Dual Mixed radiator/
Effect of the foil on the mass reconstruction

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Outlook

- ✓ Dual radiator configuration
  - Setup
- ✓ NaF.vs.AgI: reconstruction efficiency
- ✓ Simulation conditions
- ✓ Foil effect
  - Reconstructed Kinetic energy shift
- ✓ Mass reconstructions and isotopic separation
  - Fit method
- ✓ Mass reconstructions with and without foil
- ✓ Reconstructed isotopic ratios
- ✓ Conclusions

Dual radiator configuration: setup

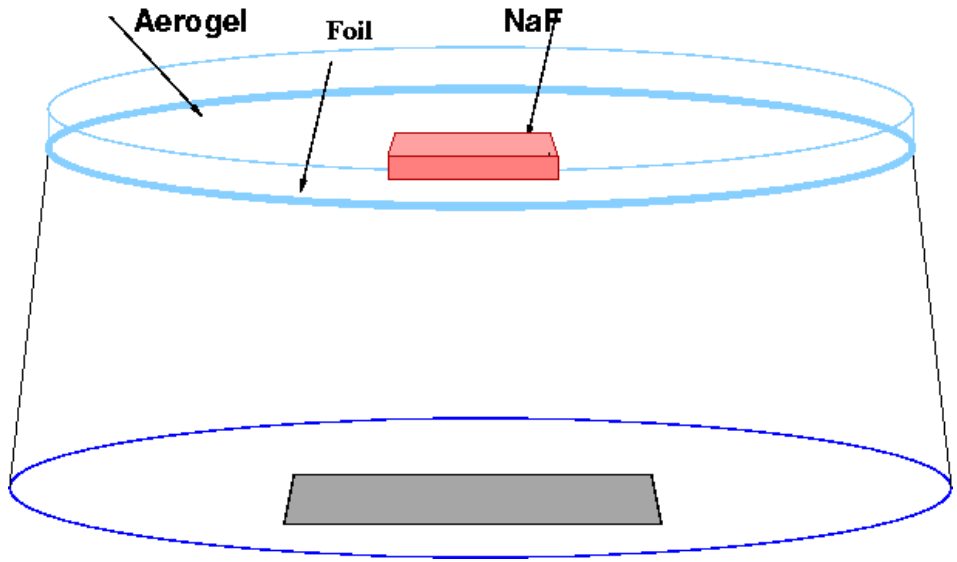
A square of NaF n= 1.334 with ~ 30x30x0.5 cm^3 placed in the center of the RICH radiator

=> an amount of matter corresponding to ~4% of X_0 (aerogel is ~3%)

3 cm thick aerogel n= 1.030

1 mm thick layer of acrylic plastic foil (Bicron - BC800)

n =1.490

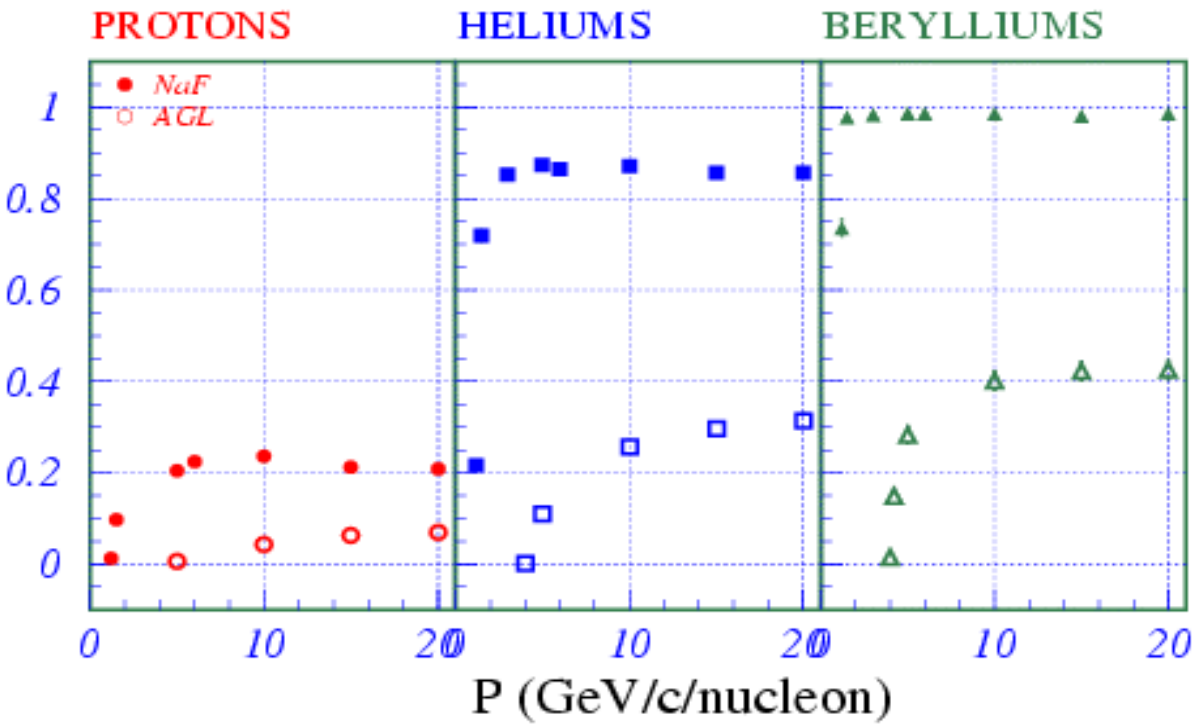


✓ RICH acceptance increases which implies larger reconstruction efficiencies

✓ kinetic energy range is extended down to values around 0.5 GeV/nuc

NaF.vs.AgI: reconstruction efficiency (30cm square)

Expected efficiencies



The fraction of particles that impact on the NaF square and are reconstructed (N_{hits} >2) depends strongly on the charge.

Simulation of Hidrogen, Helium and Beryllium nuclei

Element	Statistics	Observation time
^{2}H	1.5×10^{4}	3 hours
^{1}H	1.8×10^{6}	
^{3}He	3.4×10^{5}	1 day
^{4}He	1.7×10^{6}	
^{10}Be	1.5×10^{5}	1 year
^{9}Be	7.0×10^{5}	

- They were subject to the RICH acceptance
- Geomagnetic field taken into account: modulation of the nuclei energy with the ISS location (thanks to Madrid)
- Tracker momentum uncertainty folded $\Delta p/p \sim 2\%$

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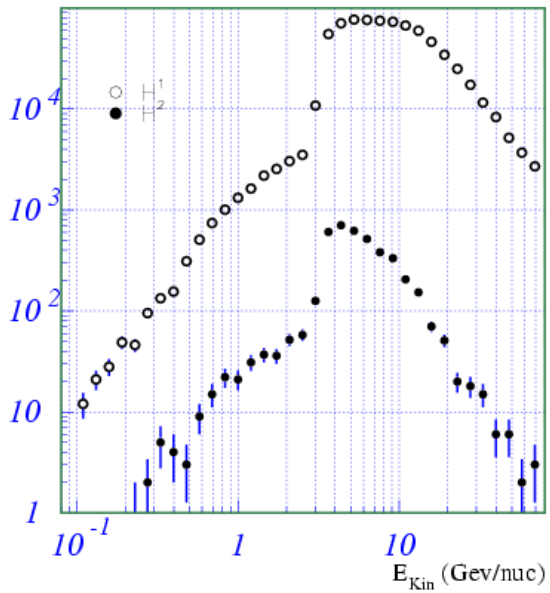
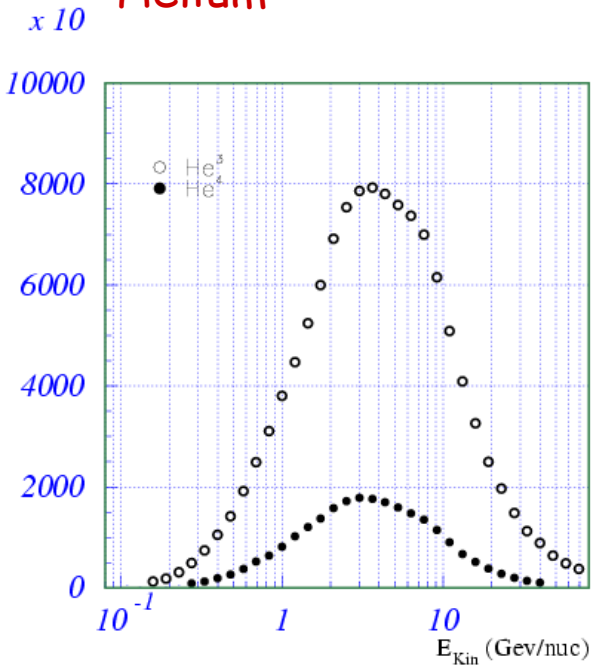
Simulation of Hidrogen, Helim and beryllium nuclei

Hidrogen



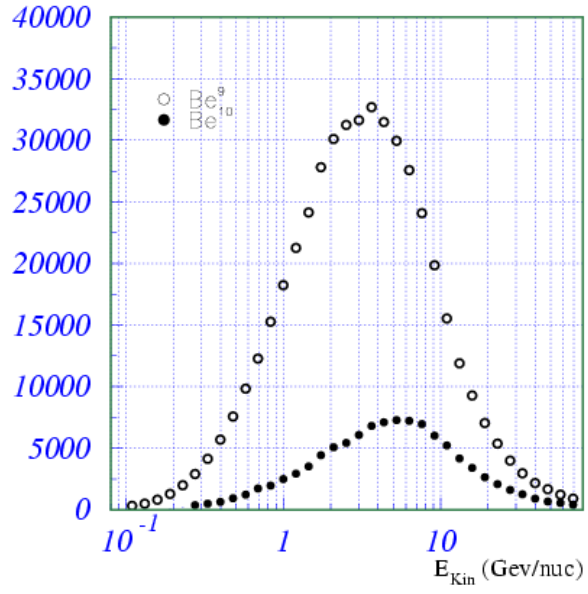
Leaky Box by Stephens et al.

Helium



Leaky Box by Stephens et al.

Beryllium



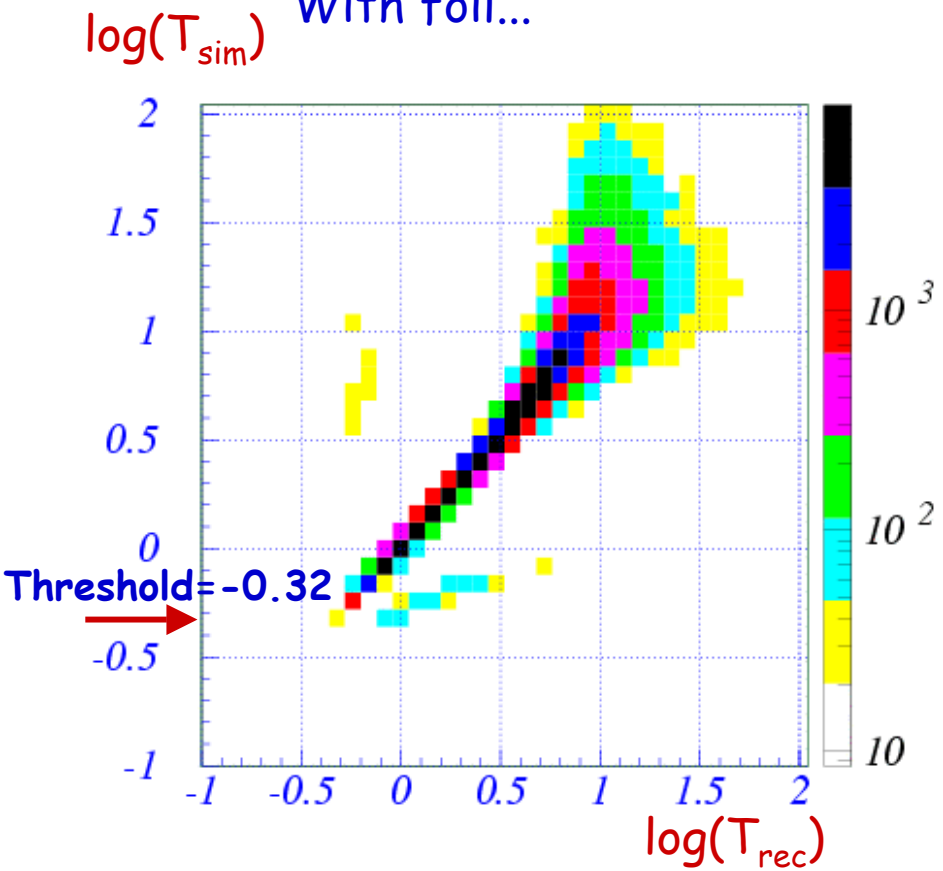
Strong & Moskalenko

Foil effect: shift on Kinetic Energy

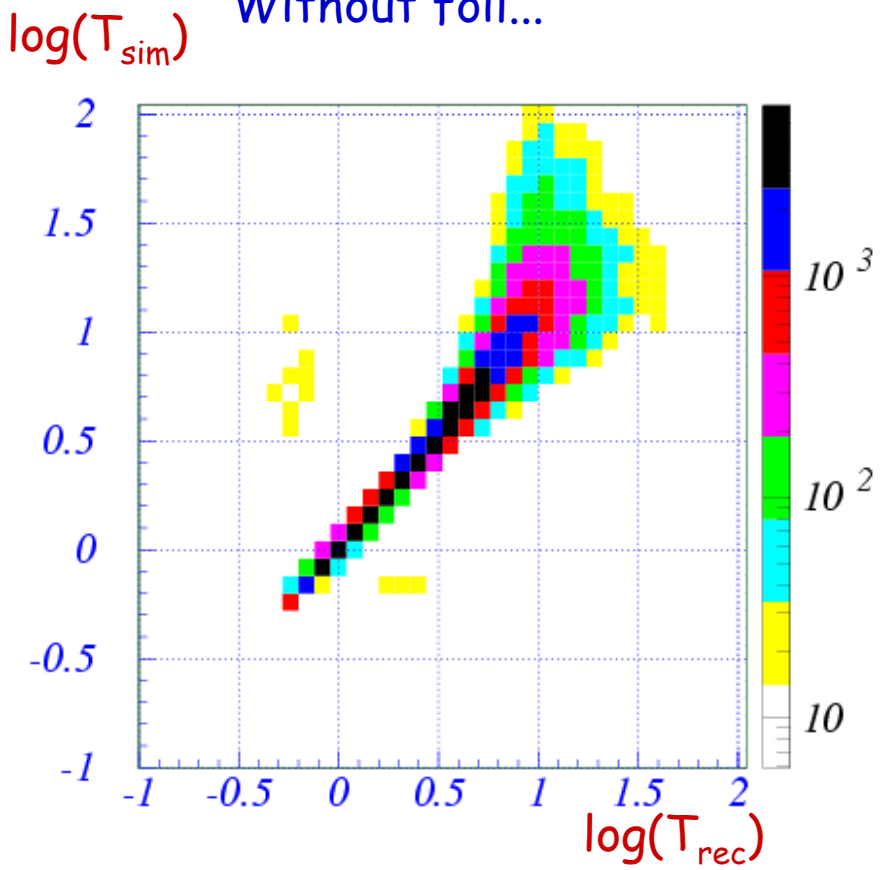
Heliums reconstructed in NaF:

$T_{rec/sim} = m\,(\gamma_{rec/sim} - 1)$

With foil...

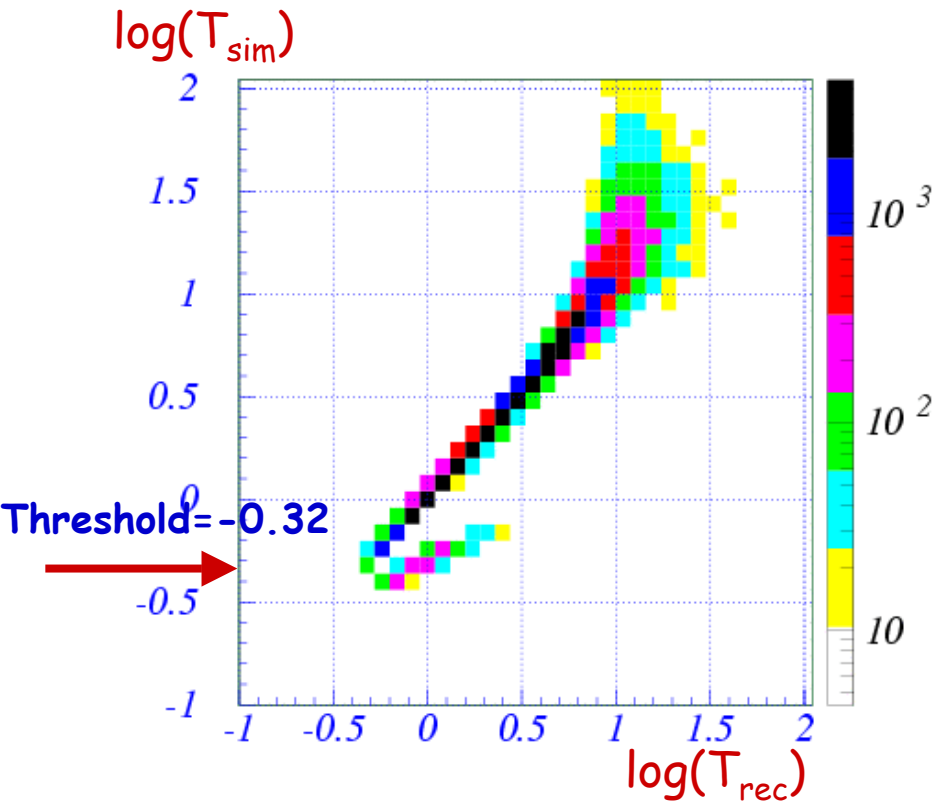


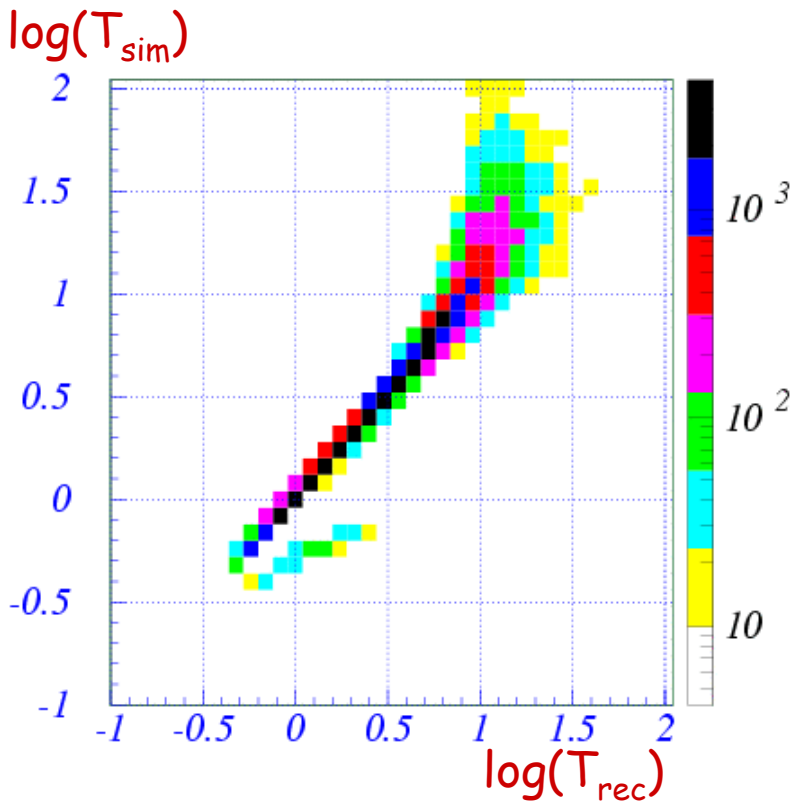
Without foil...



Foil effect: shift on Kinetic Energy

Berylliums reconstructed in NaF:





Masses reconstruction and isotopic separation: fit method

The reconstructed masses were fitted with a sum of two Gaussian functions: (6 parameters)

$$f(m) = \frac{N1}{\sigma_1 \sqrt{2\pi}} \exp - \frac{1}{2}\left(\frac{m - M1}{\sigma_1}\right)^2 + \frac{N2}{\sigma_2 \sqrt{2\pi}} \exp - \frac{1}{2}\left(\frac{m - M2}{\sigma_2}\right)^2$$

where: N_i is the number of evts for each isotope

σ_i its mass width

M_i mass mean value

It can be reduced to a 5 parameter fit once: $\sigma_1 / M_1 = \sigma_2 / M_2$

$$\sigma_i / M_i = \gamma^2 \Delta\beta/\beta + \Delta p/p \quad i=1,2$$

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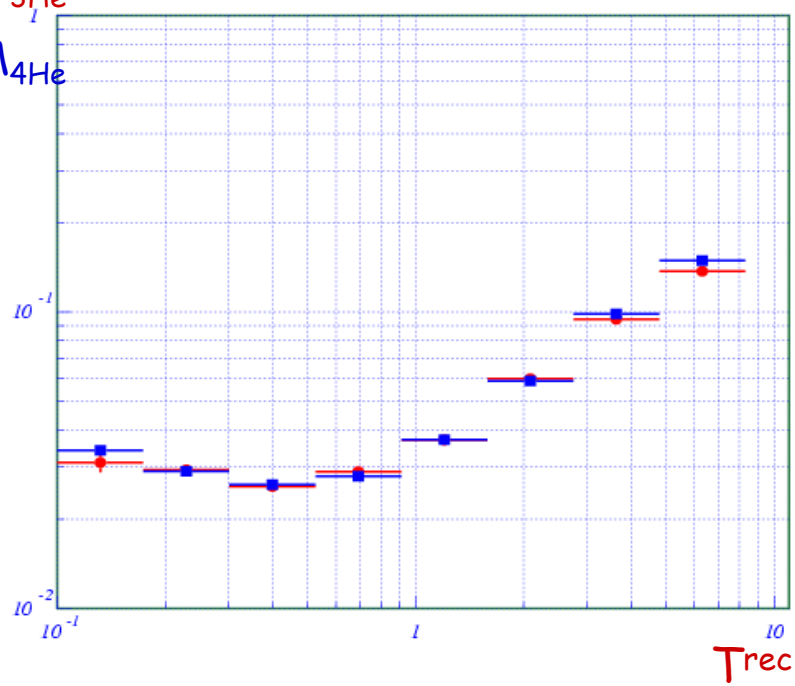
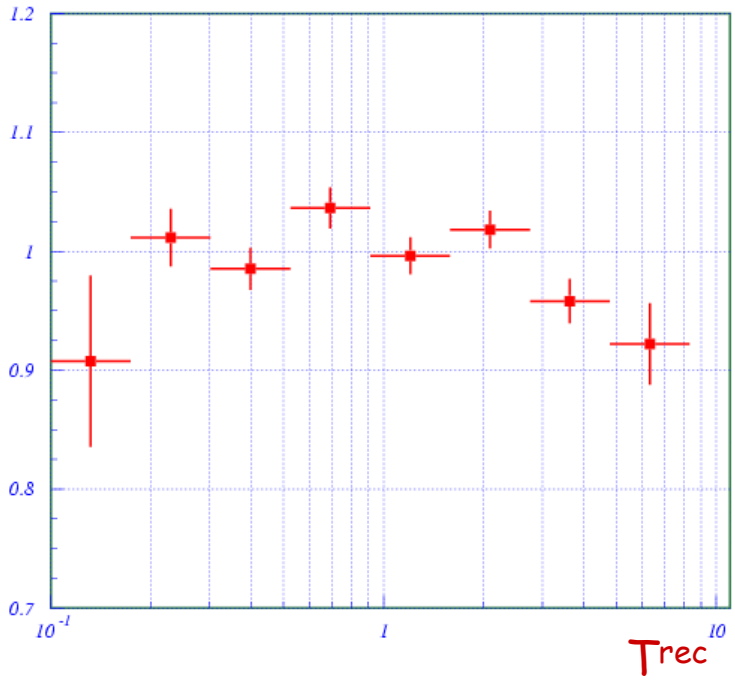
Masses reconstruction and isotopic separation: fit method

For reconstructions in NaF radiator:

σ_{3He}/M_{3He}
σ_{4He}/M_{4He}



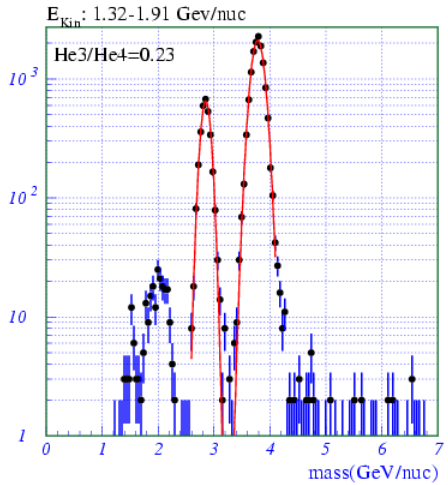
$(\sigma_{3He}/M_{3He})/(\sigma_{4He}/M_{4He})$

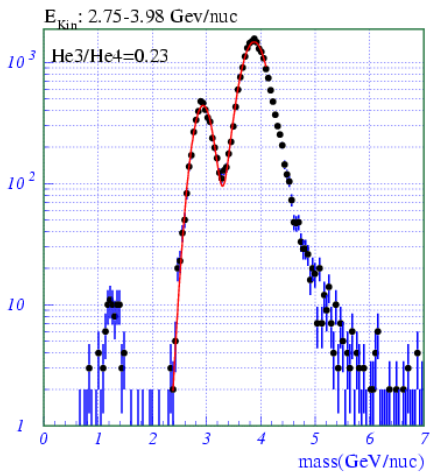


$(\sigma_{3He}/M_{3He}) \sim (\sigma_{4He}/M_{4He})$

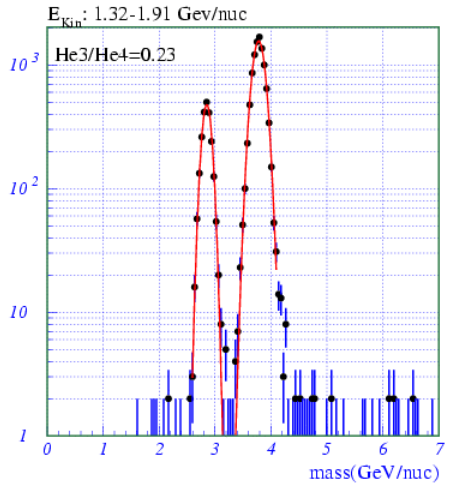
Helium isotopic separation

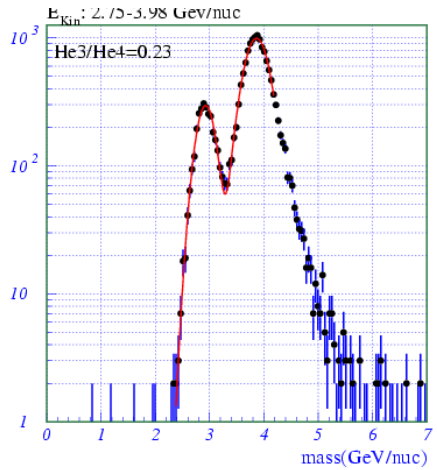
NaF with foil...





NaF without foil...

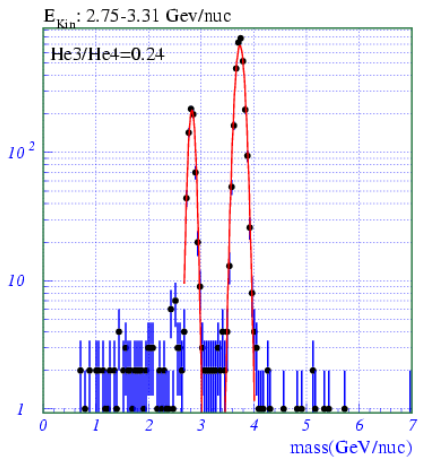


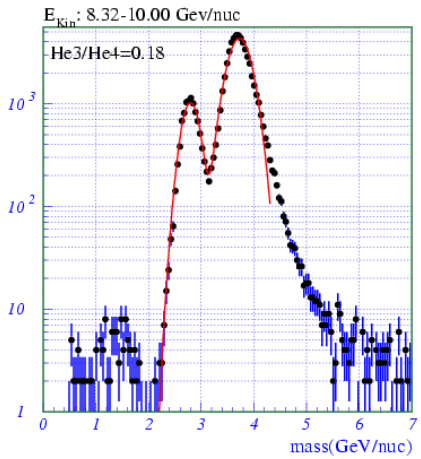


Taking out the foil almost all the bad reconstructions dissapear!

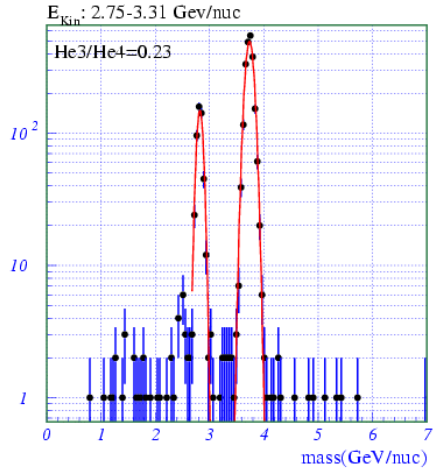
Helium isotopic separation

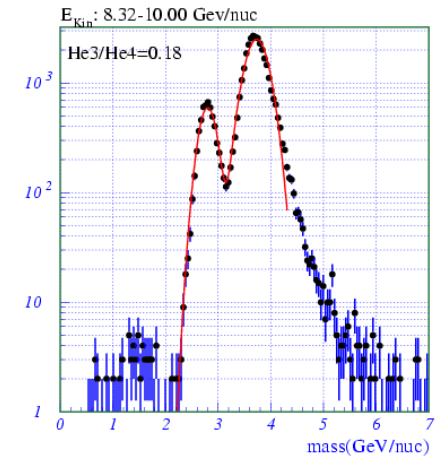
AgI with foil...





AgI without foil...





Taking out the foil doesn't clean a lot of bad mass reconstructions!!

There is another font of hits for fake reconstructions!!

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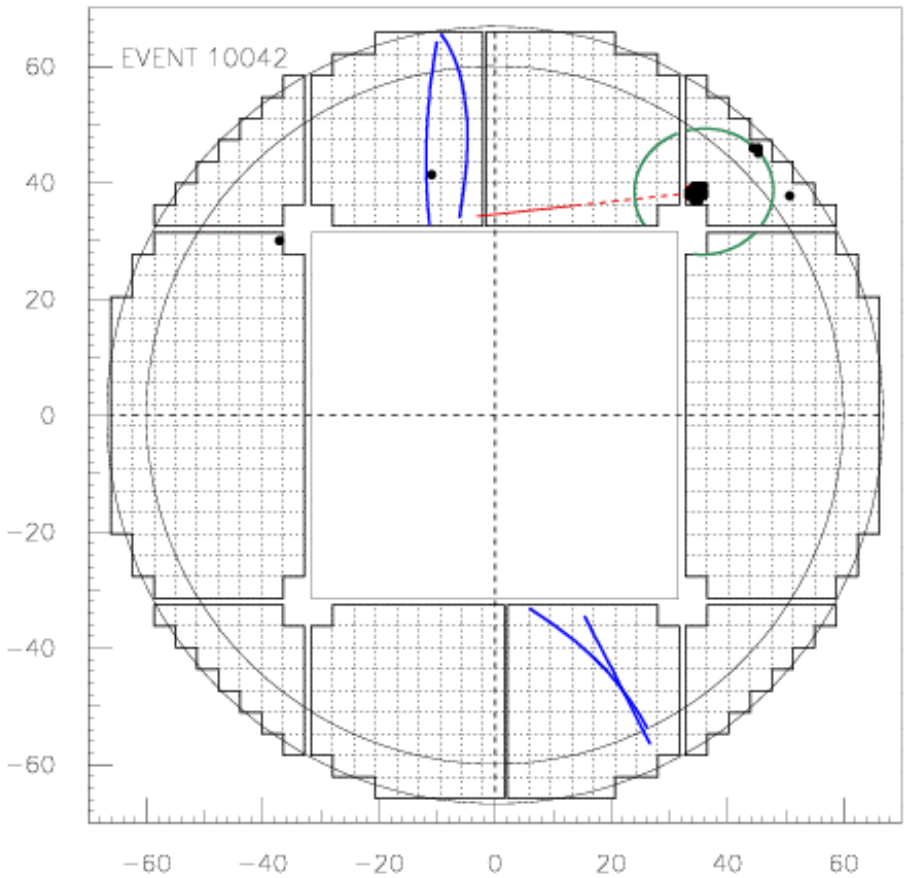
Helium isotopic separation: aerogel fake reconstructions

Agl 1.03



Agl reconstructed pattern

Foil expected pattern

Agl: θ_c^{rec}=11.392 θ_c^{sim} = 0.0

T^{sim}= 1.289 GeV/nuc < T_{th}=2.97 GeV/nuc

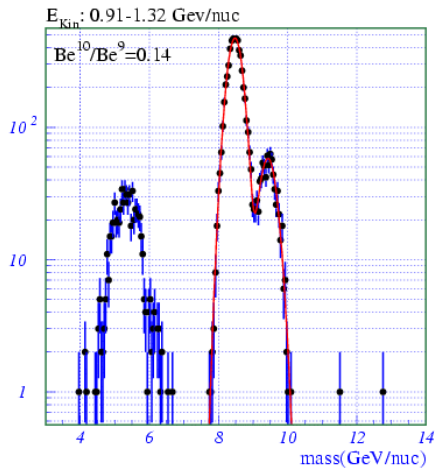
T^{rec}= 5.84 GeV/nuc

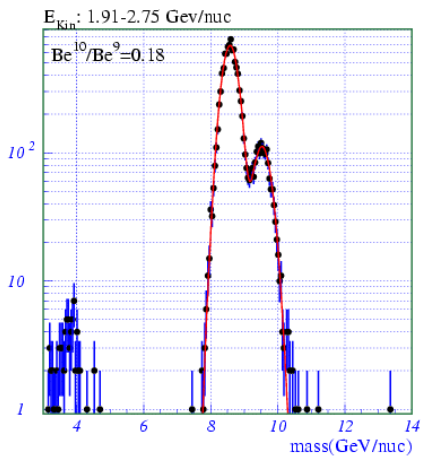
Foil: θ_c^{rec}=42.27

There are noise hits producing fake reconstructions from below threshold events

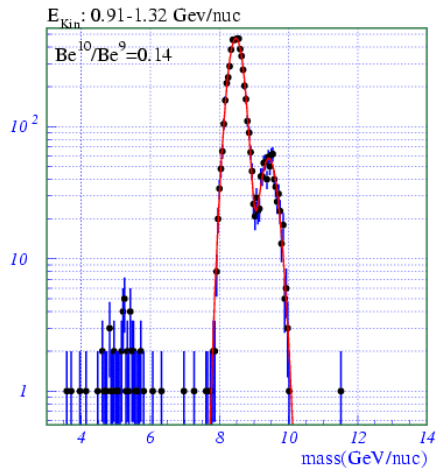
Beryllium isotopic separation

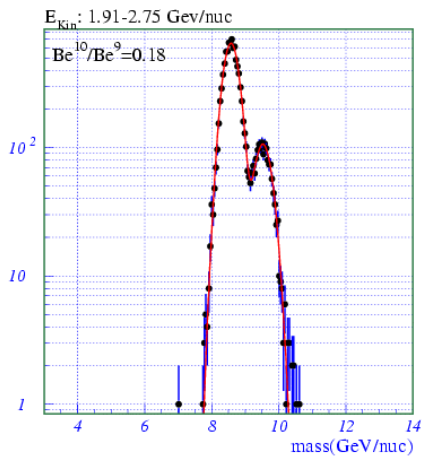
NaF with foil...





NaF without foil...

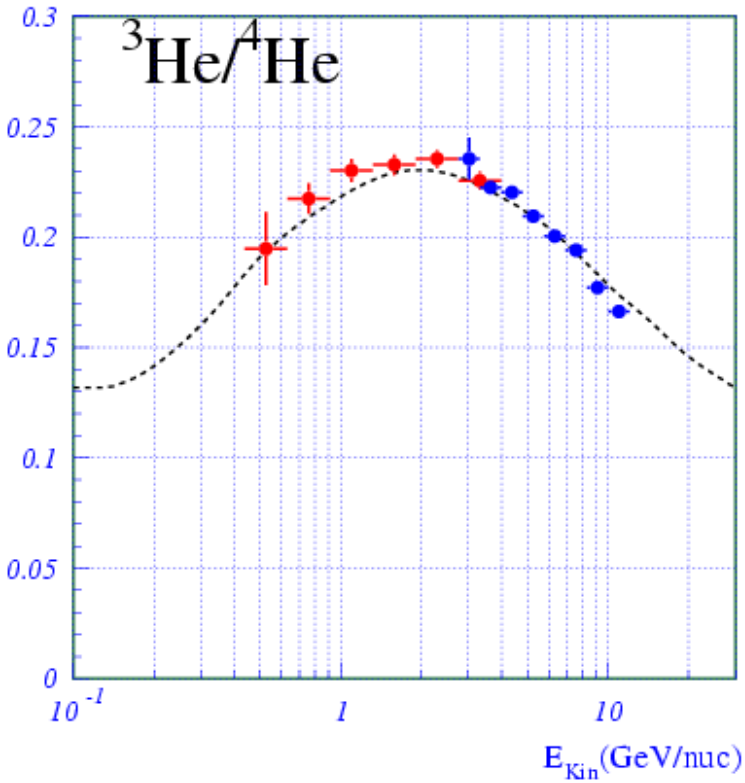




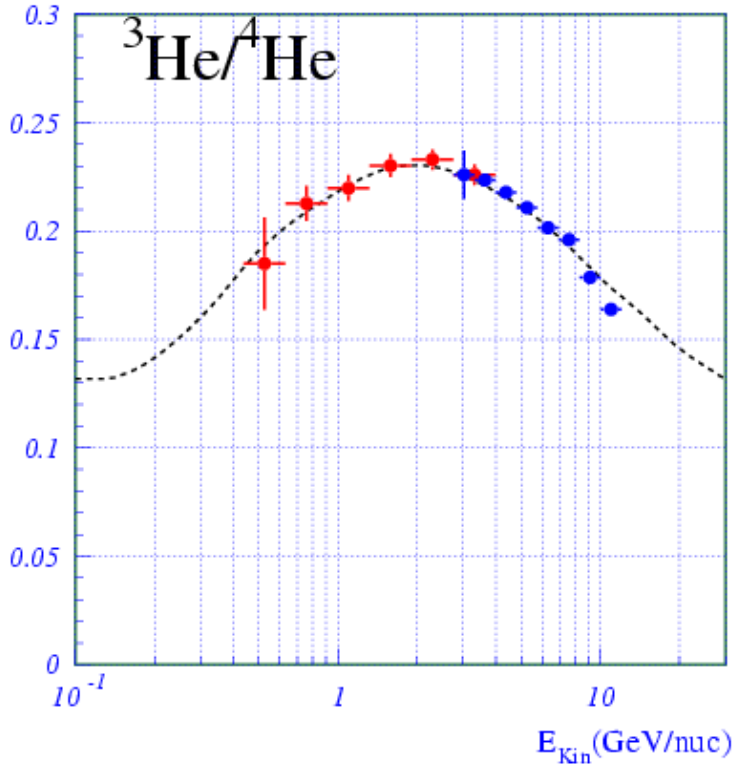
The region near of ^{7}Be events is strongly cleaned without the foil!!

Reconstructed isotopic ratios for He and Be

With foil

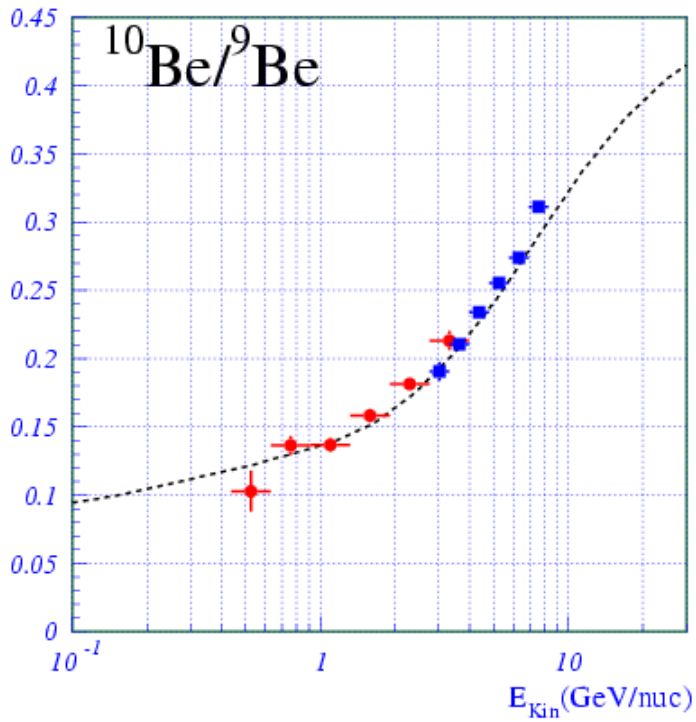


Without foil

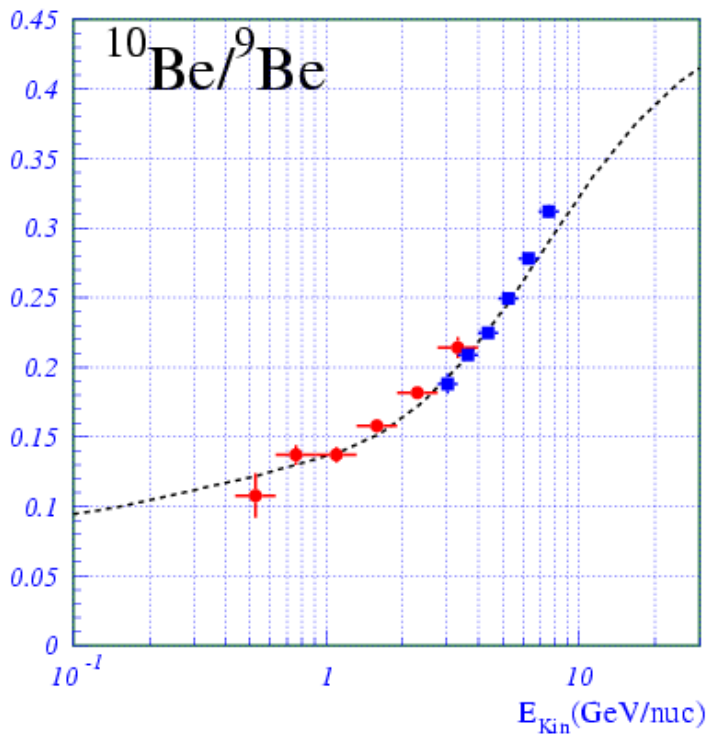


Reconstructed isotopic ratios for He and Be

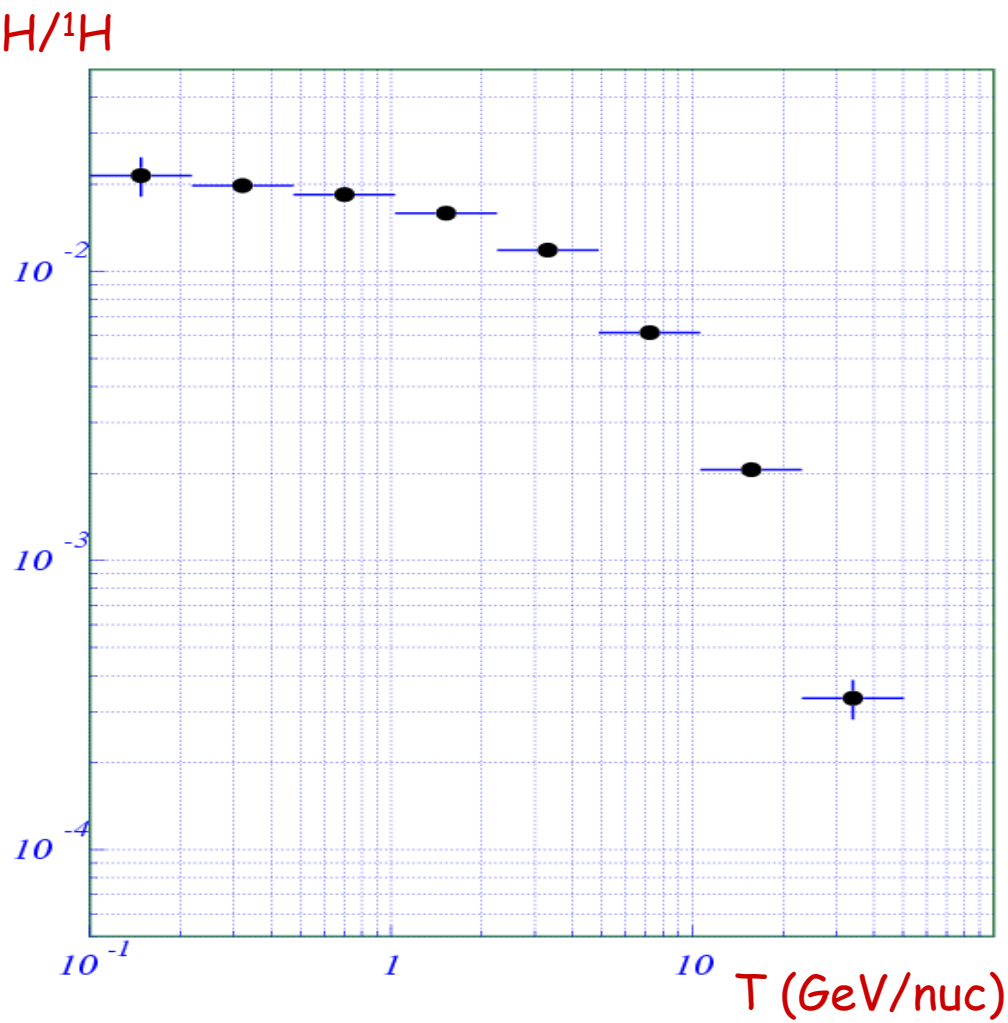
With foil



Without foil

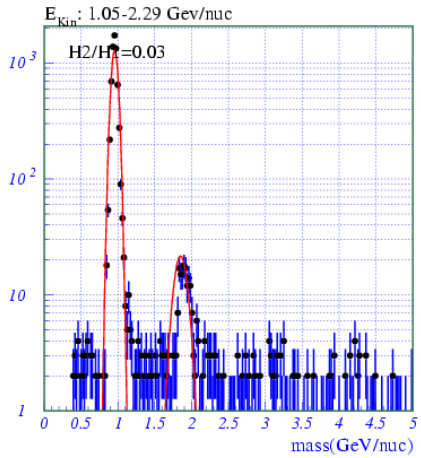


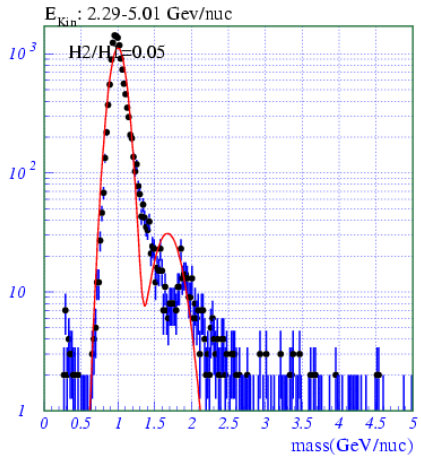
Expected ratios for Hidrogen isotopes



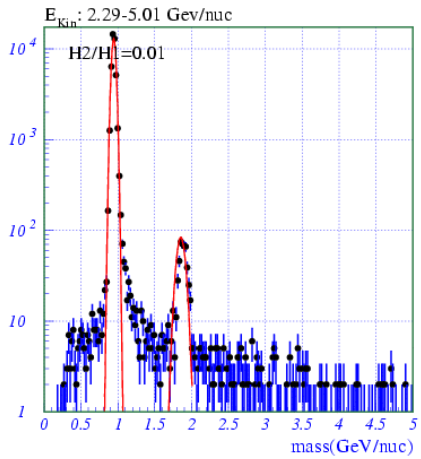
Hidrogen isotopic separation

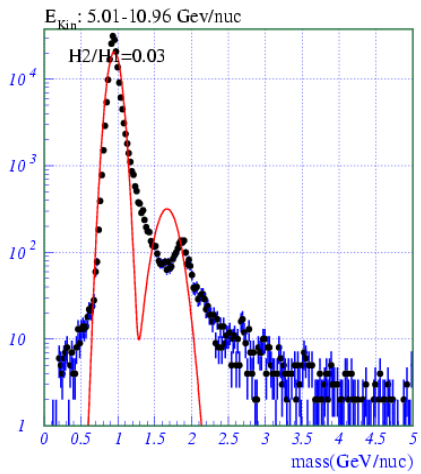
NaF:





AgI:





A fit using the sum of 2 Gaussian functions doesn't appear to result for $^2H/^1H$ separation: there is a non Gaussian tail

- a large nb of hits shall be required
- non Gaussian tail: understand it

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Conclusions

- ✓ The placement of a NaF radiator at the center of the radiator plane (~30x30 cm^2) increases substancially the number of reconstructed events (N_{hits} >2), when compared with aerogel
- ✓ The introduction of a NaF radiator allows AMS to cover the complete spectrum of helium and beryllium isotopic measurements from 0.5 GeV/nuc up to around 10 GeV/Nuc. With TOF the range is extended down to 0.2 GeV/nuc
- ✓ The presence of an acrylic plastic foil with n=1.49, 1mm of thickness introduce fake reconstructions that affect mass reconstructions in NaF
  - ✓ in AgI there are fake reconstructions with background noise essentialy from below threshold events
- ✓ It is not possible to separate ^2H from ^1H in almost all the energy bins with the current statistics and with a fit using the sum of two Gaussian functions
  - ✓ Futher investigation