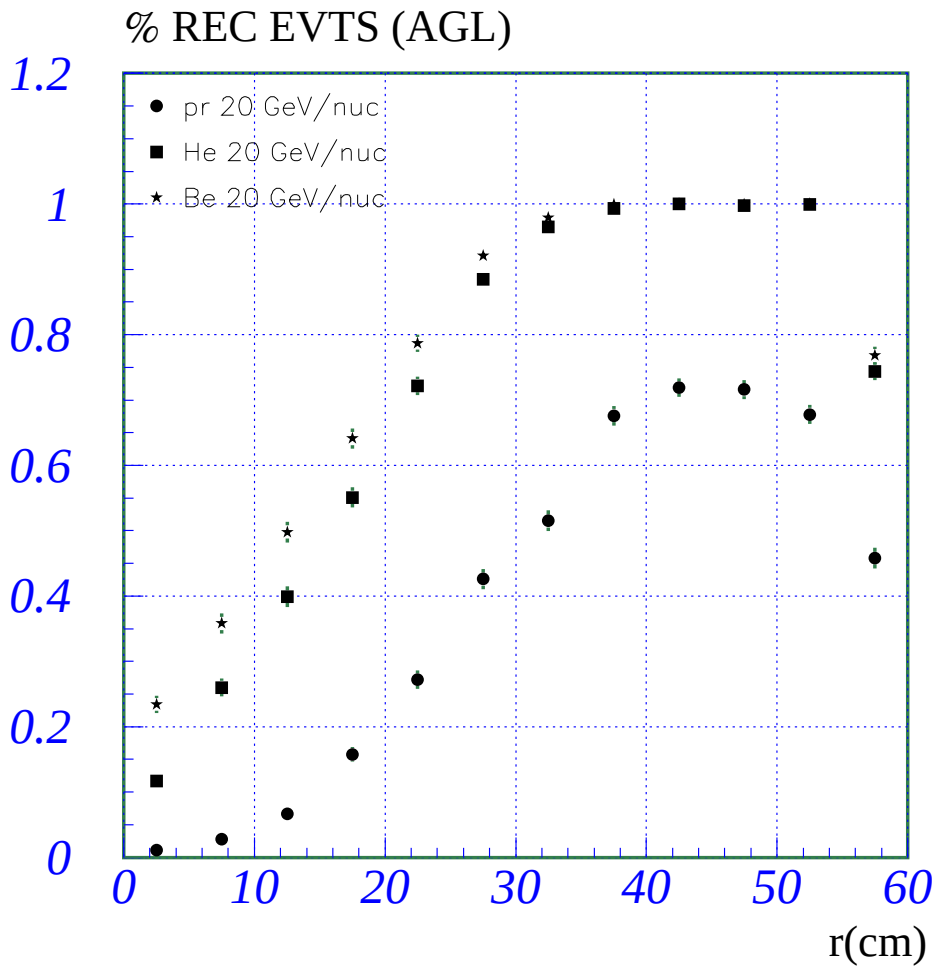
the fraction of detected photons depends on:

- particle impact point on the radiator
- particle direction



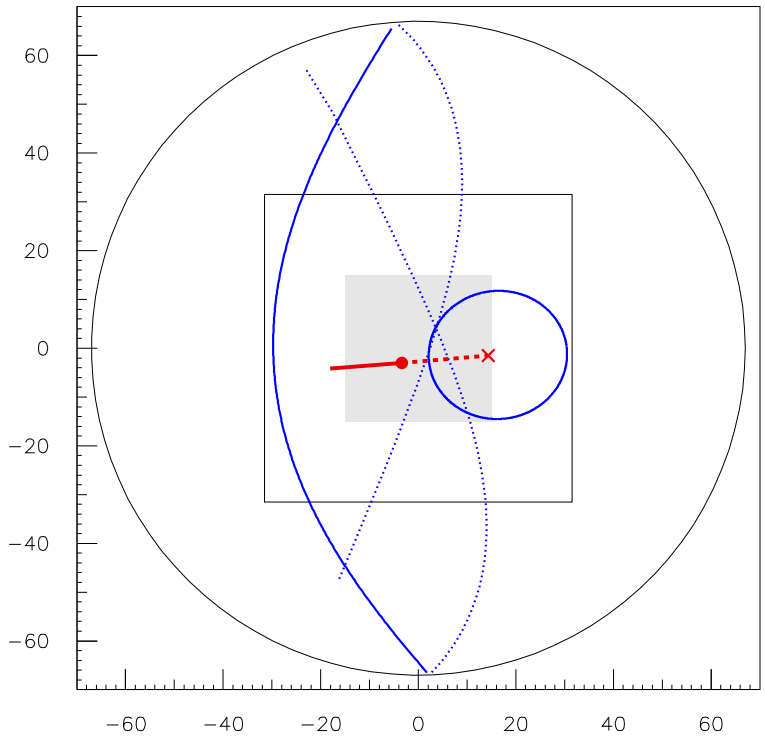
Aerogel: event reconstruction efficiencies

- ≥ 3 hits required
- protons, heliums and berylliums



Radiator Configuration

- A proposal for a two radiators arrangement
  Note on the radiator configuration for the RICH of AMS
  M. Buénerd
  ISN-note 00/63 (2000)
- Superimposed radiator scenario (AGL on top of NaF)
- Contiguous radiator scenario



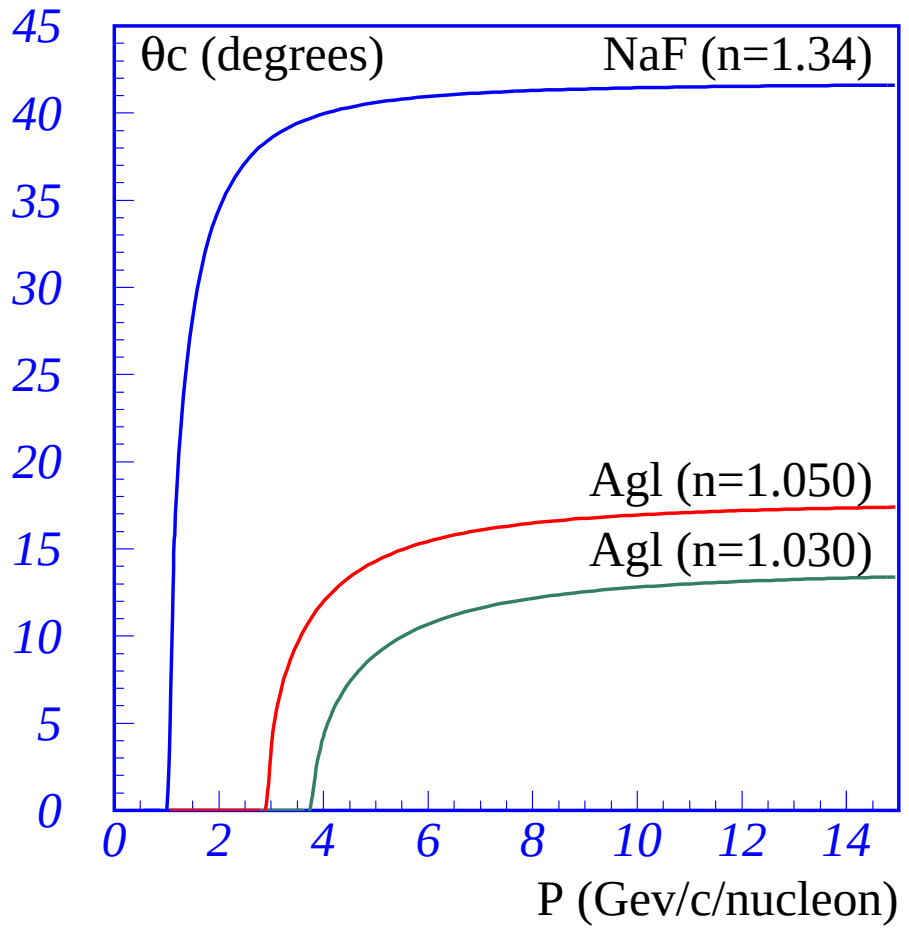
RICH radiators

Aerogel

- n=1.030/1.050
- light yielding:
  $\sim 50/cm$ - $\sim 85/cm$
- scattering and absorption
  $\Lambda \sim 3.5cm$
- chromaticity

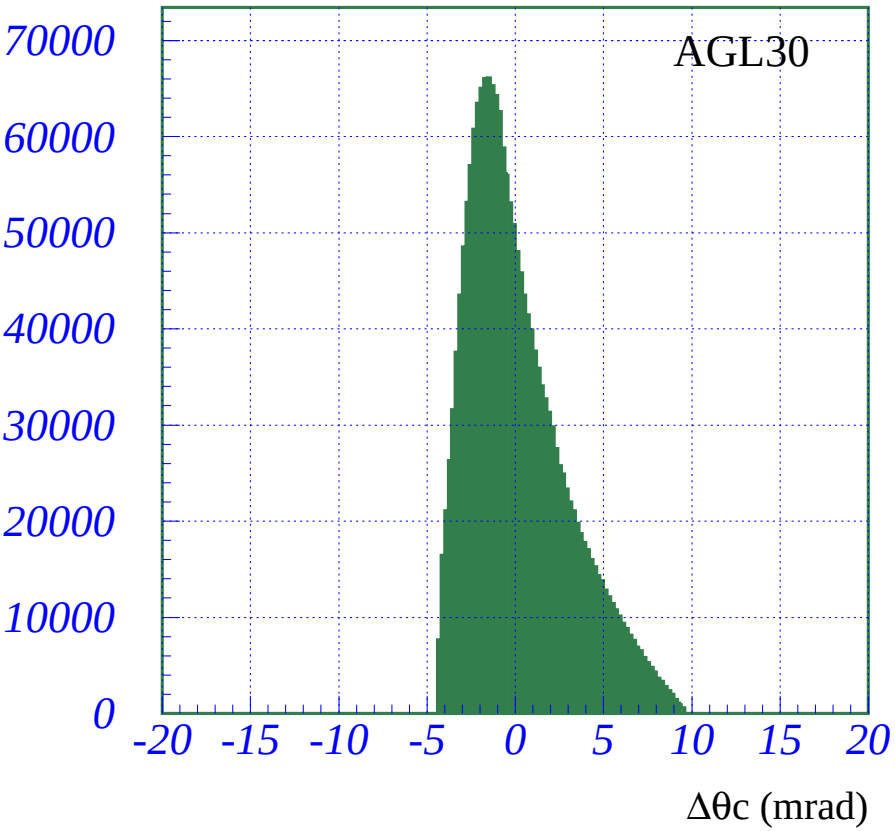
NaF

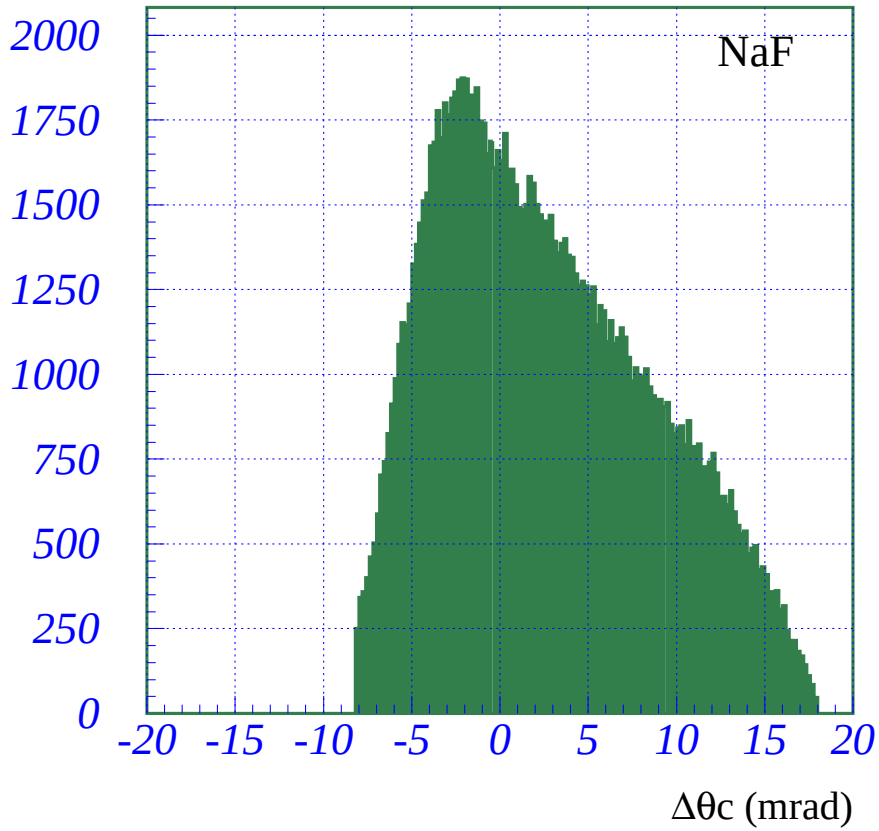
- n=1.33
- light yielding:
  $\sim 400/cm$
- no interactions
- larger chromaticity effects
- lower event geom acceptance
- lower light guide efficiency



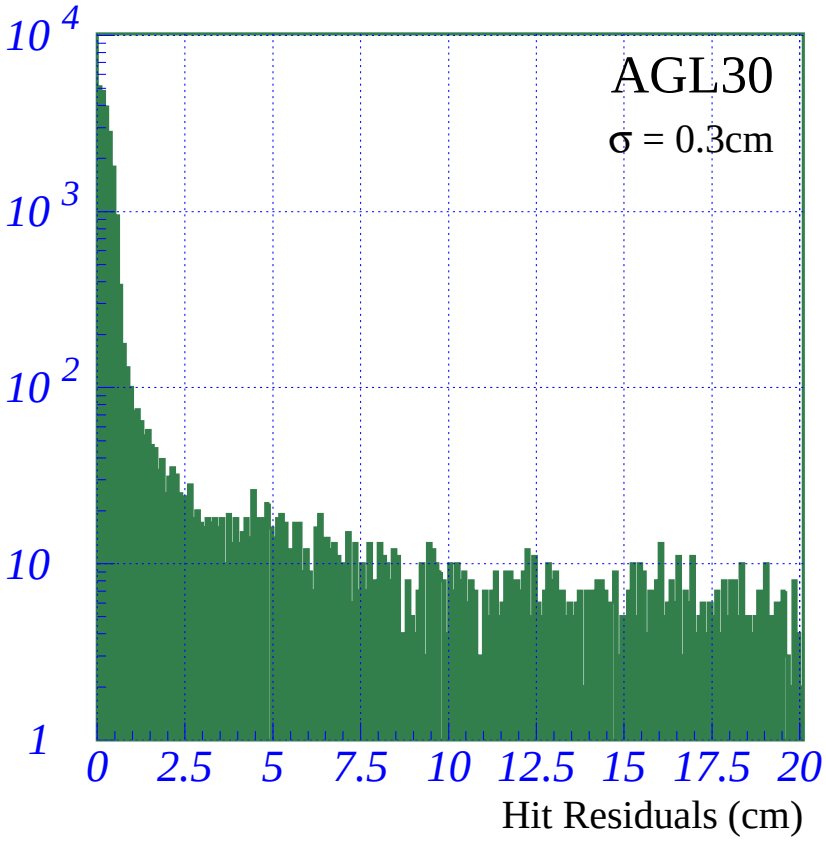
Chromaticity dispersion

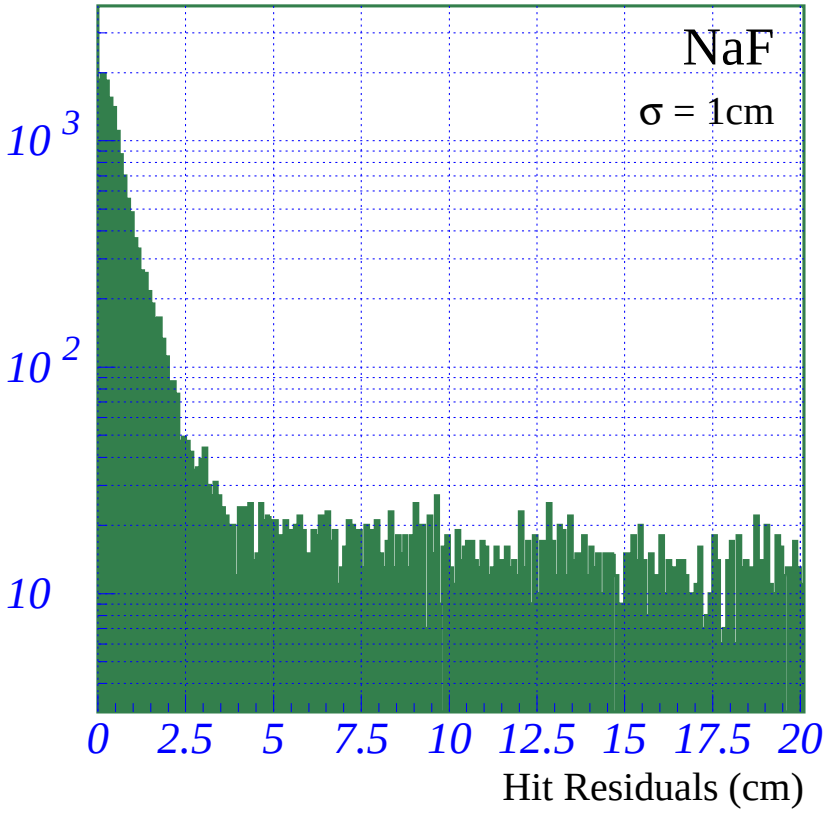
$$cos\theta_c(\lambda) = \frac{1}{\beta\, n(\lambda)}$$





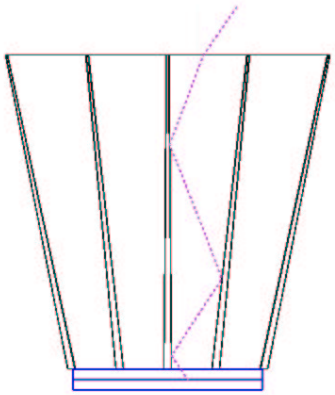
Photon ring width

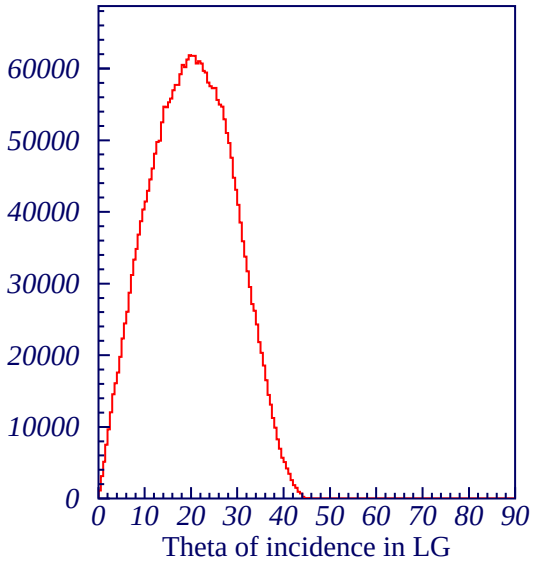


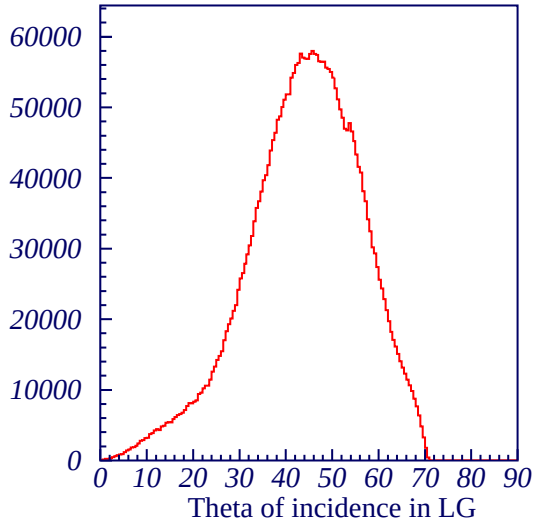


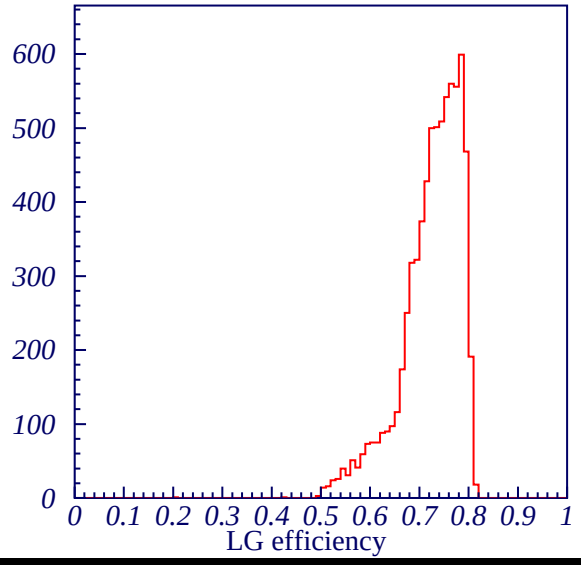
Light Guide Efficiency

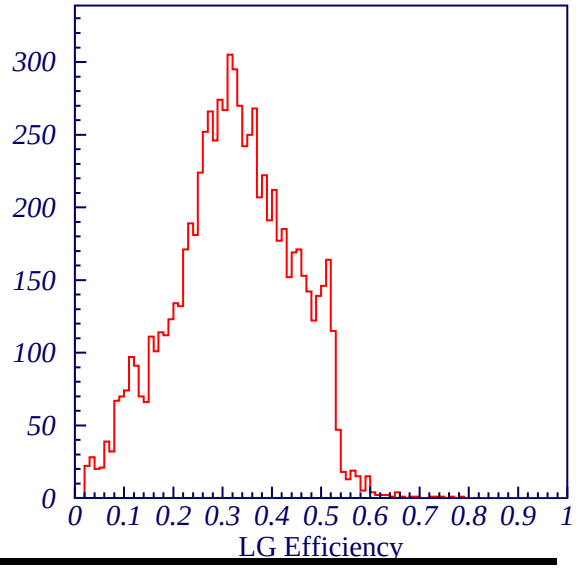
- The light guide efficiency depends on the photon entrance angle (θ_γ)
  - NaF radiated photons have larger entrance angles and therefore lower efficiencies



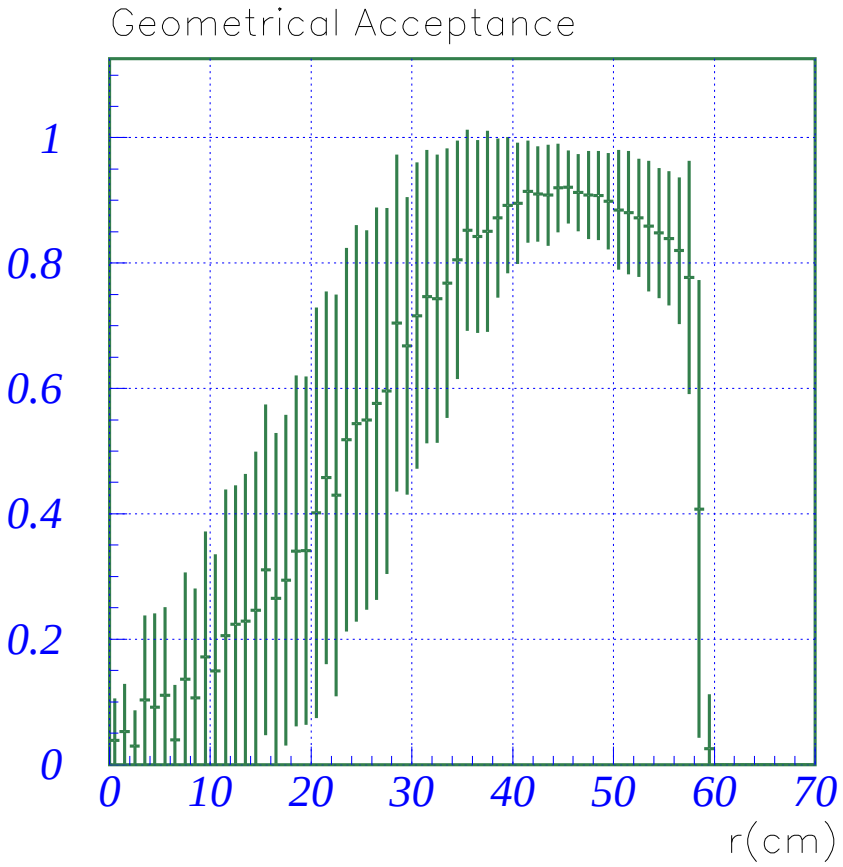


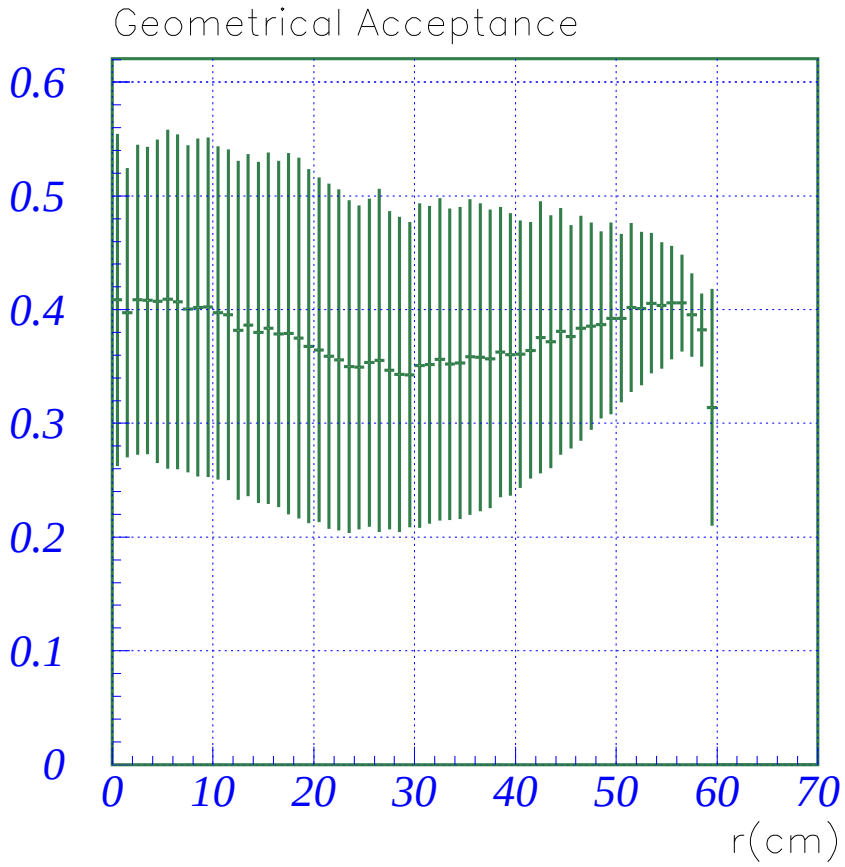






Naf.vs.Agl: Geometrical acceptance





Which size for NaF?

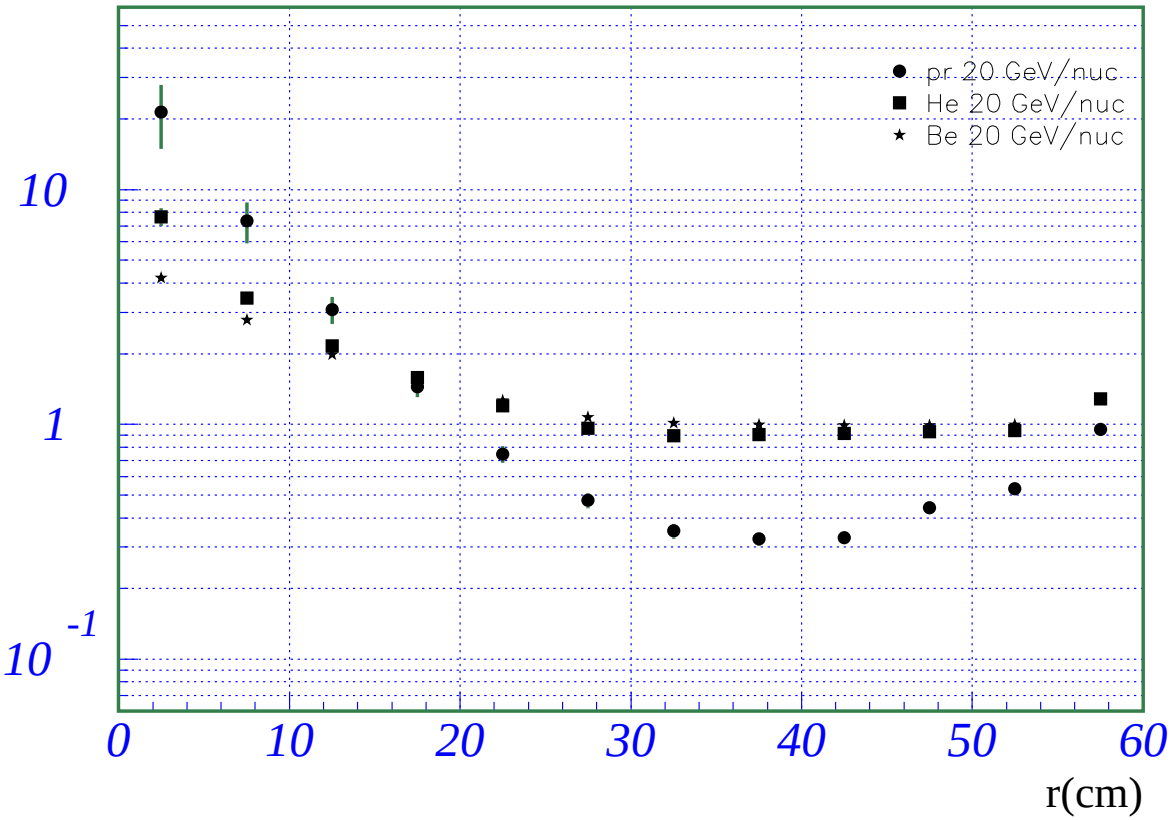
- A minimal number of 3 hits required on θ_c reconstruction
- The ratio of the events reconstructed on **NaF** and **Agl30** as function of the incident particle distance to the radiator center

$$\frac{\%\ Recevents(NaF)}{\%\ Recevents(Agl30)}$$

- NaF reconstruction is dominant for

  $R < 15\ cm$

  $R > 58\ cm$

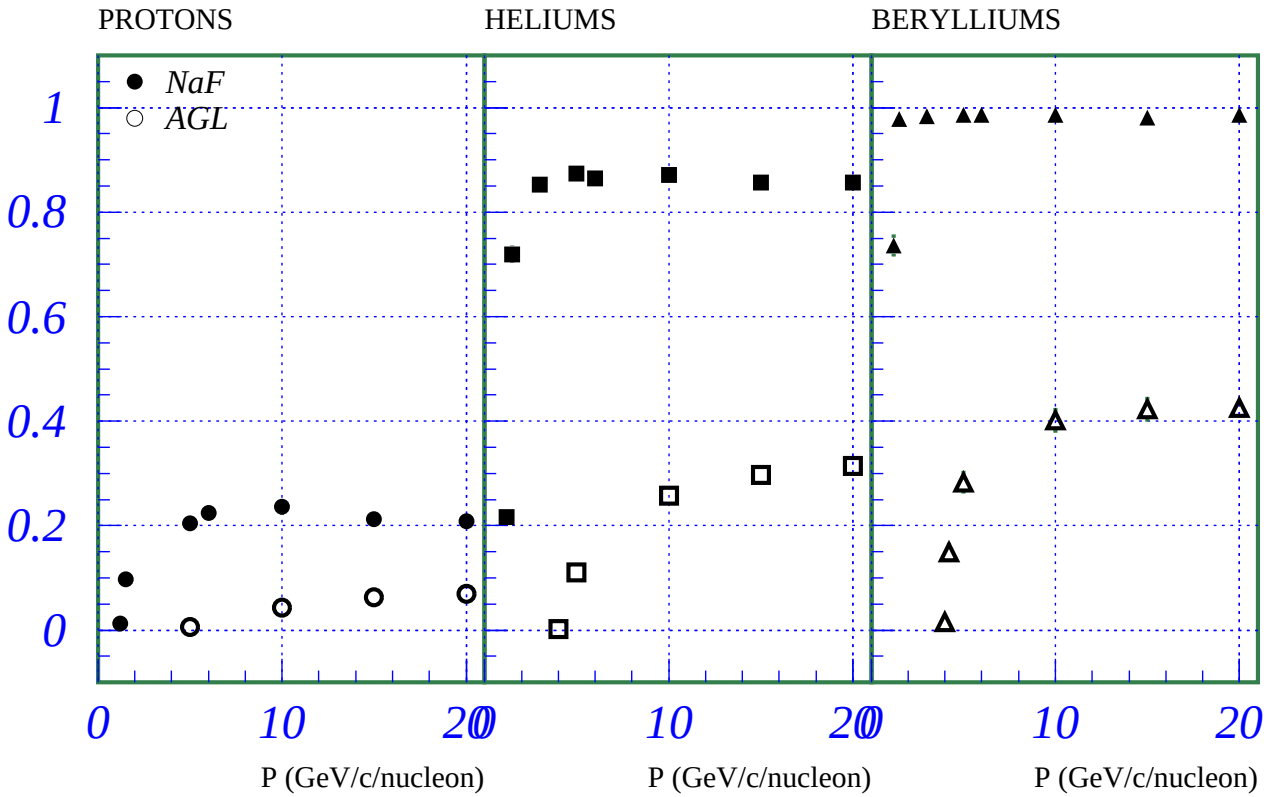


$\beta \sim 1$

NaF configuration

- A square of sodium fluoride with $\mathbf{30 \times 30 \times 0.5\ cm^3}$ placed on the center of the radiator
- Consequences:
  - ✔ momentum range extenden down to values up around 1 GeV/c/nucl
  - ✔ Rich acceptance increases which implies larger reconstruction efficiencies
- matter: $\sim 4\%$ of $\boldsymbol{X_0}$

θ_c Reconstruction efficiency



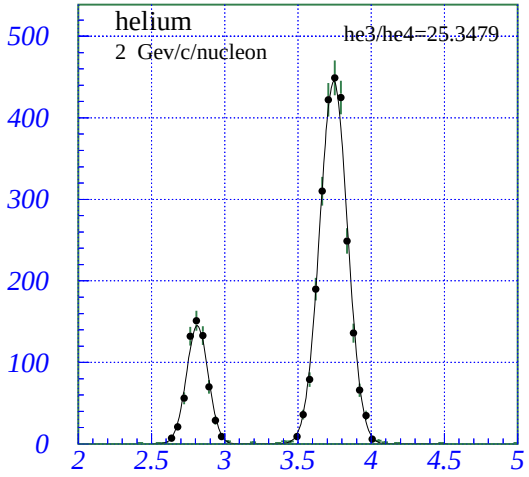
- NaF radiator area corresponds to $\sim$ **8%** of the RICH acceptance
- The fraction of particles impinging on the NaF area and being reconstructed ($\boldsymbol{N_h its > 2}$) depends strongly on the charge

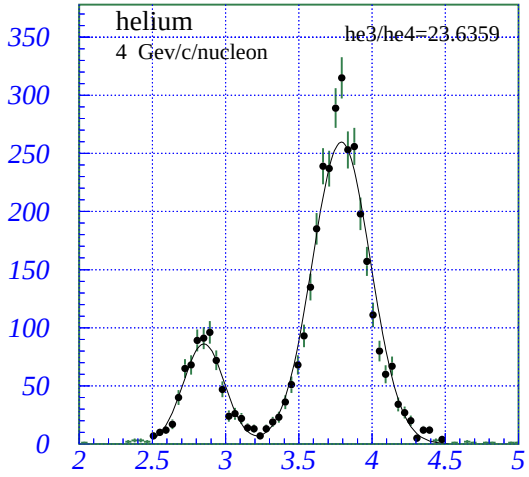
  NaF efficiency reaches 100% for Berylliums

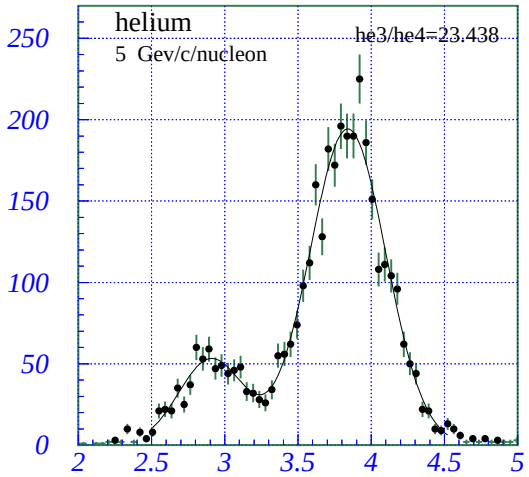
helium and beryllium isotopes abundances

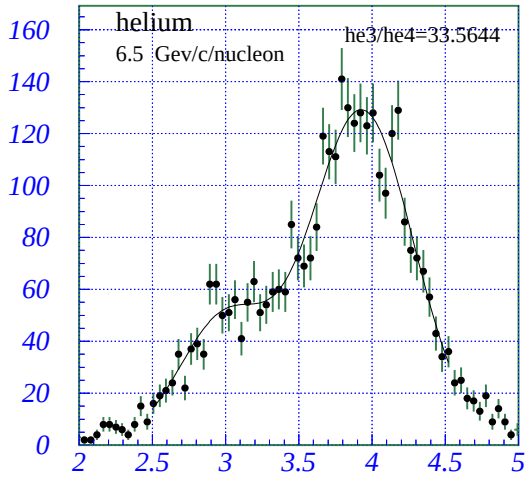
P (GeV/c/nuc)	$^3He/^4He$ simul	$^3He/^4He$ meas	$^{10}Be/^9Be$ simul	$^{10}Be/^9Be$ meas
1.5	21.9%	**22.0 ± 0.9%**	18.0%	**18.7 ± 0.8%**
2.0	25.2%	**25.3 ± 1.1%**	19.7%	**19.8 ± 0.8%**
3.0	25.0%	**25.1 ± 1.0%**	21.7%	**20.9 ± 1.3%**
4.0	23.1%	**23.6 ± 1.0%**	35.3%	**35.9 ± 2.2%**
4.5	20.6%	**21.1 ± 1.0%**	35.3%	**49.8 ± 4.9%**
5.0	20.6%	**23.4 ± 1.2%**	39.1%	**77.5 ± 12.0%**
5.5	20.6%	**20.2 ± 1.4%**	37.8%	**91.8 ± 2.4%**
6.5	19.6%	**33.6 ± 3.5%**		

Helium isotopic separation with NaF



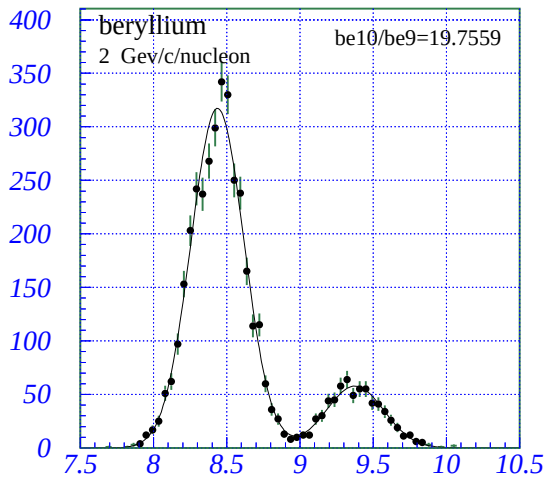


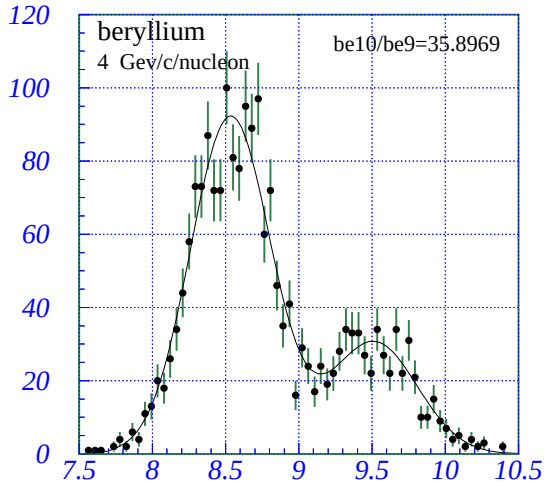


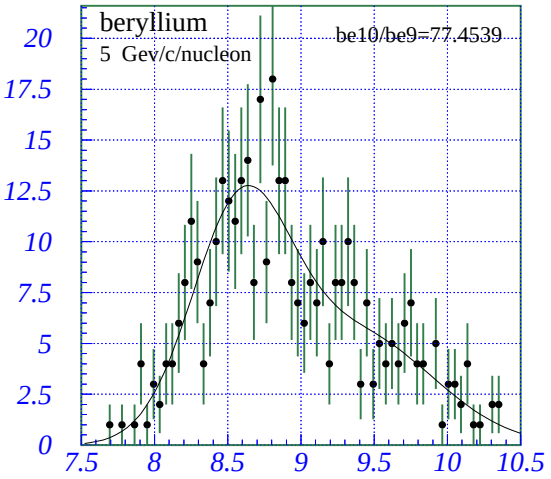


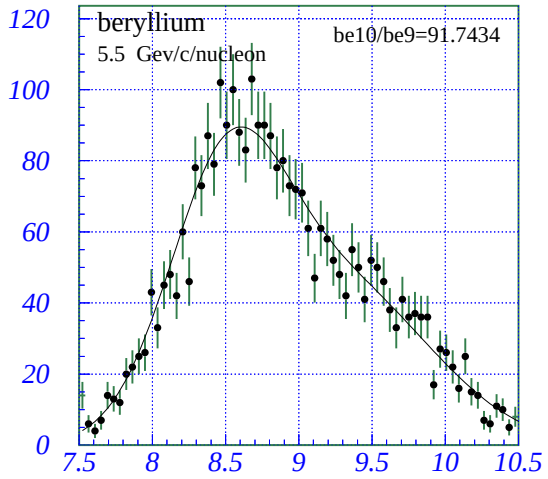
- 2% of momentum uncertainty folded

Beryllium isotopic separation with NaF



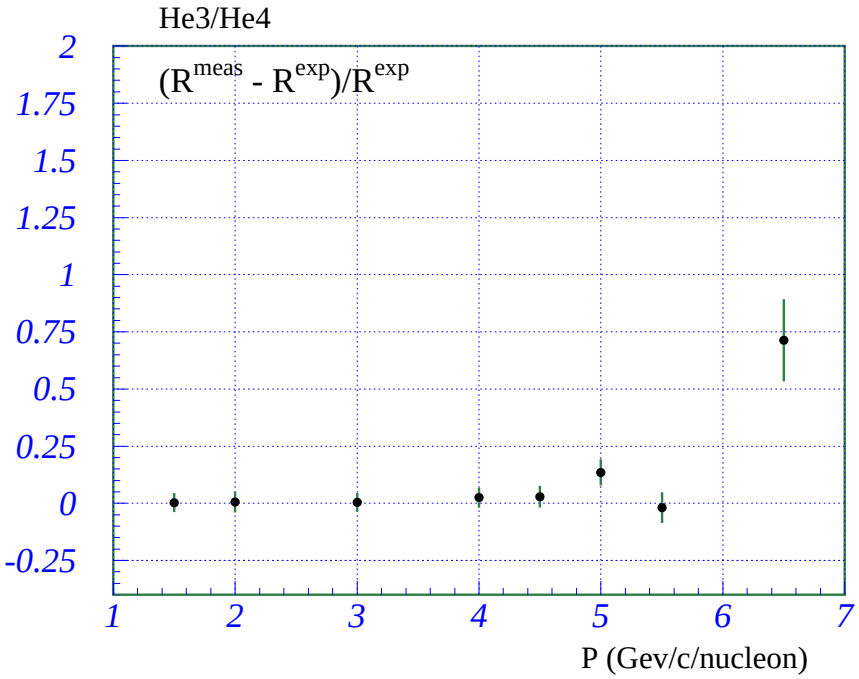


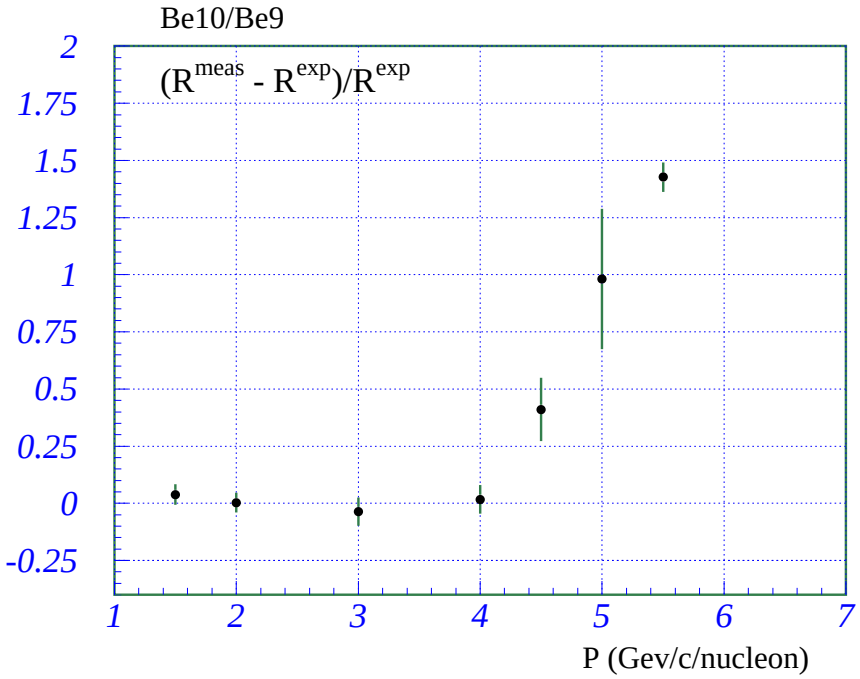




- 2% of momentum uncertainty folded

Isotopic separation with NaF





Conclusions

- The possibility of having a mixed radiator configuration with both a large and a low refractive index radiators, was studied
- Aerogel radiator shows low event geometrical acceptances for particles impinging close to the radiator center
- The placement of a NaF radiator at the center of radiator plane ($\mathbf{30 \times 30\ cm^2}$) increases at least by 3 the number of reconstructed events (Nhits>2)
- A 90% recontruction efficiency is already obtained for Heliums with P=3 Gev/c/nucl
- With a $\mathbf{3\sigma}$ mass separation criterium helium and beryllium isotopes can be resolved up to 5.5 and 4 Gev/c/nucl, with the NaF radiator