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A first look at SDCS

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S(D)DCS measurements: ingredients

$$\frac{d\sigma_i}{dE,d\theta} = \frac{Y_i}{\boxed{N_{^{12}C}} \times N_{t,S} \times \boxed{BW_E \times BW_\theta} \times \Omega(\theta) \times \varepsilon_{rec}(E,\theta) \times \varepsilon_{sel}(E,\theta)}$$

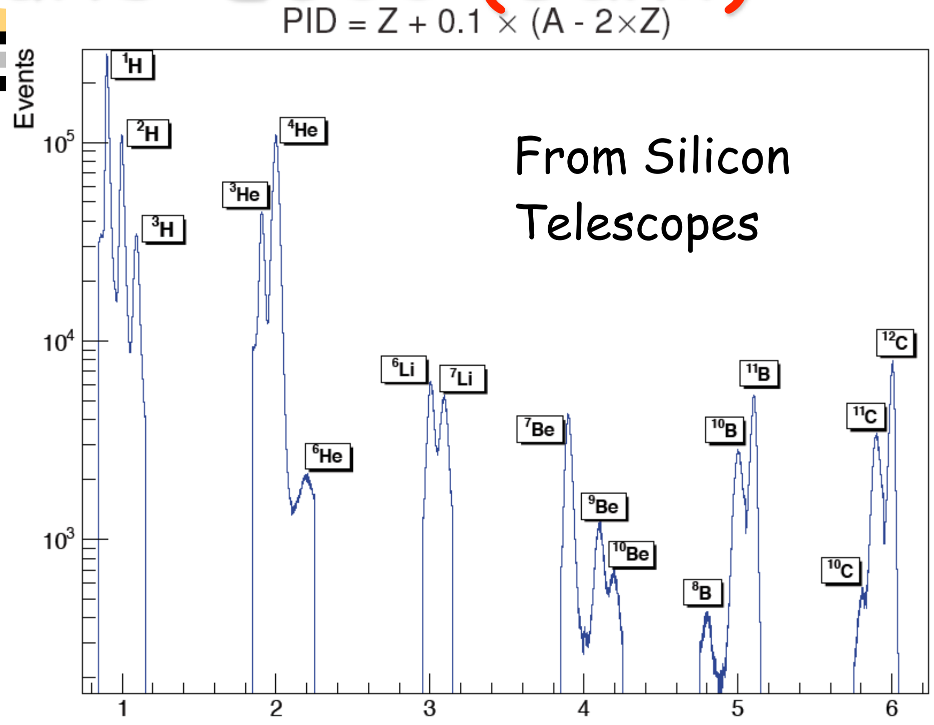
- N_{12C} is measured from the SC
- N_t is the number of nuclei of the C and Au target(s) [to be computed]
- Binning is chosen to have a decent statistics: first really raw estimate.. To be changed in the future...
- The angular acceptance will be measured from MC simulations
  - depending on the track angles
- Efficiencies are currently under evaluation (but we can expect big factors probably only for protons...

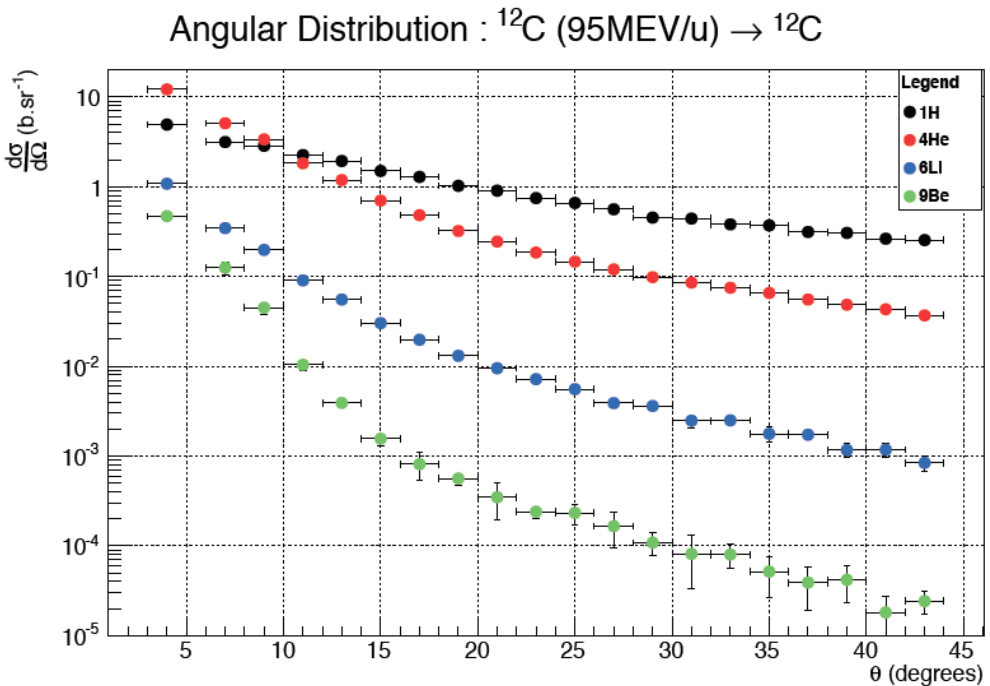
Counting the ^{12}C ions

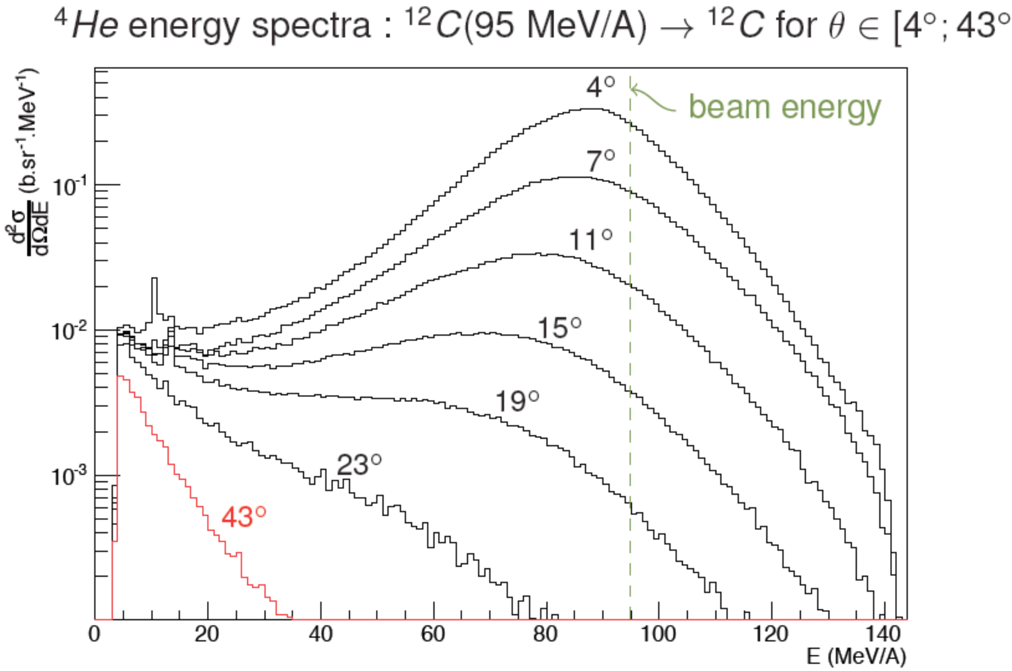
- Since we Used a minimum bias trigger (trigger fires whenever the SC gives a signal) the carbon ions counting is really easy: count the triggers!
  - TATRrawHit::Pattern() && TAGntuEventInfo::trig==1
  - For now I forget the double carbons (negligible rate, **being checked**)
  - For now I also forget the "fake signalas": is that reaaly a Carbon whenever the SC fires? (still believed a negligible contribution but **being checked**)
- Once we count the SC trigger we are basically fine: the dead time and SC efficiency are already taken into account in the "master formula", since I need to normalize to triggered carbons!

Our "competitors" results: E600 (Ganil)

- Obtained results for SDCS and DDCS
  - one interesting conclusion: Composite targets can be deduced from the cross sections of elemental targets (-> organic tissues)
  - Currently focusing on: **assessing systematics** and comparing with MC to benchmark difference nuclear MC models

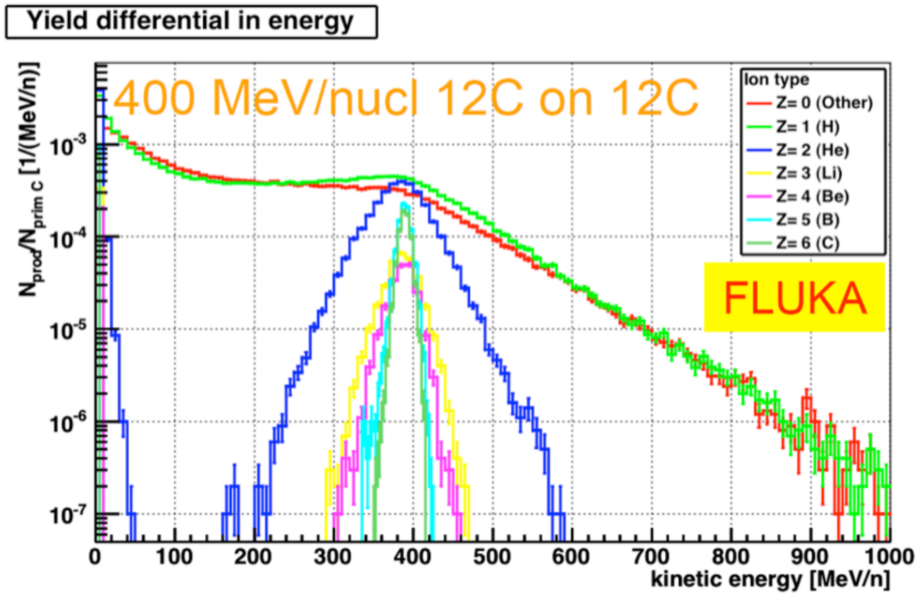




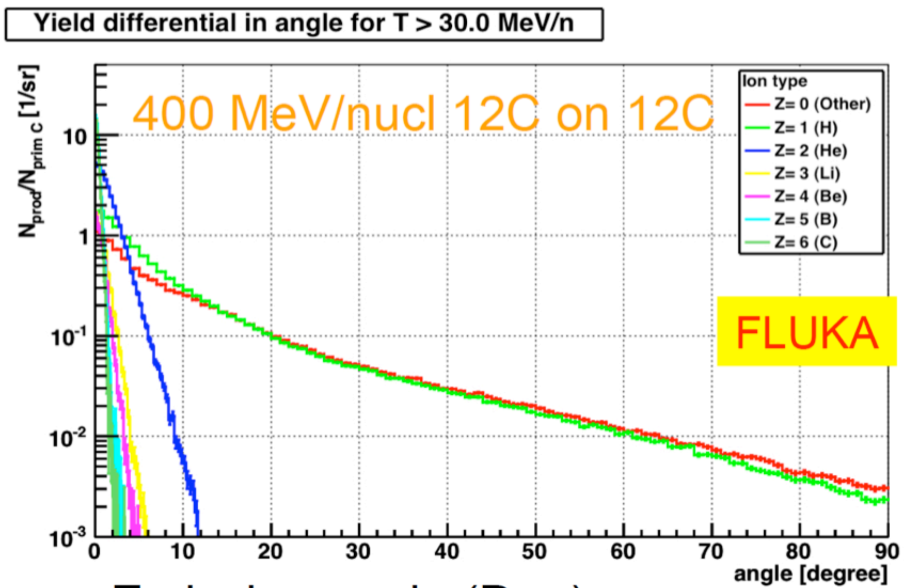


What we expect from simulations

- The Z>2 produced fragments approximately have the same velocity of the ^{12}C beam and are collimated in the forward direction
- The protons are the most abundant charged fragments with a wide β spectrum 0<β<0.6 and with a wide angular distribution with long tail
- The Z>1 fragment are all emitted within 20 deg of angular aperture
- The dE/dx released by the fragment spans from ~2 to ~100 m.i.p.



Kinetic energy (MeV/nucl)



Emission angle (Deg)

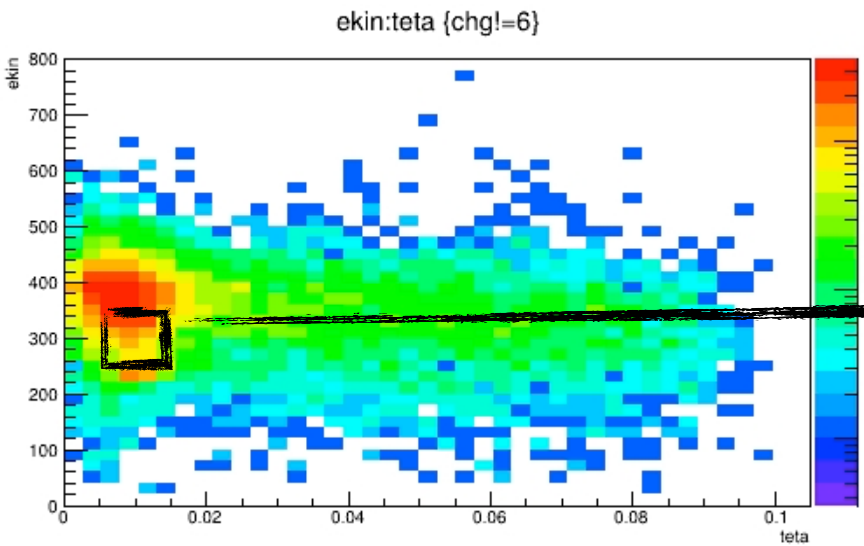
How to compute yields

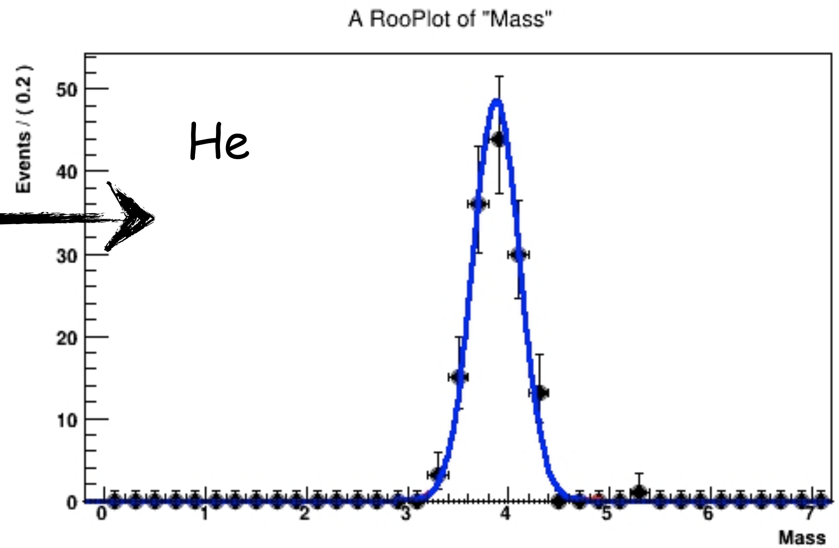
$$\frac{d\sigma_i}{dE, d\theta} = \frac{\boxed{Y_i}}{N_{12C} \times N_{t,S} \times BW_E \times BW_\theta \times \Omega(\theta) \times \varepsilon_{rec}(E,\theta) \times \varepsilon_{sel}(E,\theta)}$$

Used unbinned likelihood fits (to avoid binning effects with low statistics bins)

Select a given bin in kinetic energy AND/OR angle and perform a fit to the invariant mass ditribution!

No correction for efficiencies OR solid angle is implemented YET



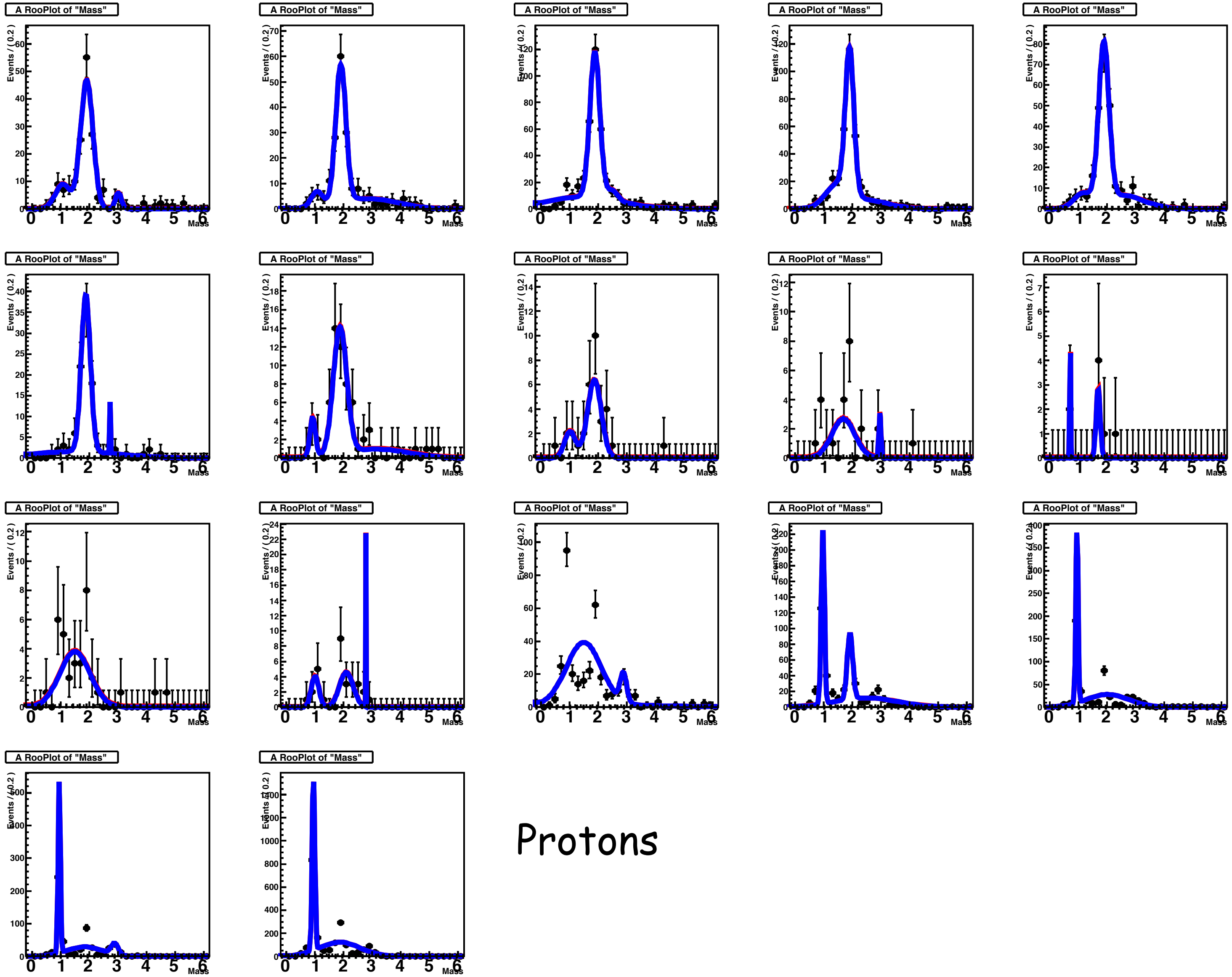


Let's start with MC

Used same ZID config as for data (this will change)

Used 100k events from LAST MC code.

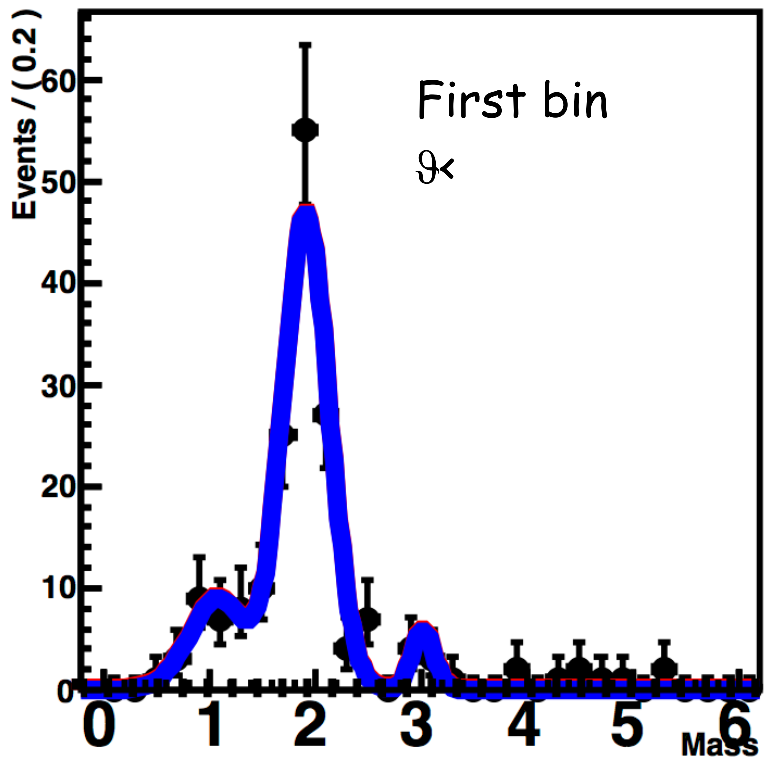
A larger production is currently delayed due to fluka problems

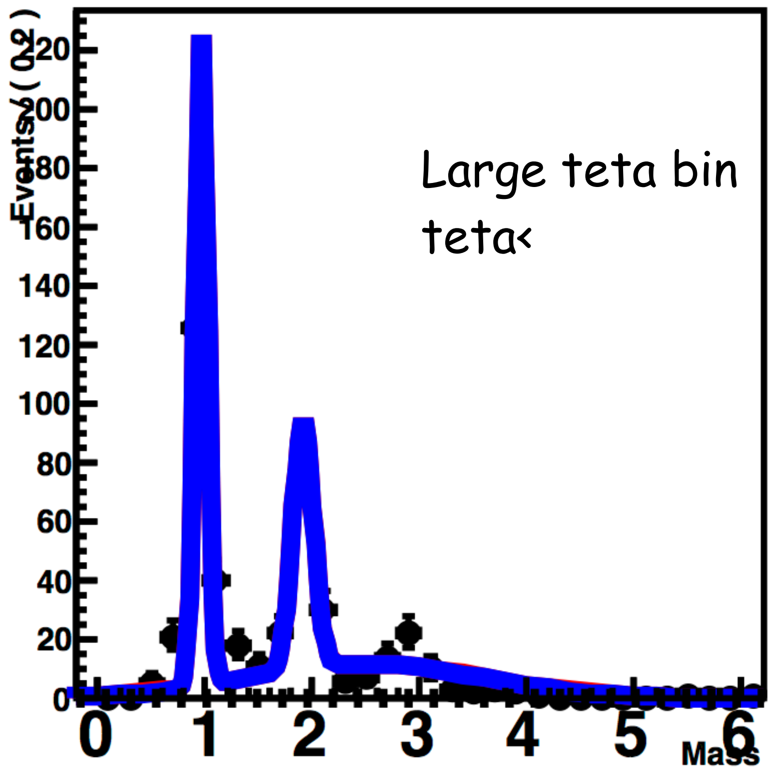


Protons

Protons ϑ fits: MC

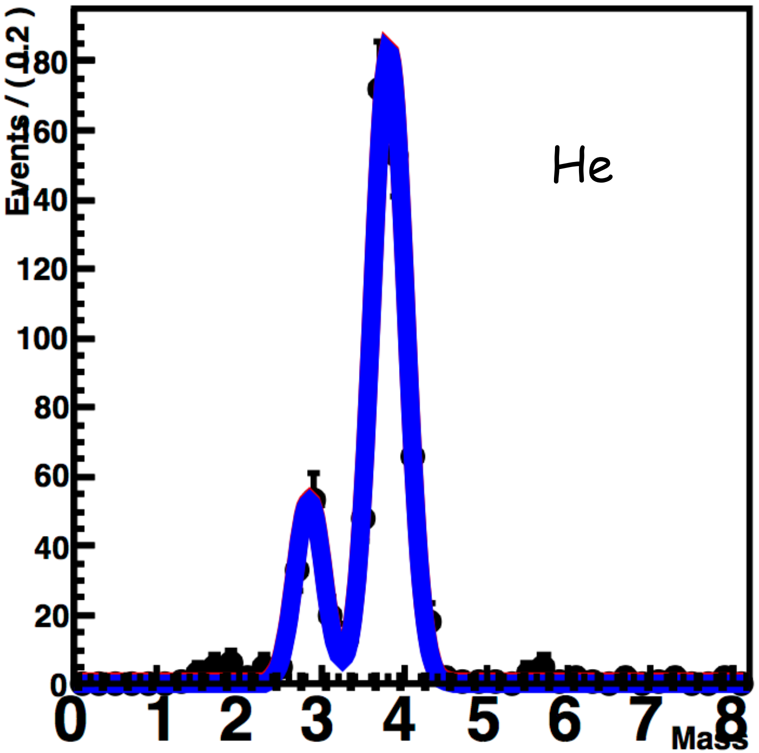
- Took into account Pr, De, Tr
  - Issues with Pr efficiencies: at low angle ~ no protons...

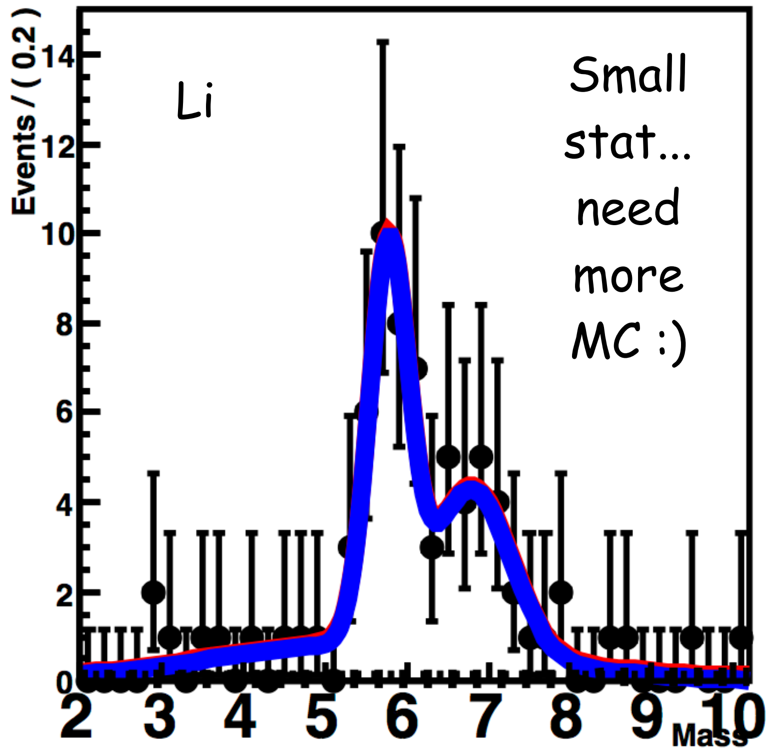




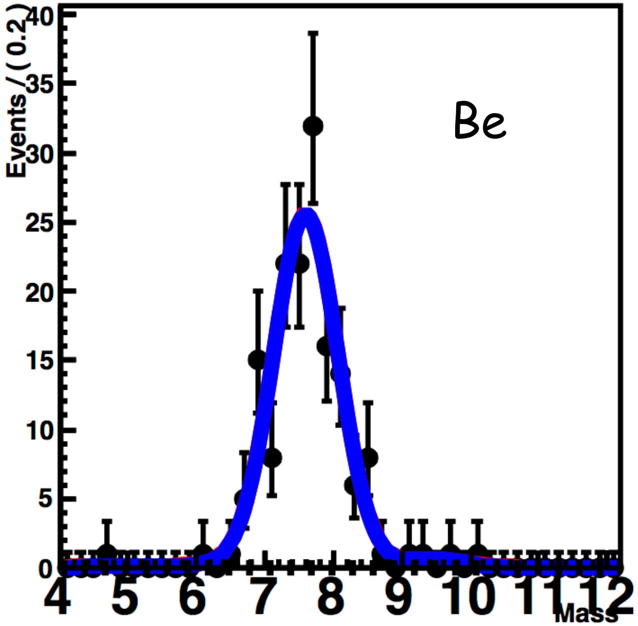
Helium, Litium ϑ fits MC

- For helium: took into account ^{3}He ^{4}He ^{6}He (observe sometimes a bump at 5!)
- For Litium: took into account ^{6}Li and ^{7}Li : peaks found also in other positions :)

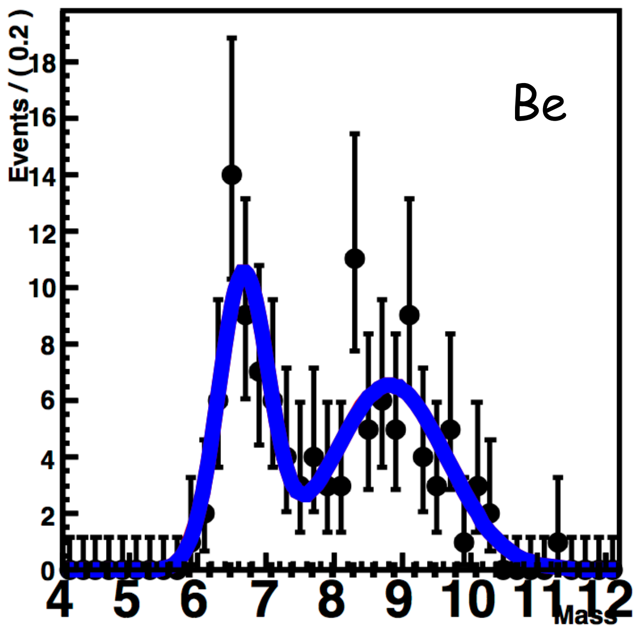


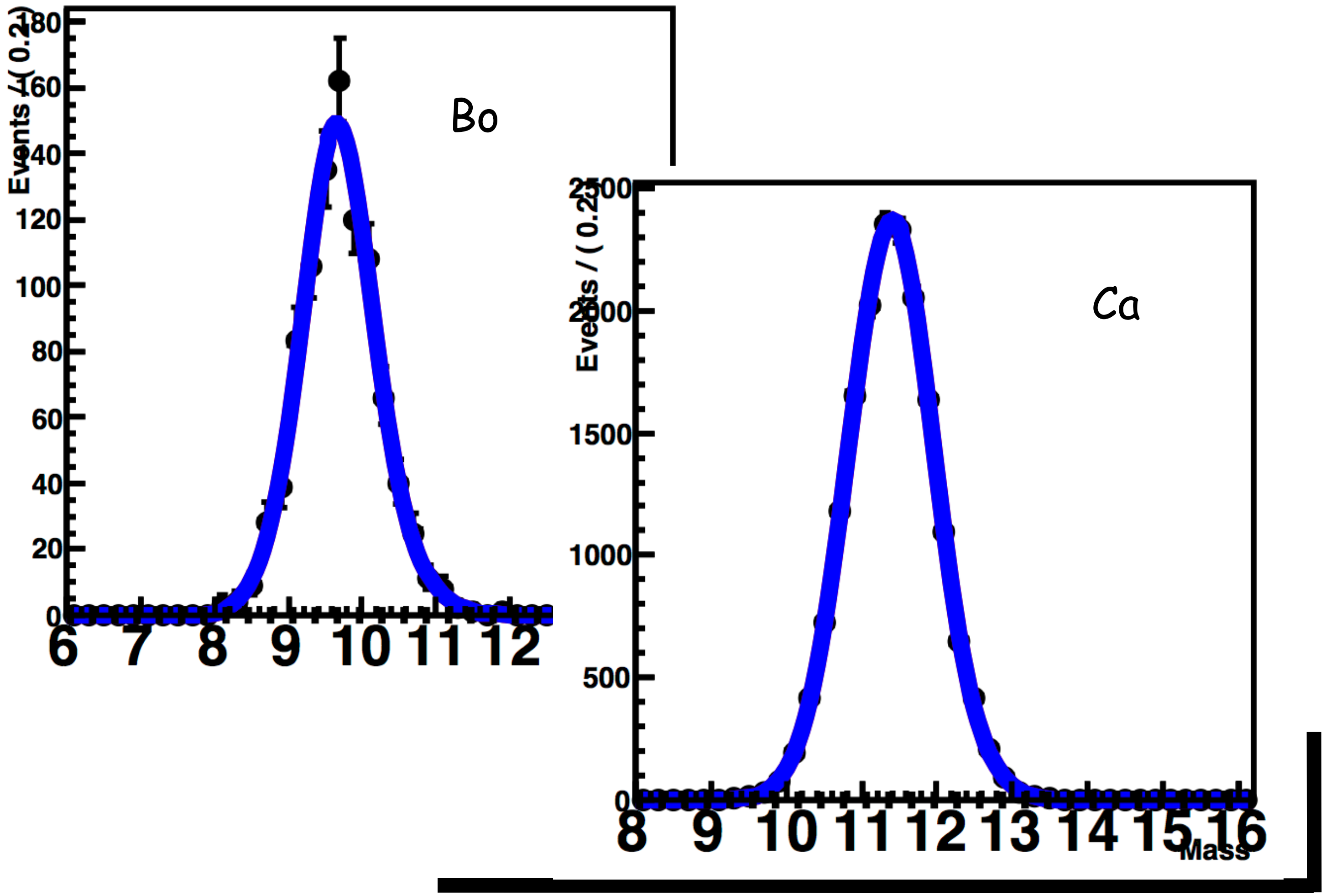


Be, B, Ca ϑ fits MC

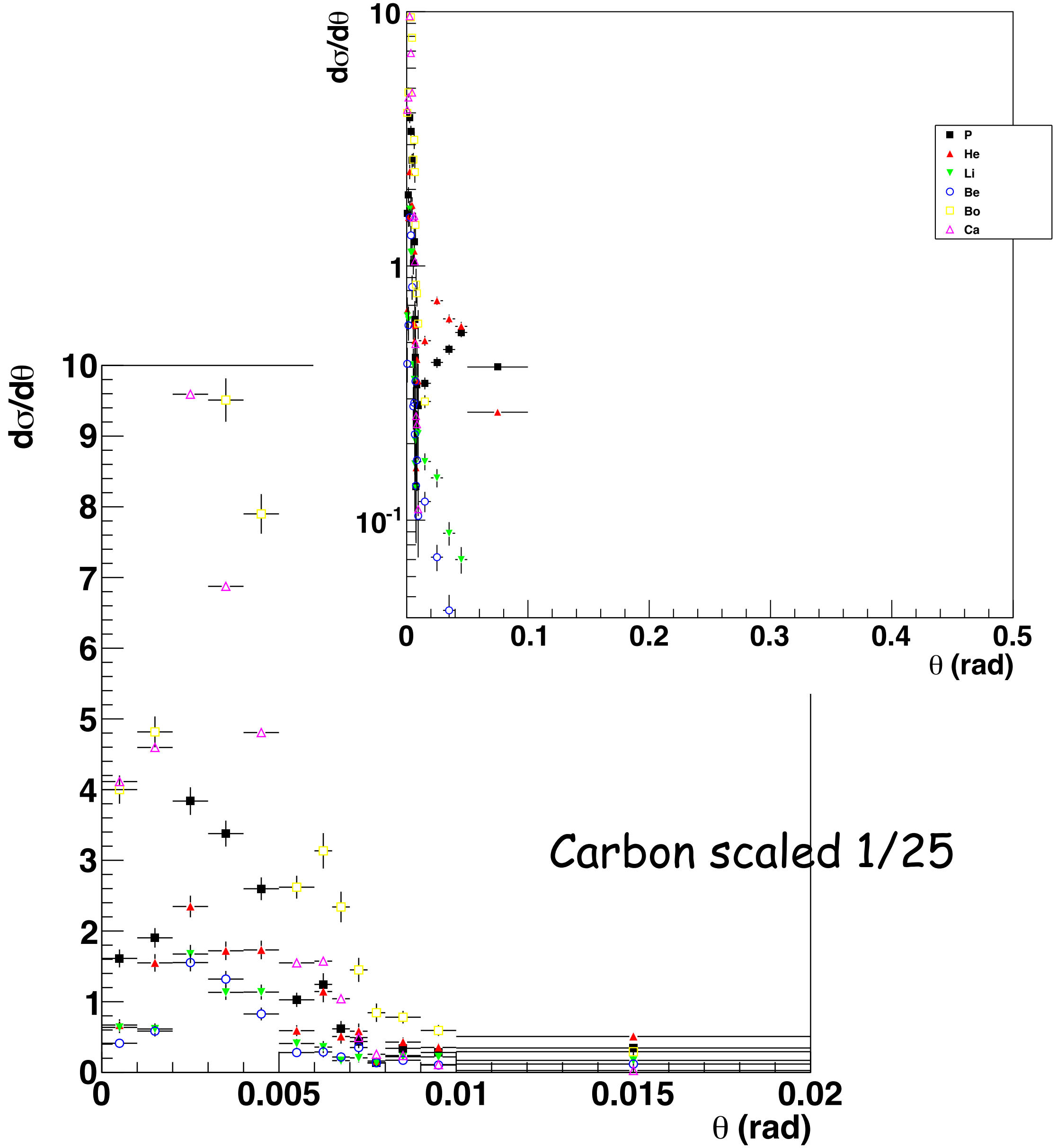


Different isotopes accounted for Be, Bo, Ca: sometimes an unwanted peak shows up: but poor resolution and biases are present so it is difficult to draw a definite conclusion.

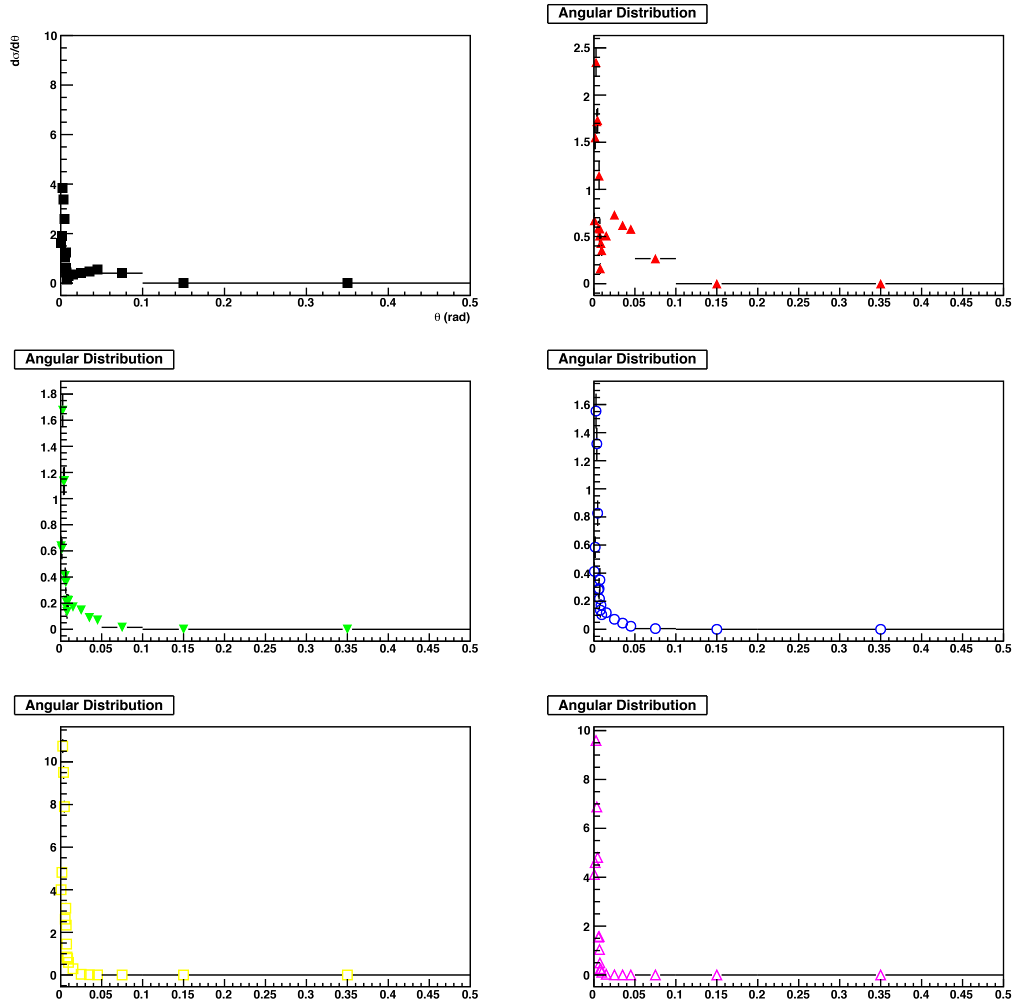




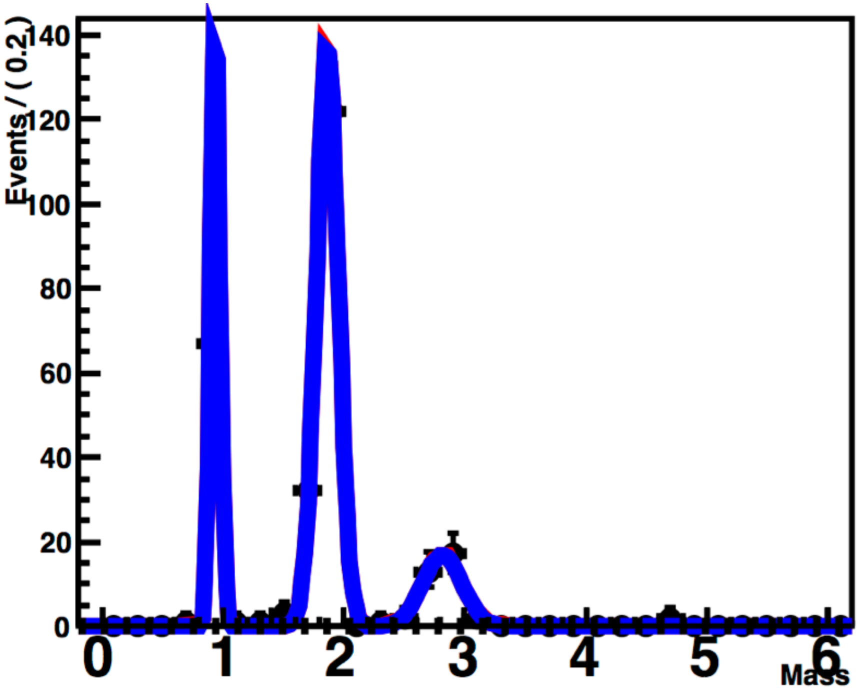
Angle SDCS results (MC)



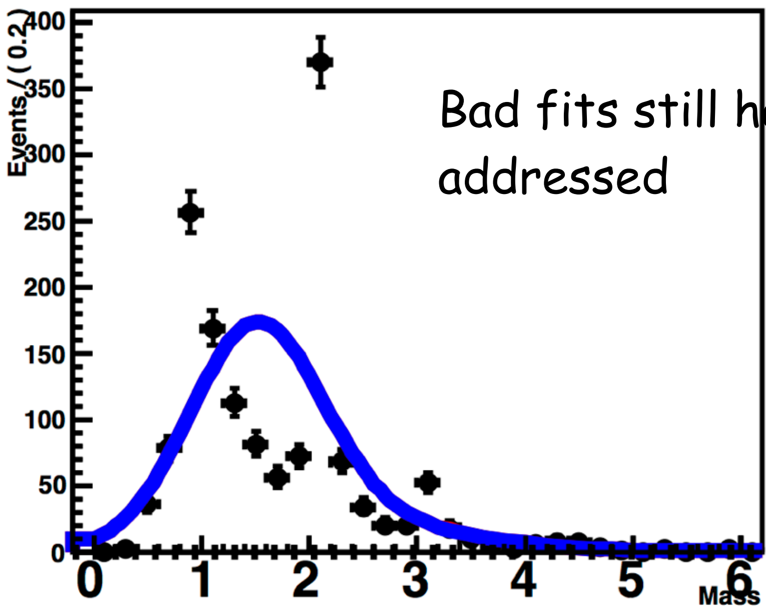
Carbon scaled 1/25



Protons Ekin fits: MC

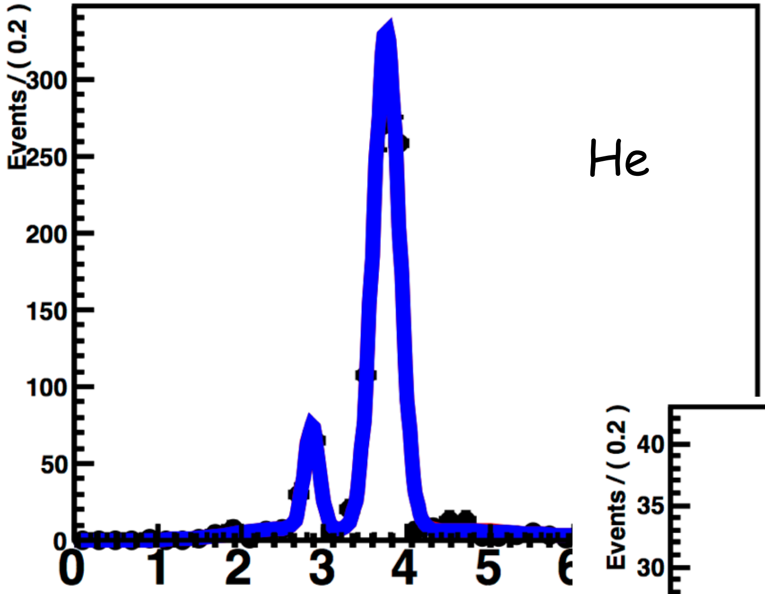


- Central bins in Ekin show a large contribution from protons

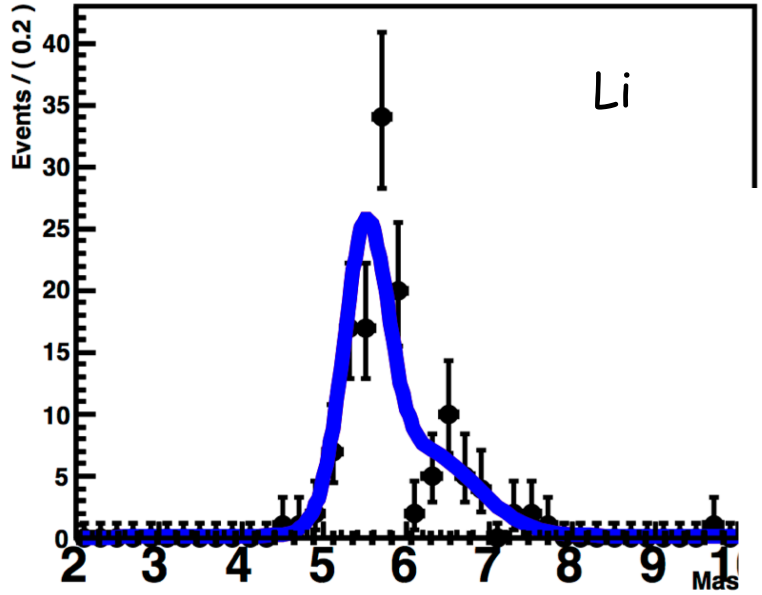


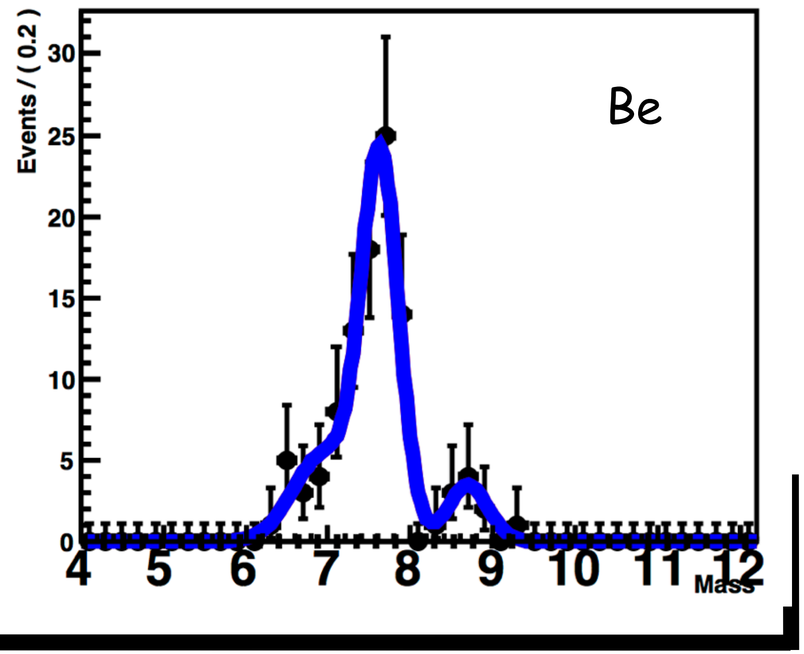
Bad fits still have to be addressed

Protons Ekin fits: MC

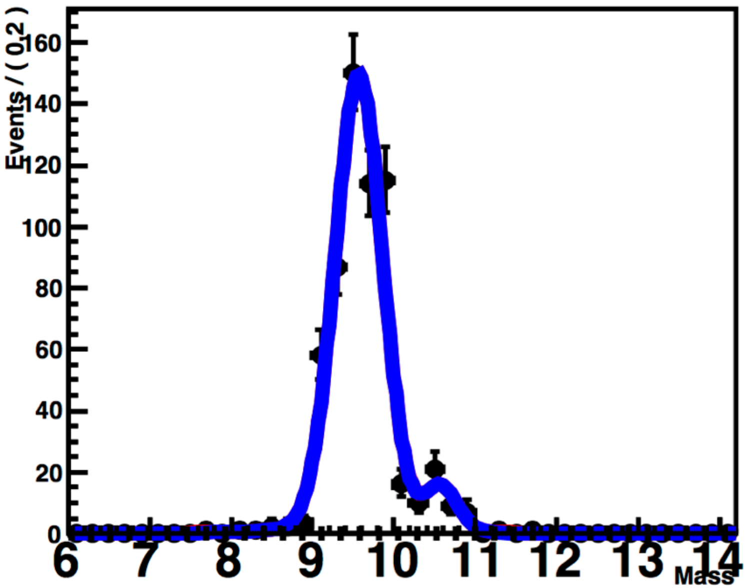


- He:
- Li and Be: thigs start to get more dirty.. need larger stat to be conclusive.

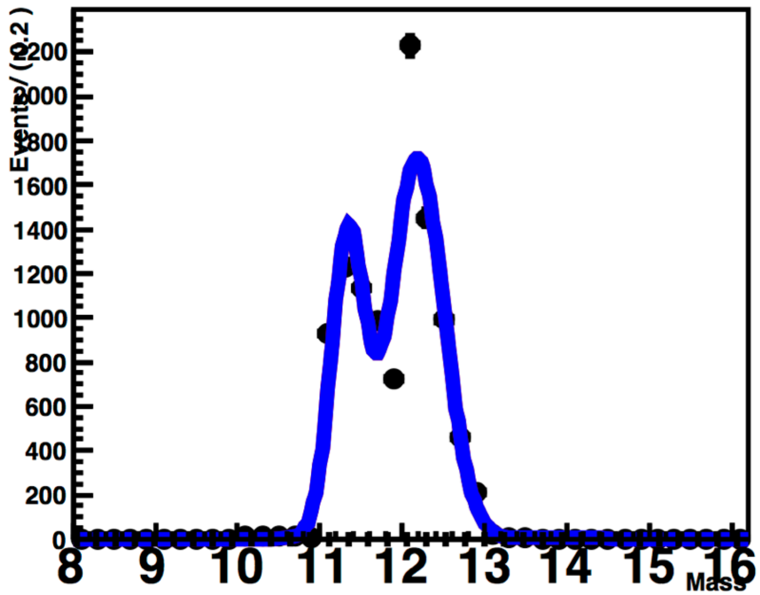




Protons Ekin fits: MC

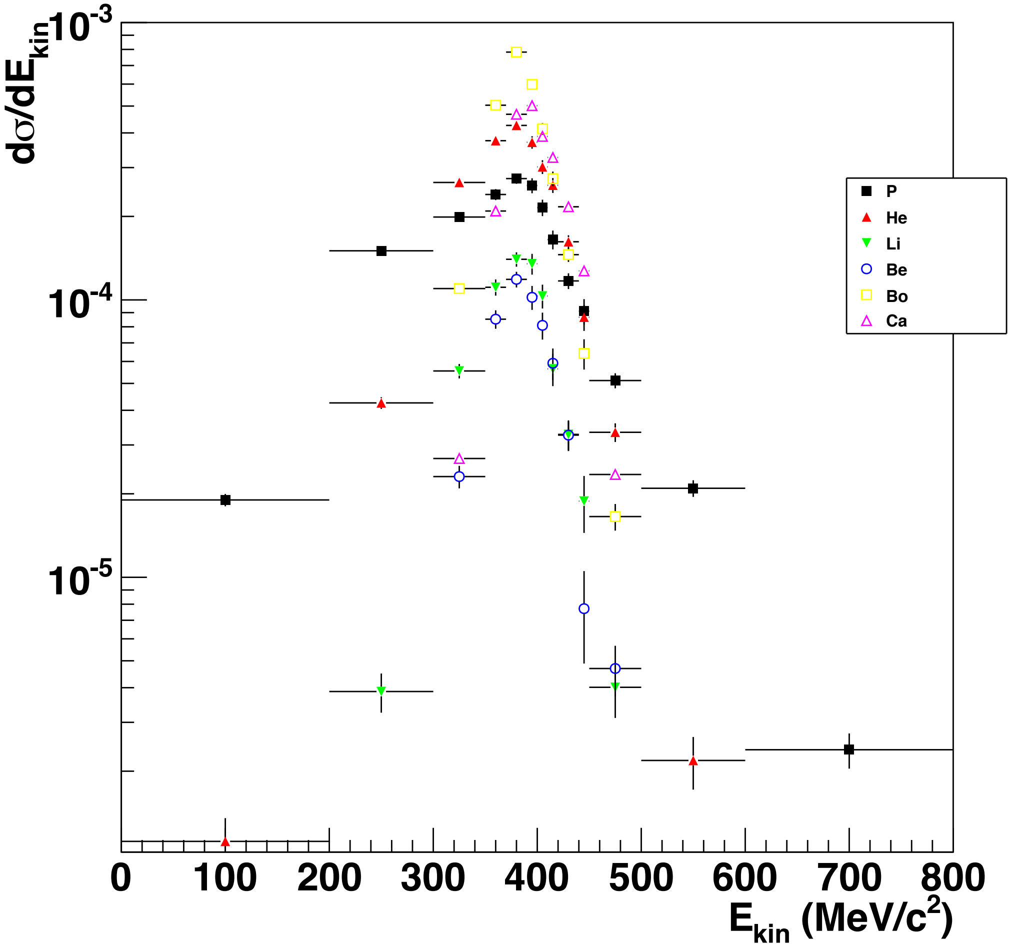


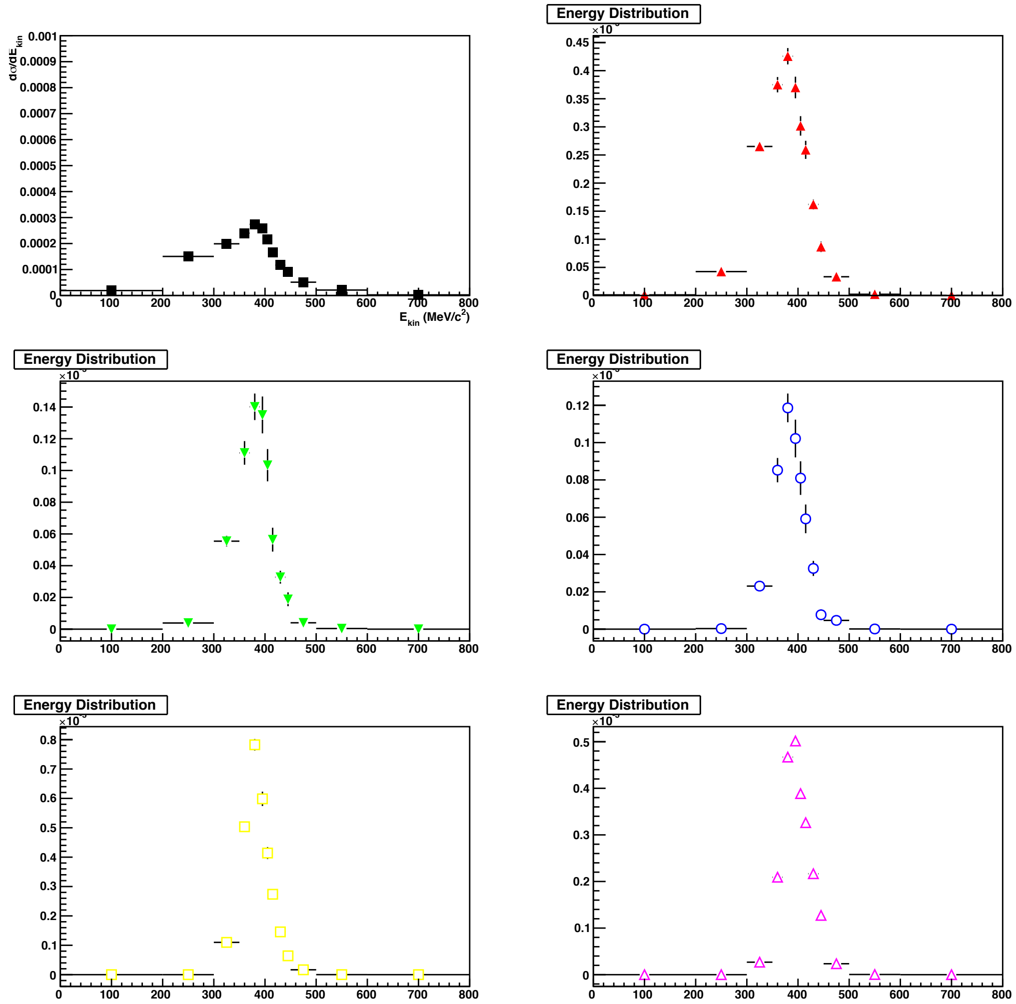
- Bo and Ca: in some bins there are hints of double peaks: should carefully check fits...
- Try to understand shifts in mass



Energy distribution results (MC)

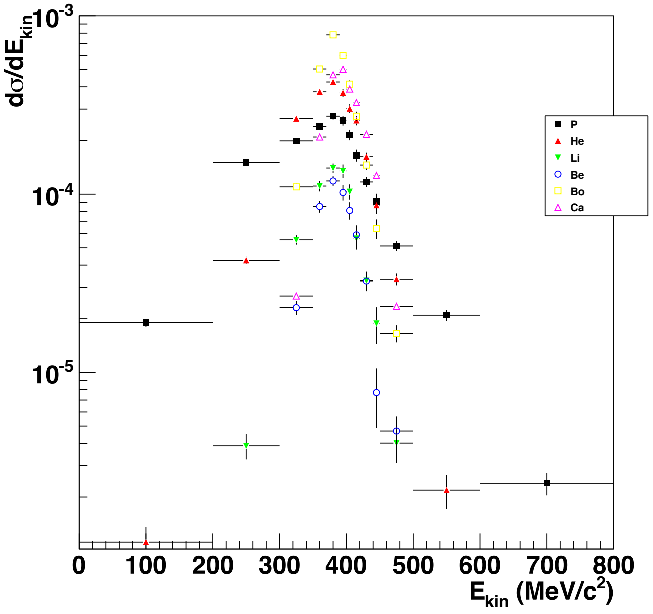
- No efficiency correction

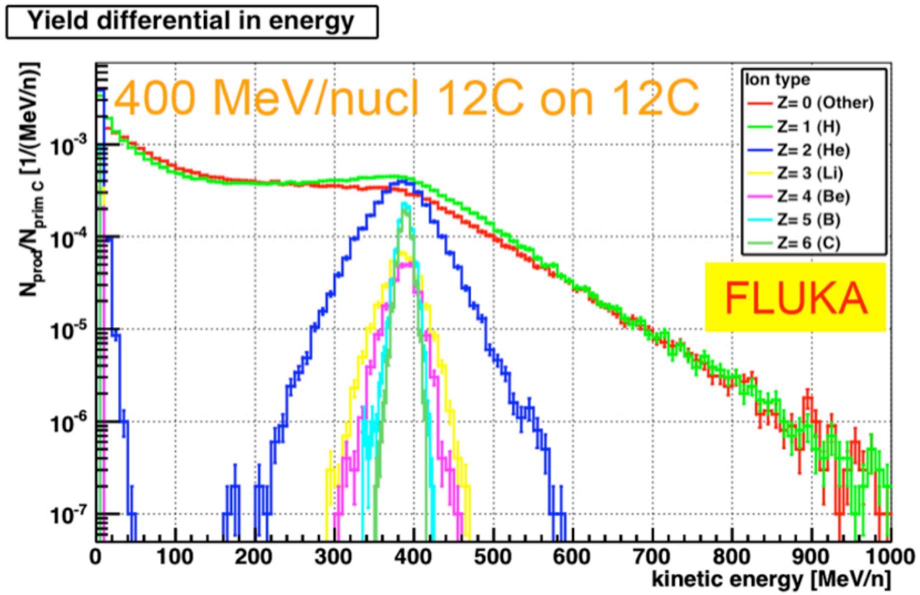




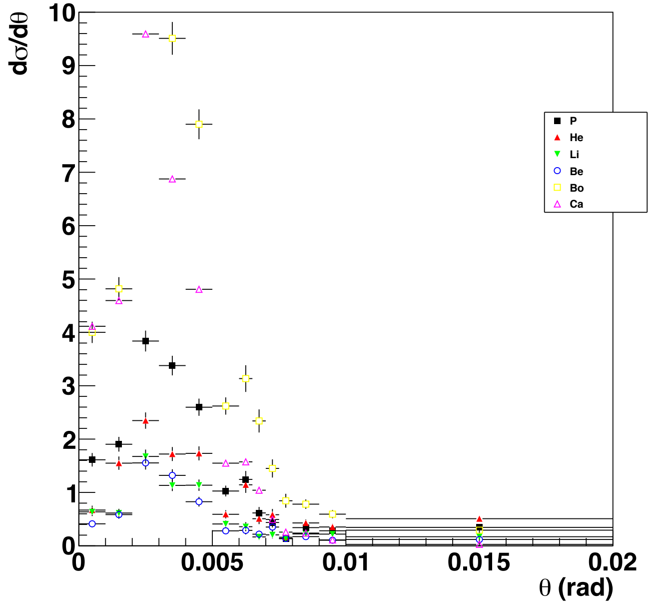
Carbon scaled 1/25

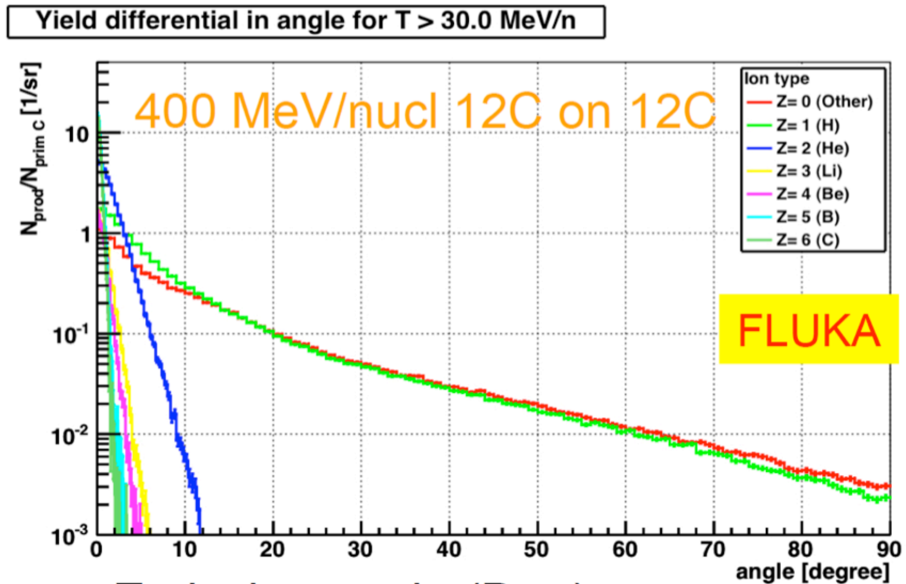
MC summary





Kinetic energy (MeV/nucl)





Emission angle (Deg)

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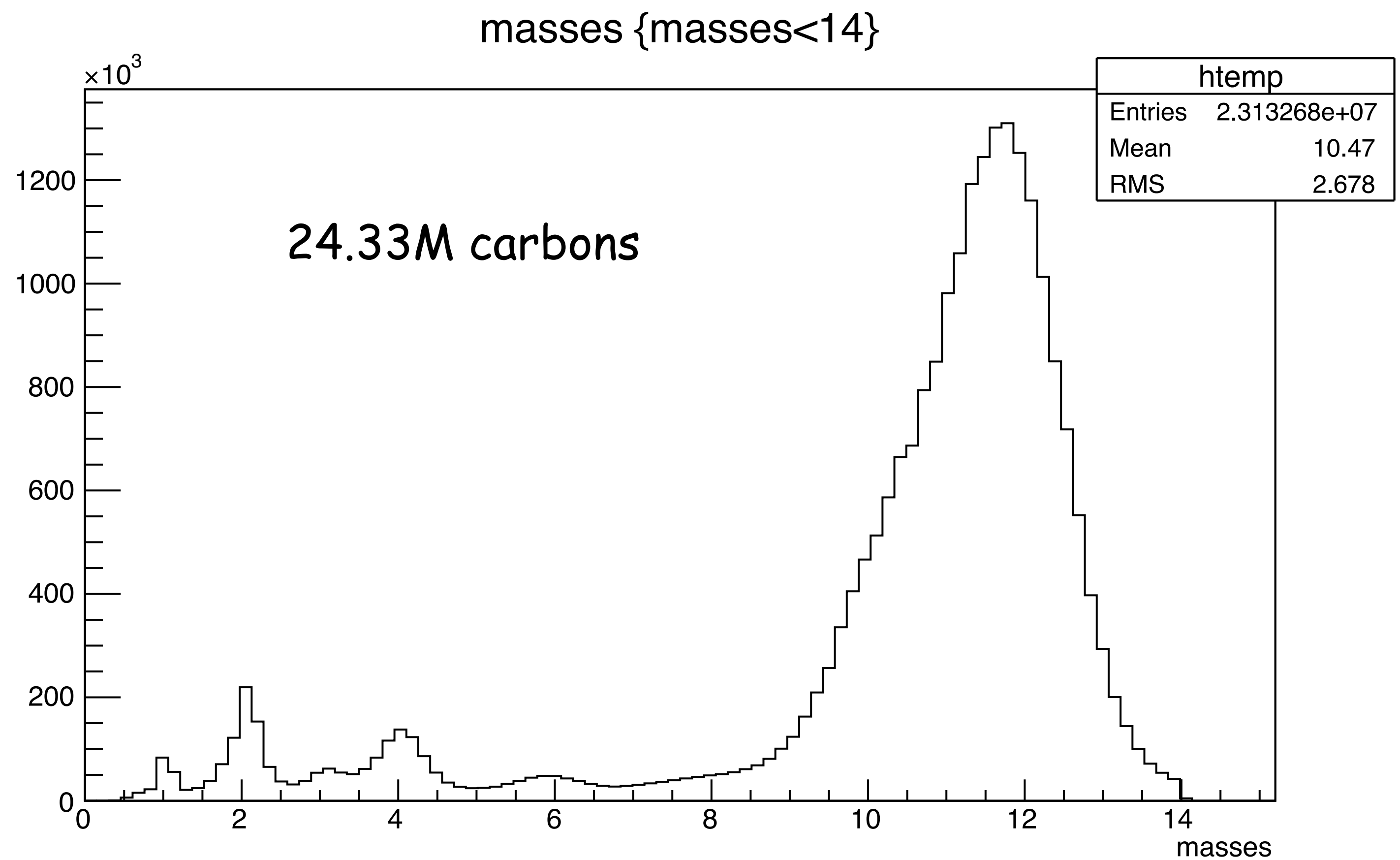
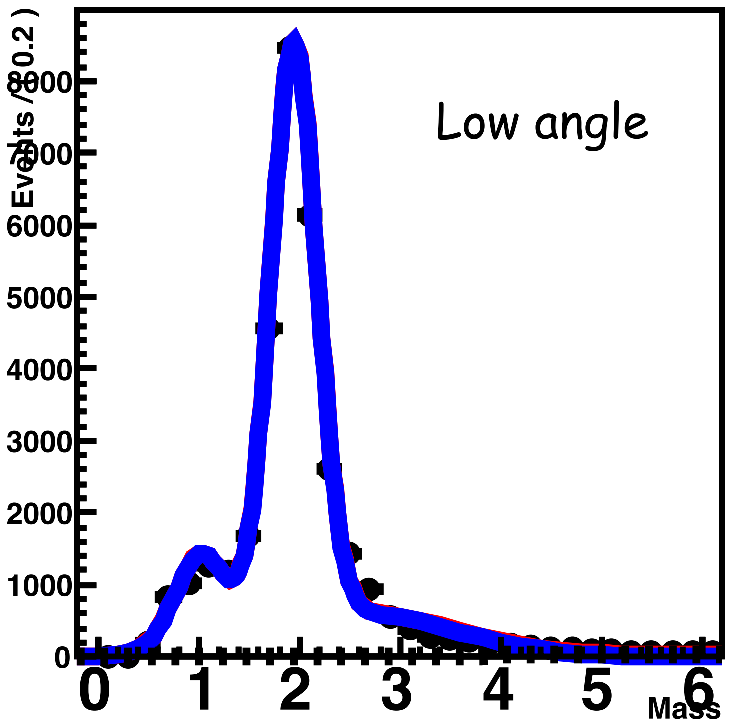
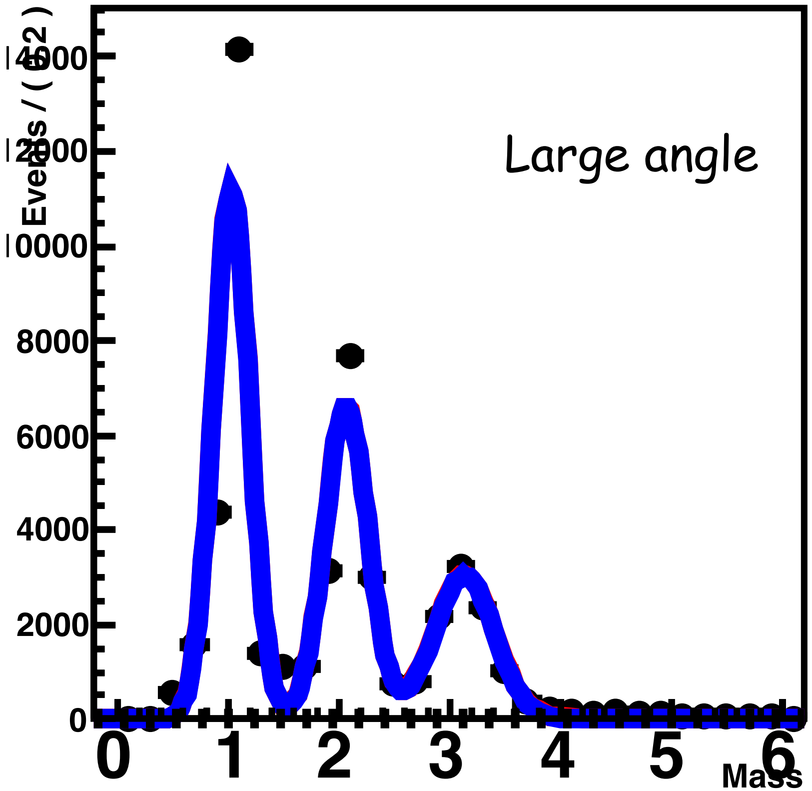
Data

- Used v55 production with latest ZID
- Merged ALL the carbon runs together

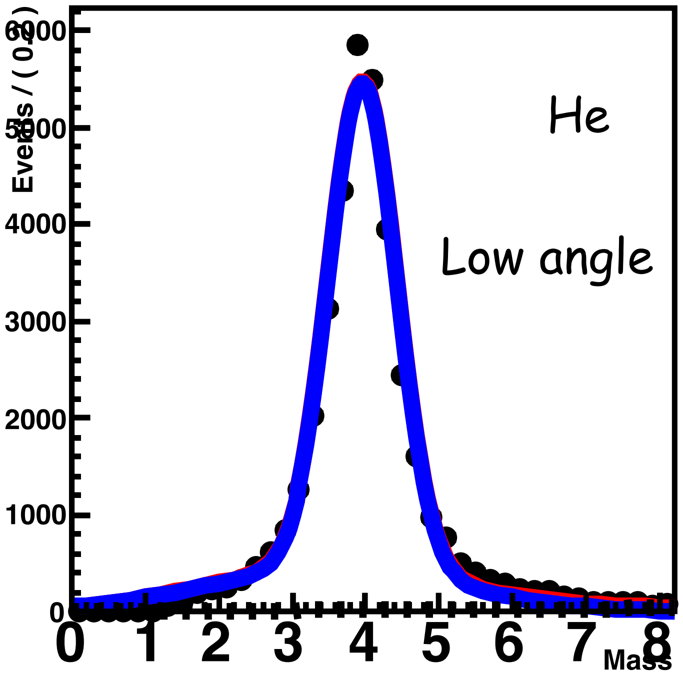


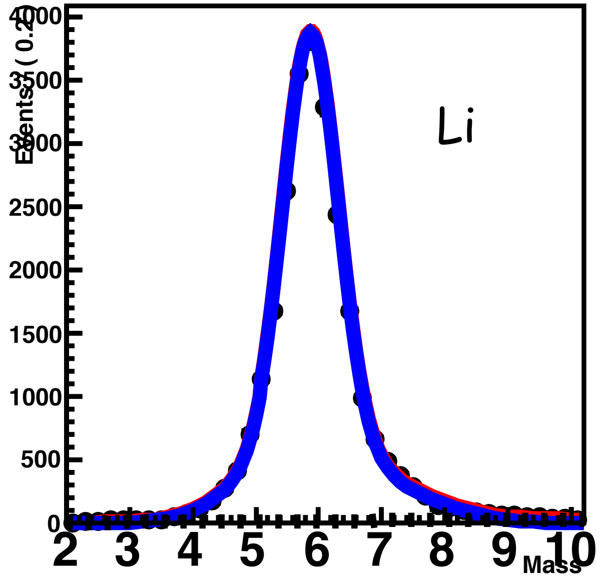
PR theta fits

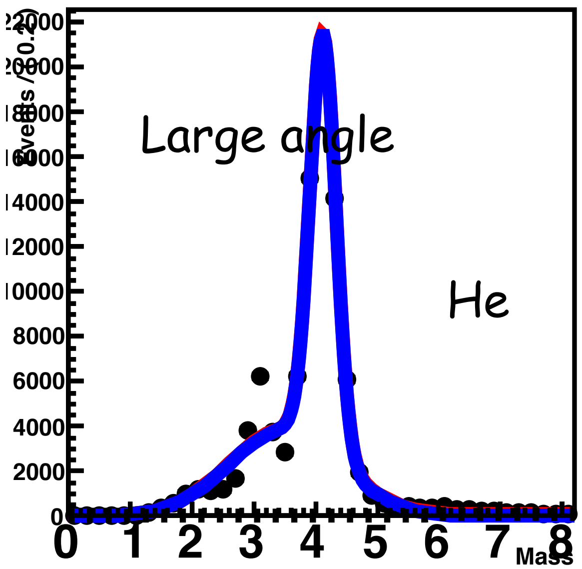


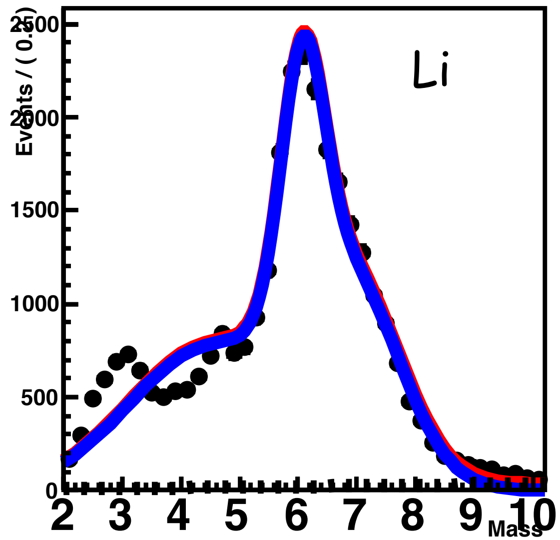


He theta fits





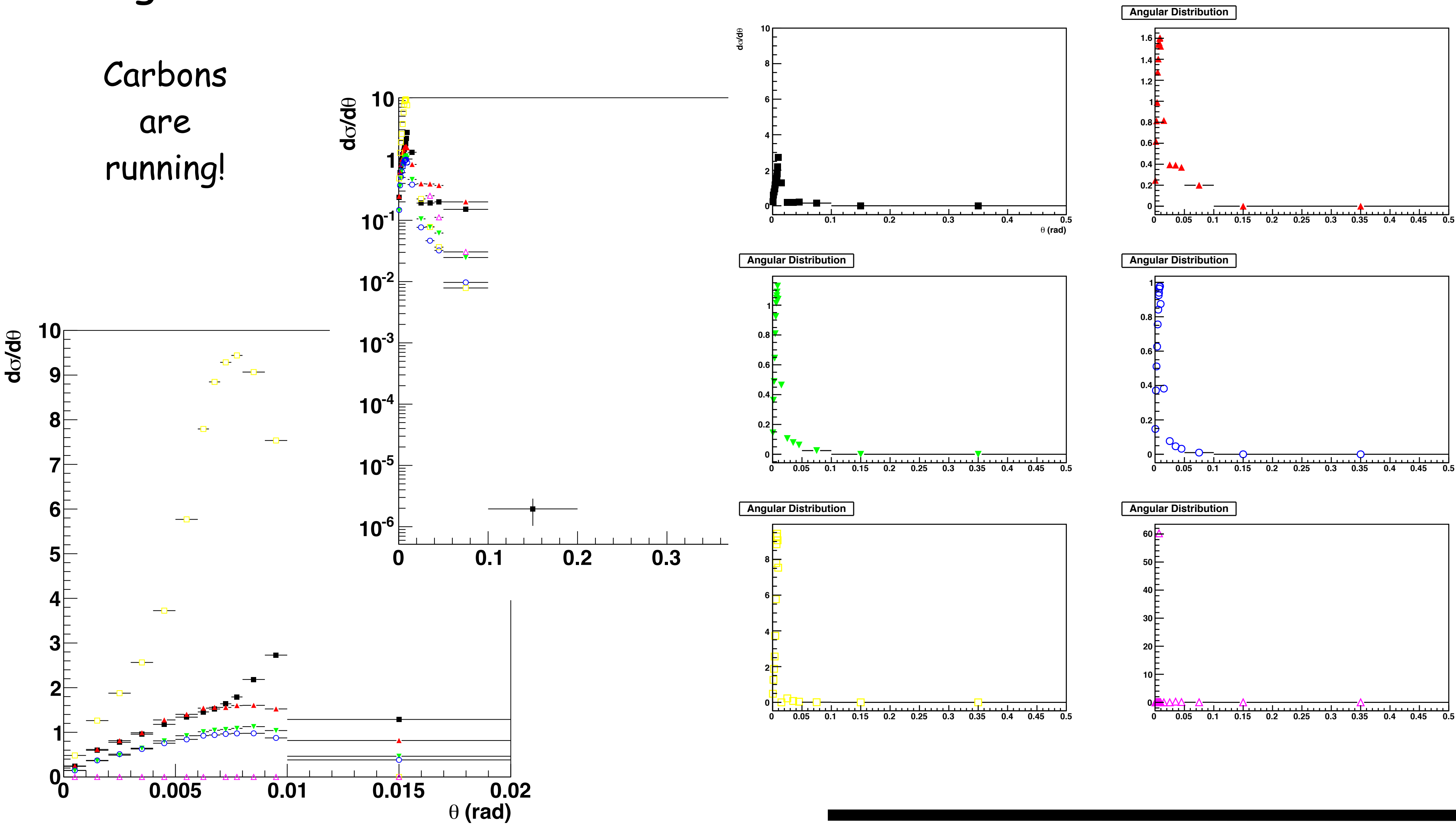




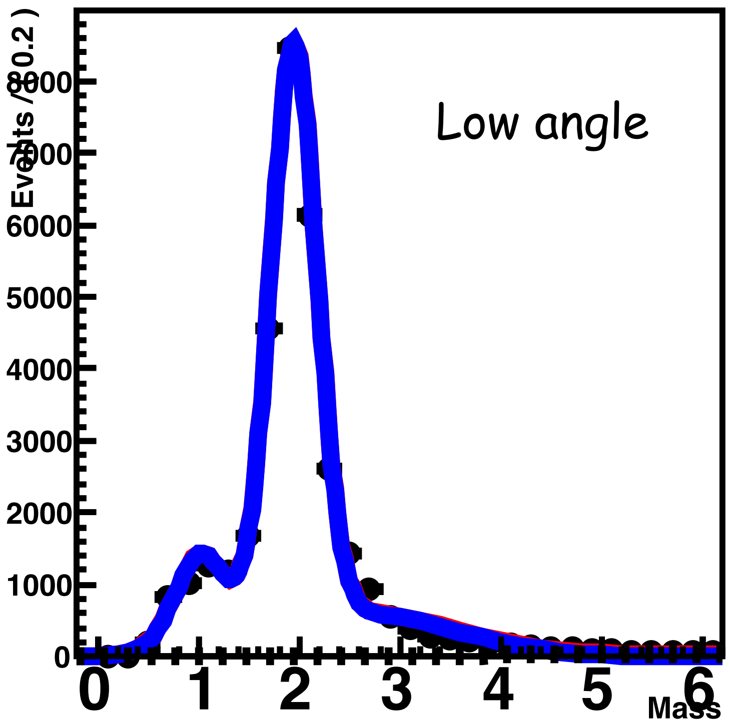
data (hyper-preliminary)

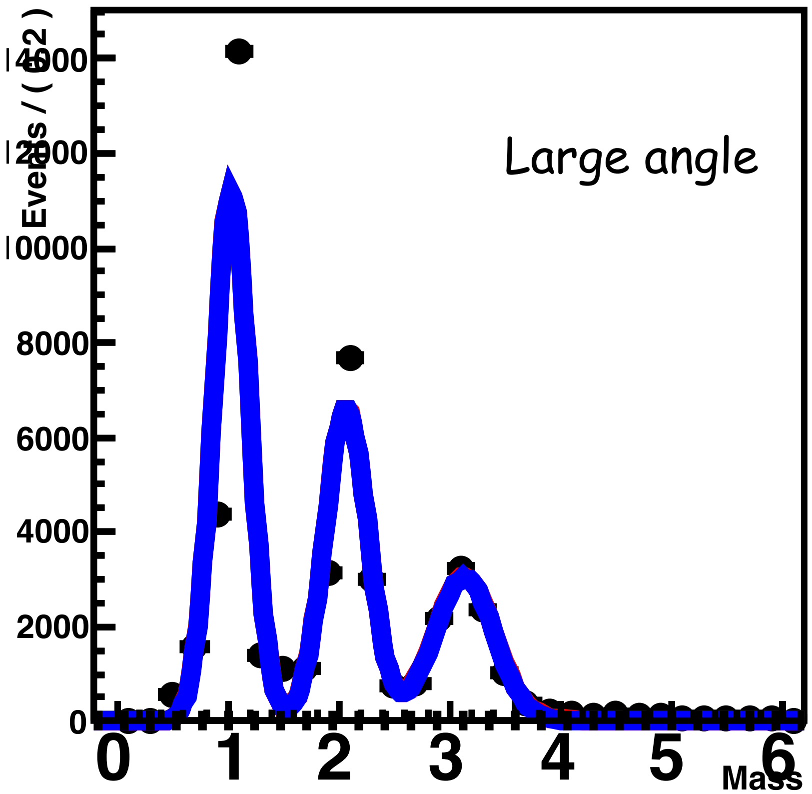
➡ Angle distributions

Carbons
are
running!

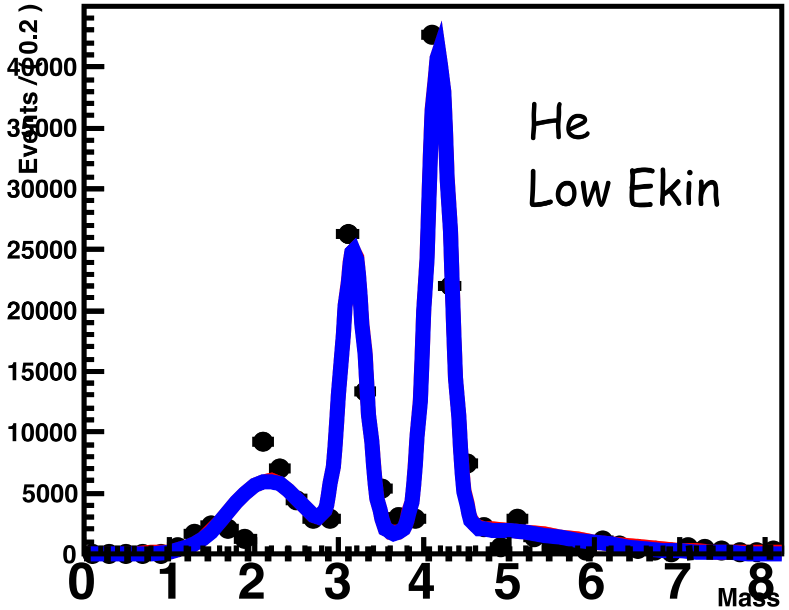


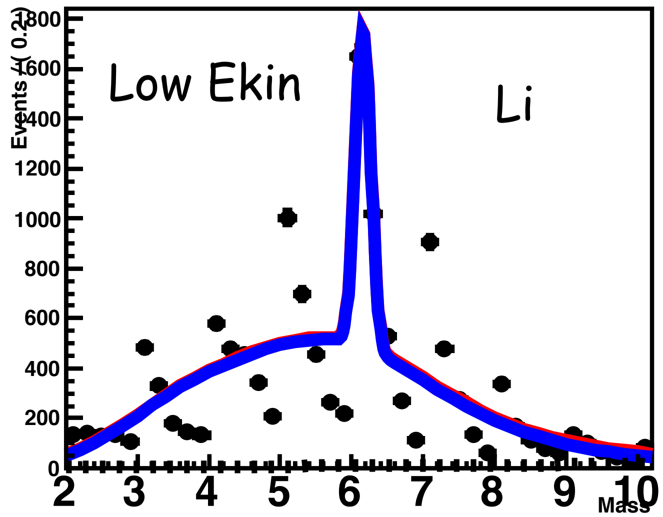
PR theta fits



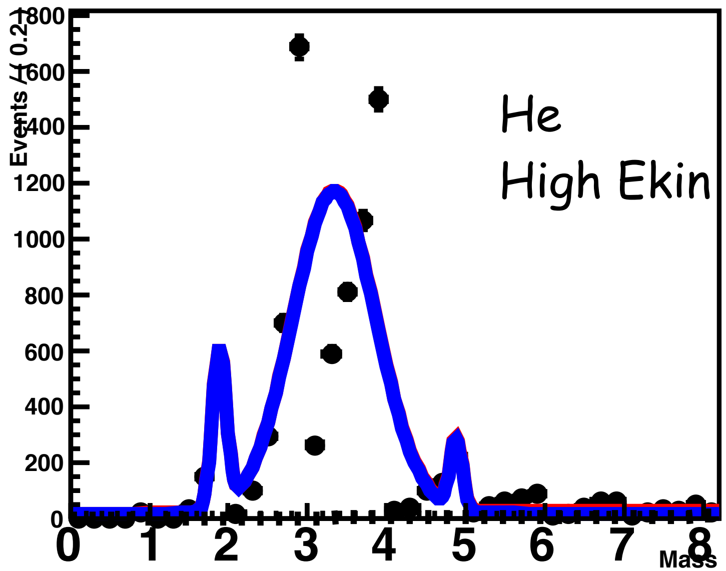


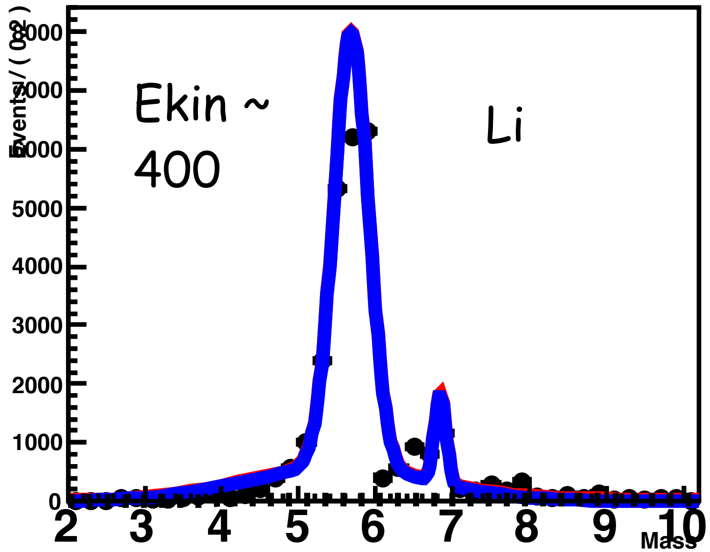
He Ekin fits

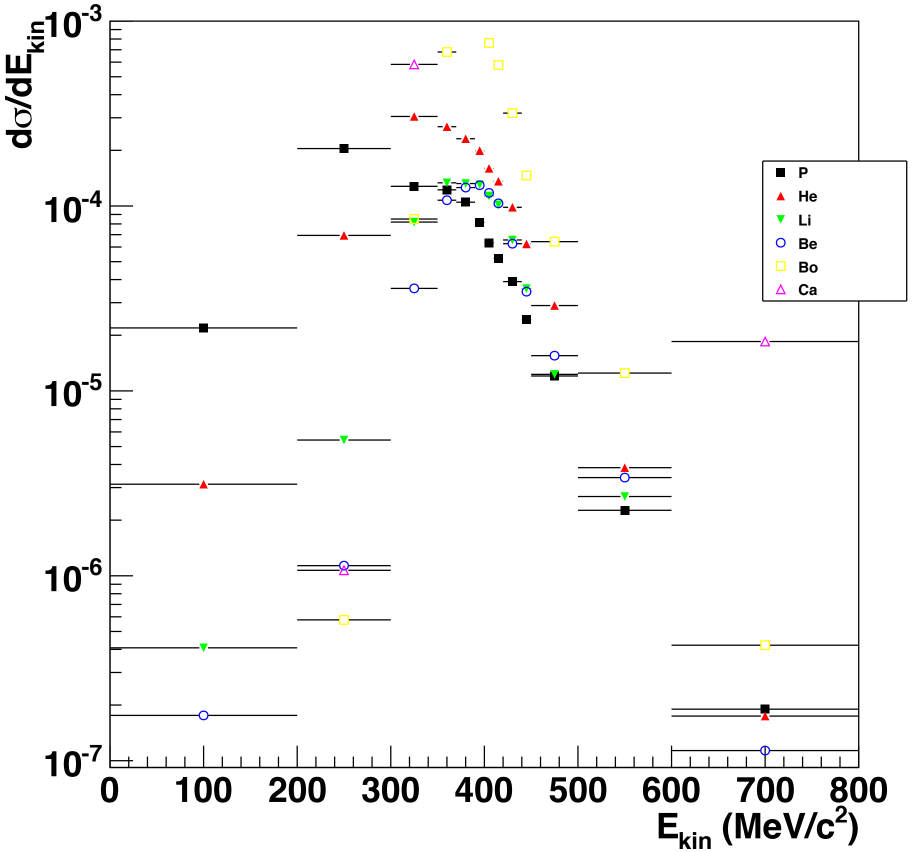




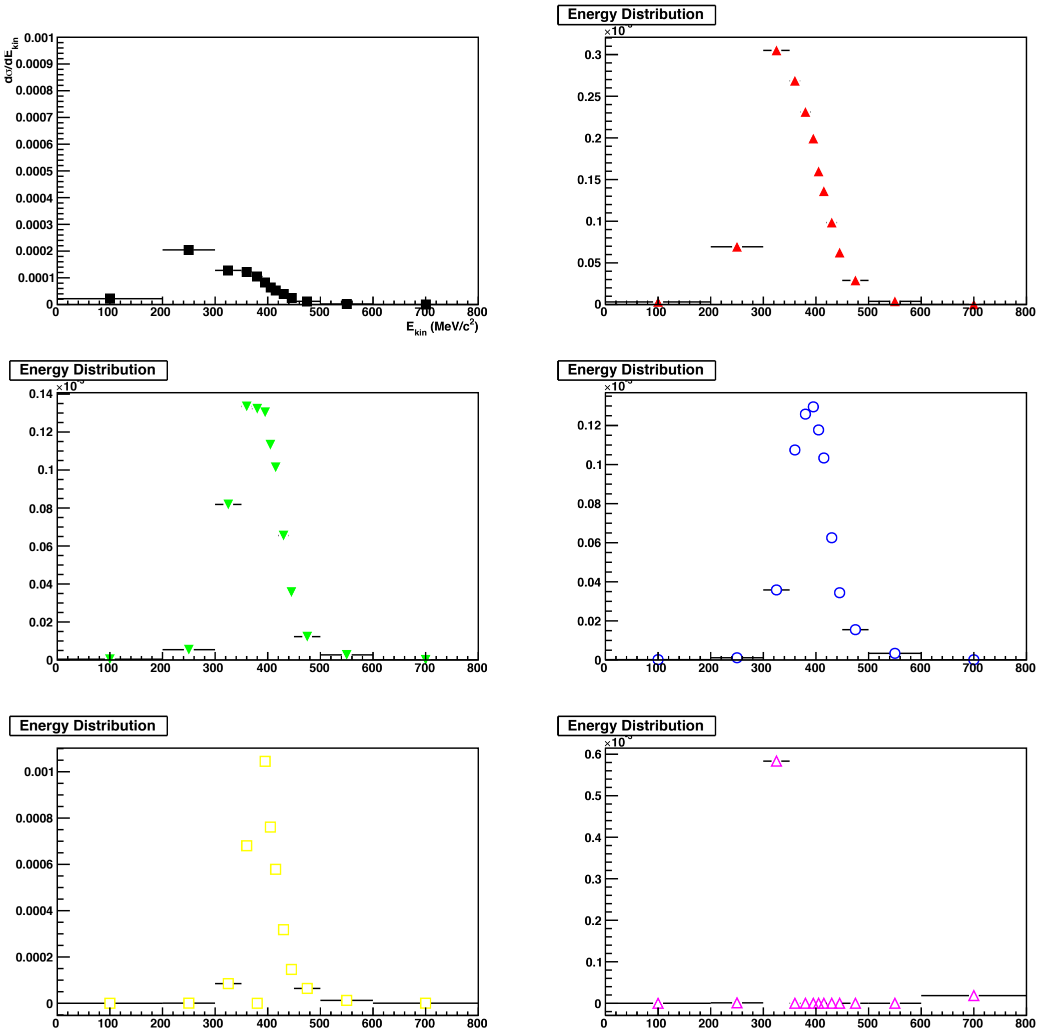
The Mass distribution observed in data still presents some **features** that have to be understood!





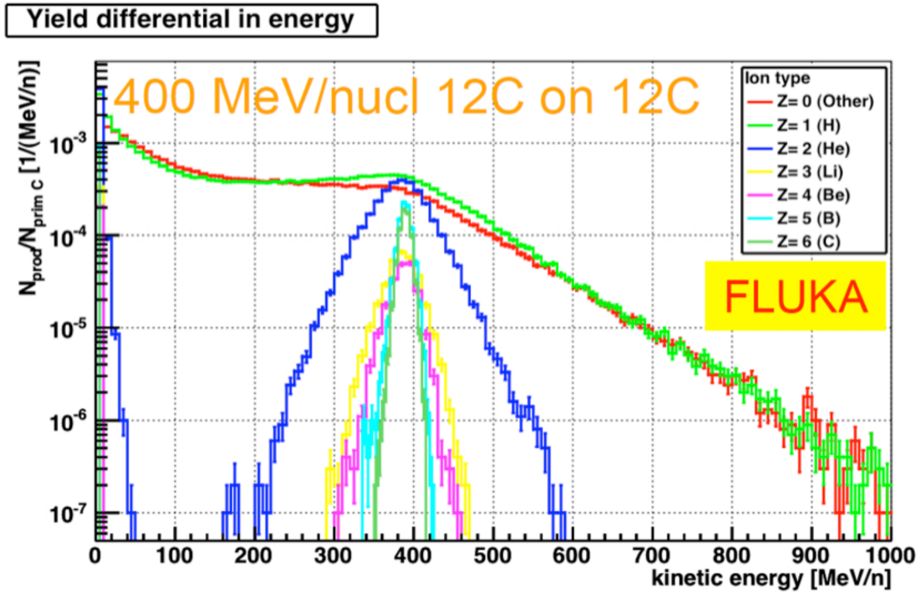


$d\sigma/dE_{kin}$
E_{kin} (MeV/c^2)
P
He
Li
Be
Bo
Ca

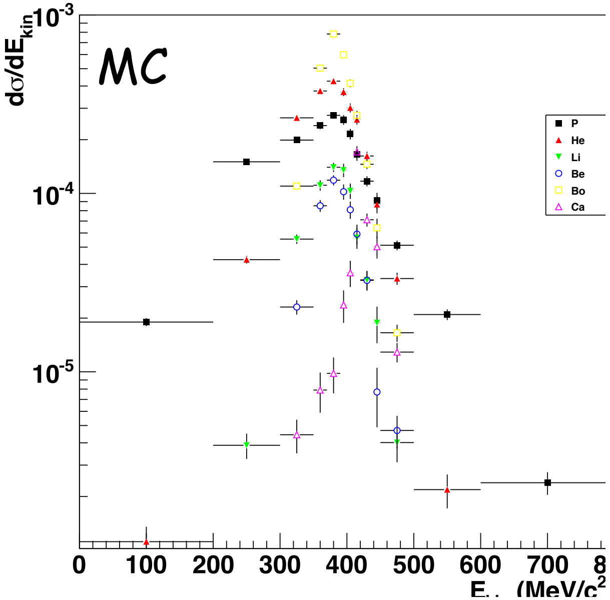


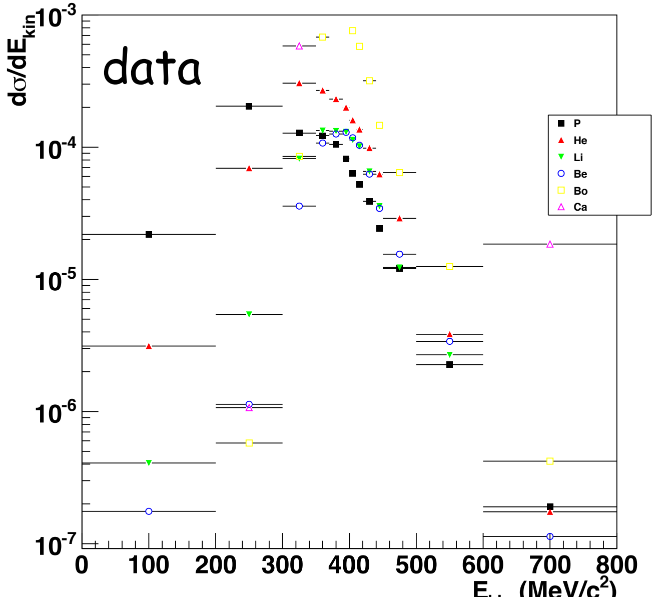
Energy Distribution
E_{kin} (MeV/c^2)

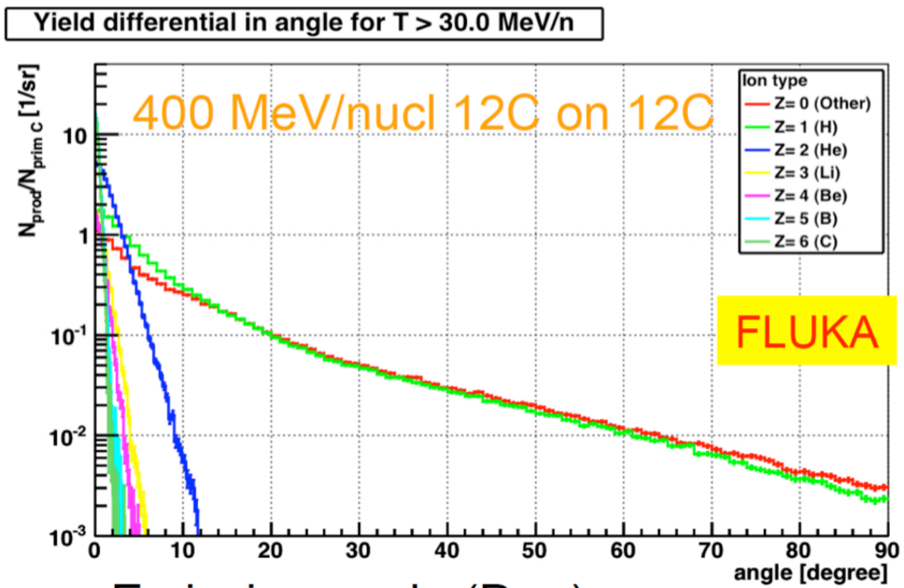
data summary



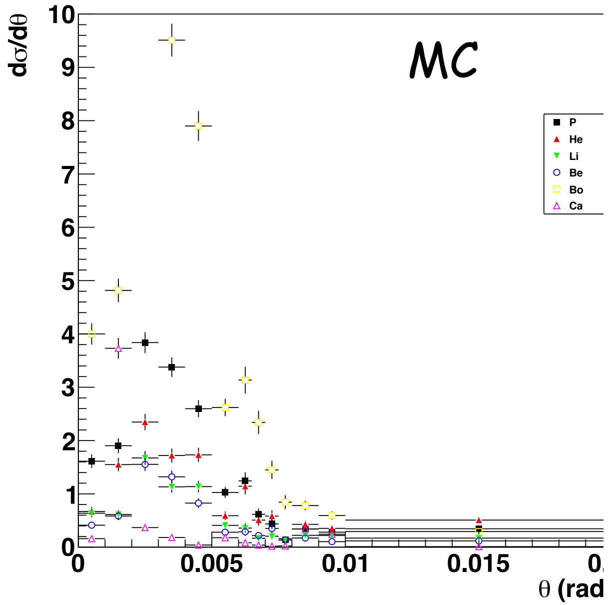
Kinetic energy (MeV/nucl)

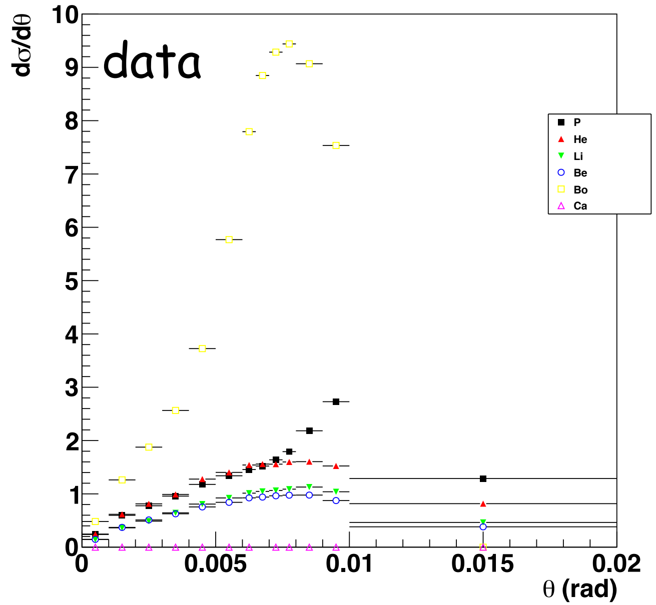






Emission angle (Deg)

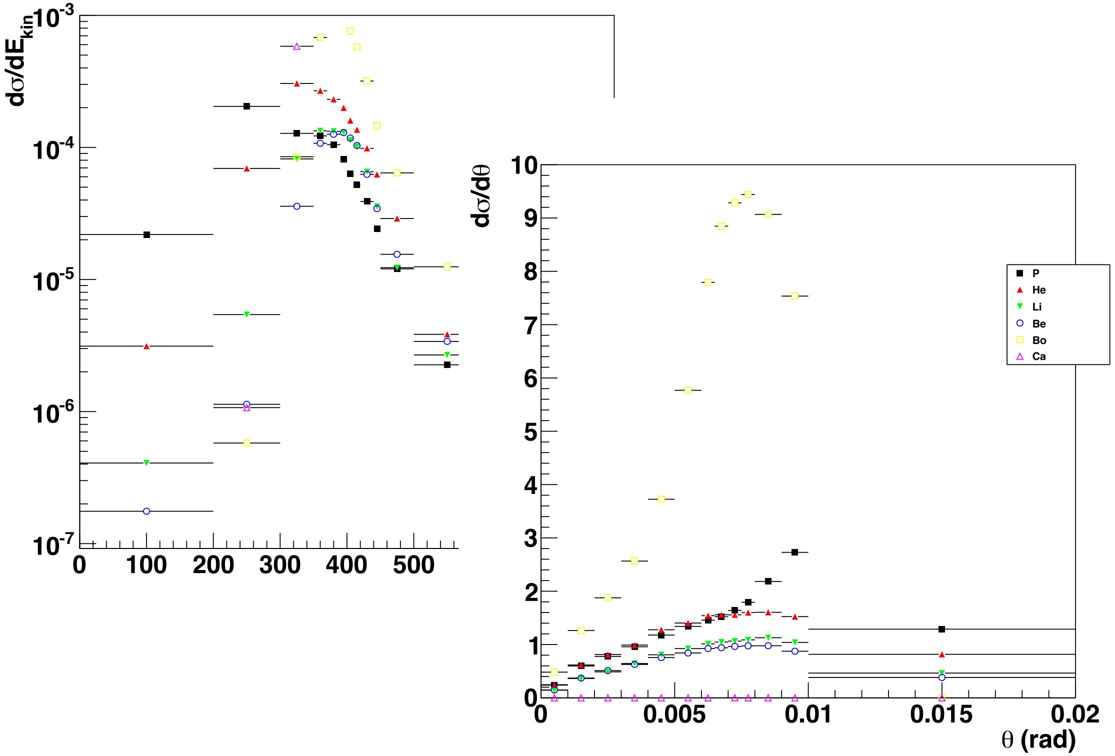


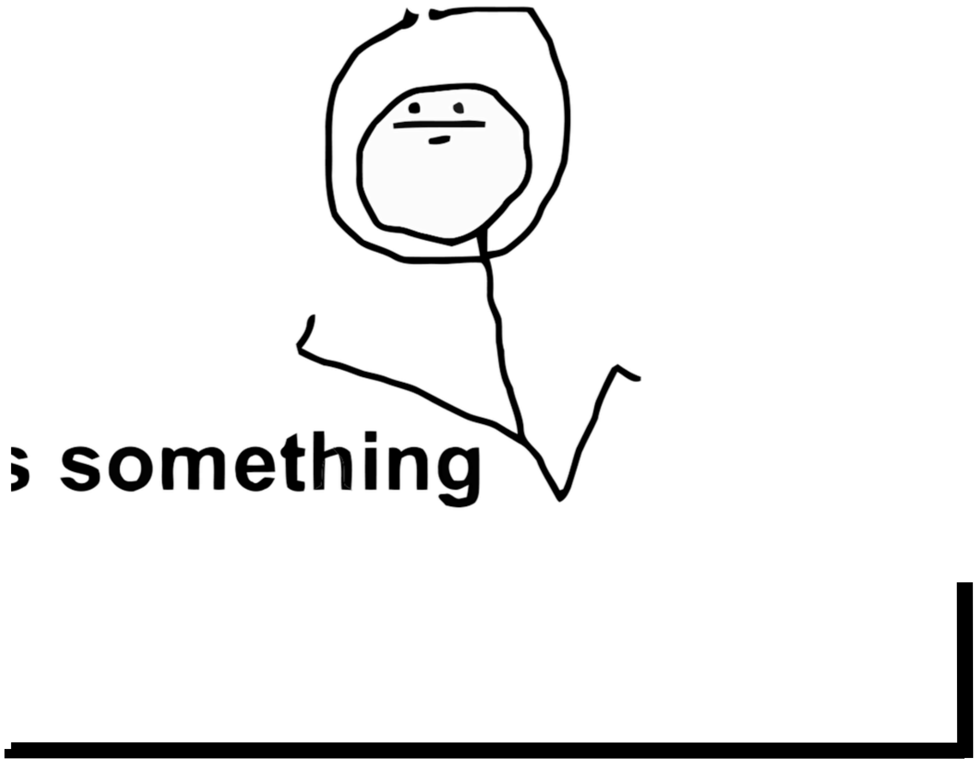


June 2012

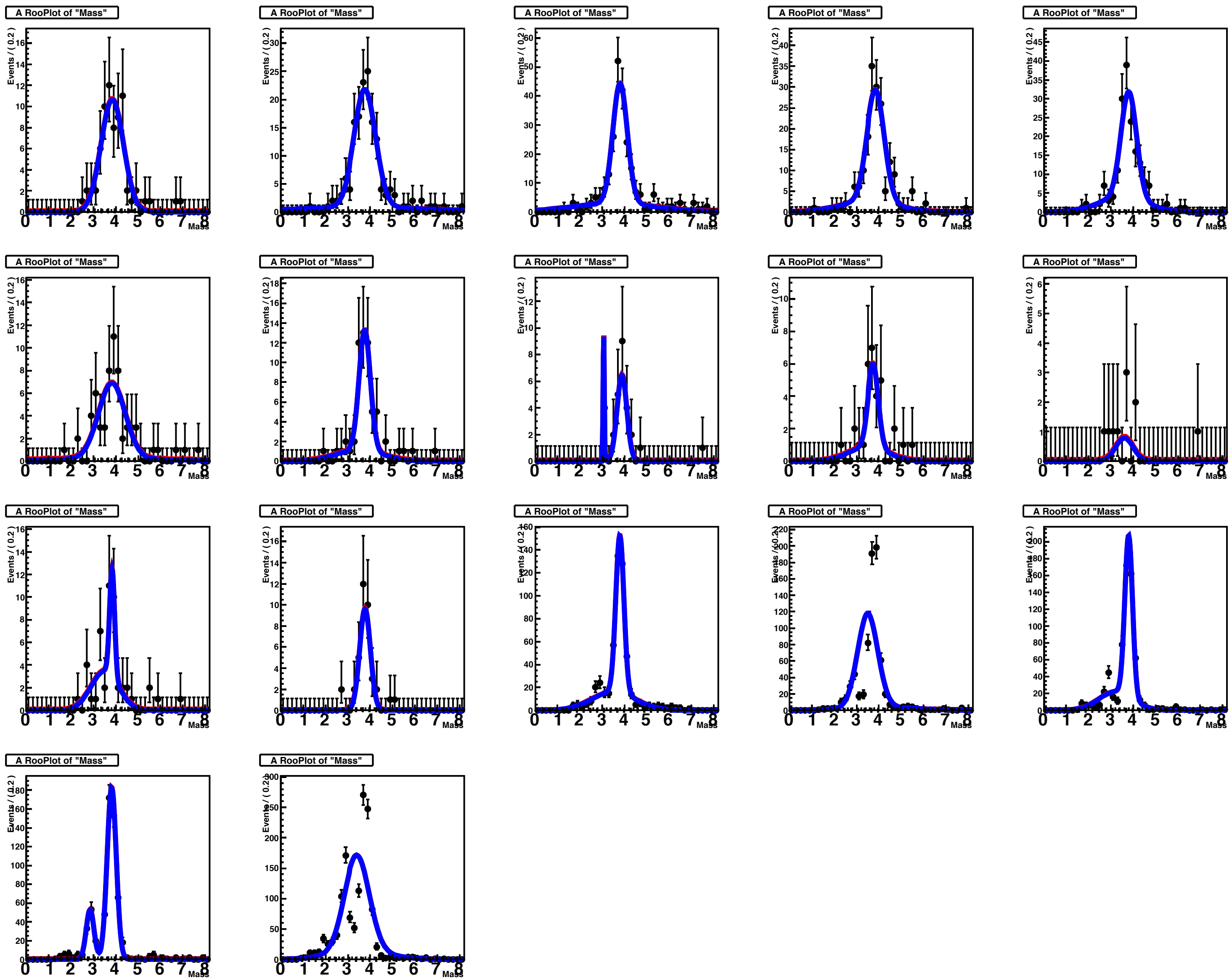
Summary

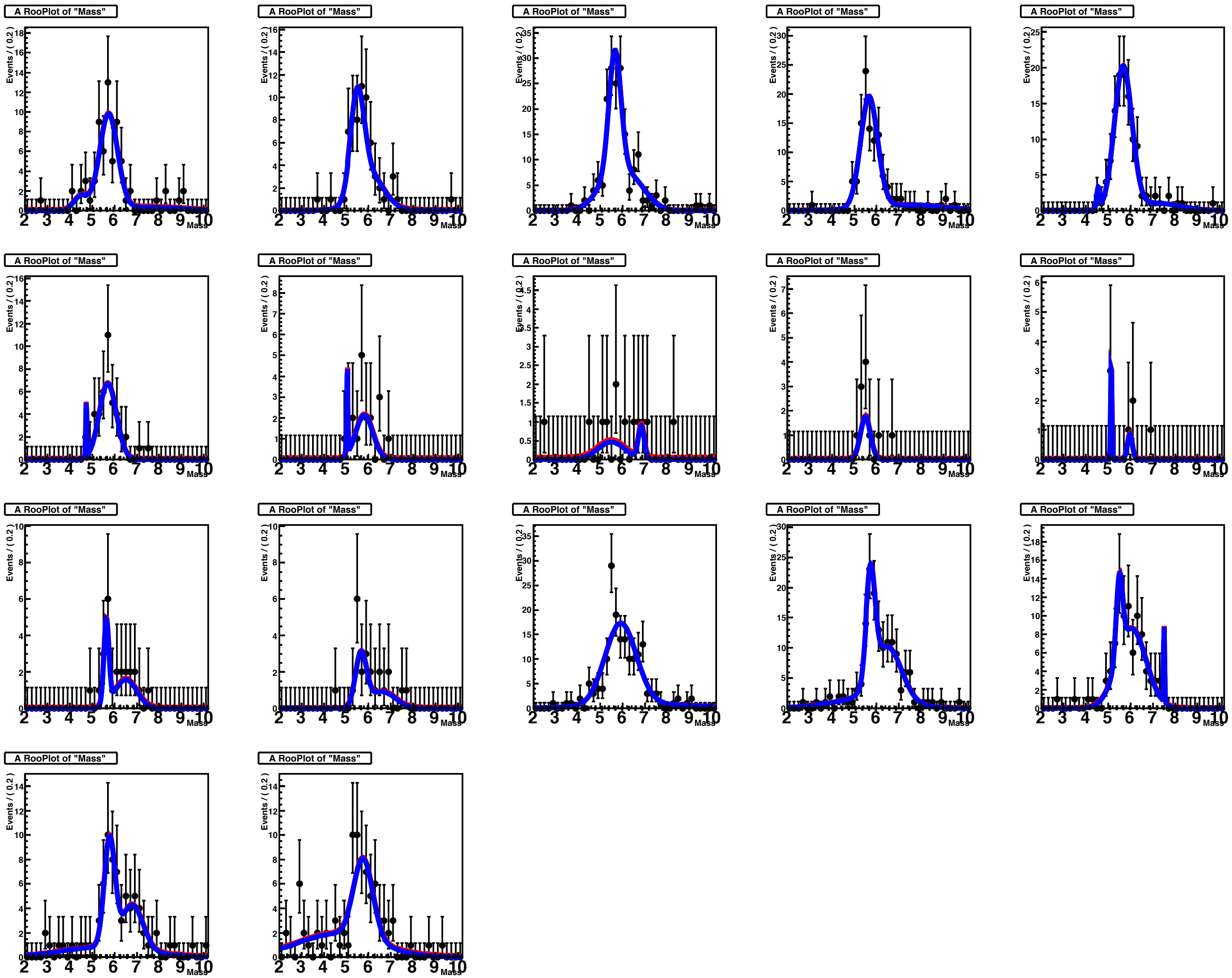
- Machinery to compute DDCS is already in place
  - but before doing that we need to understand the structures, validate the MC, improve the fit models....
  - And then : understand better our MC, the ToF charge ID, etc etc
- Ok... not everything is really under control.. but...





Spares


A RooPlot of "Mass"
Events / (0.2)
Mass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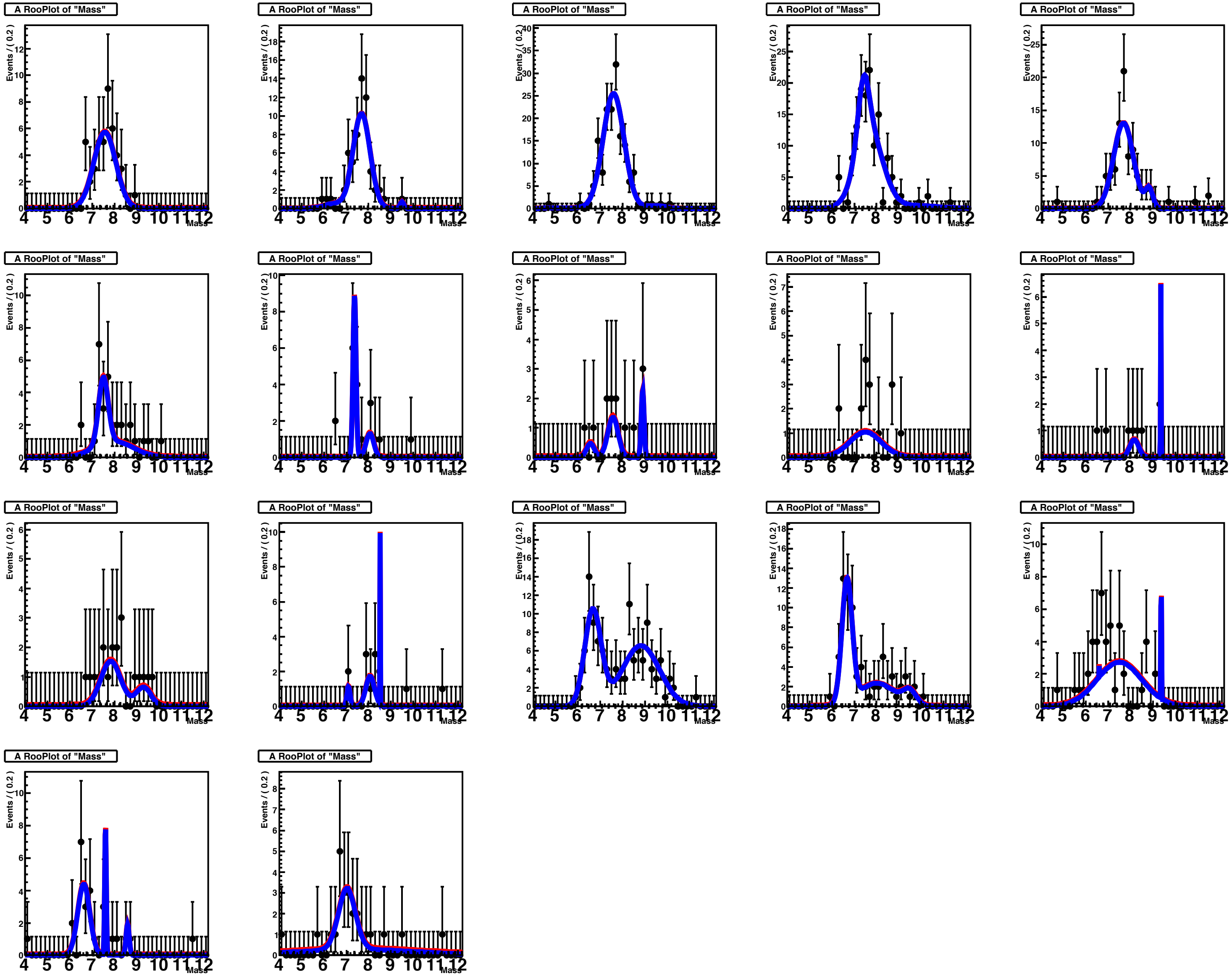
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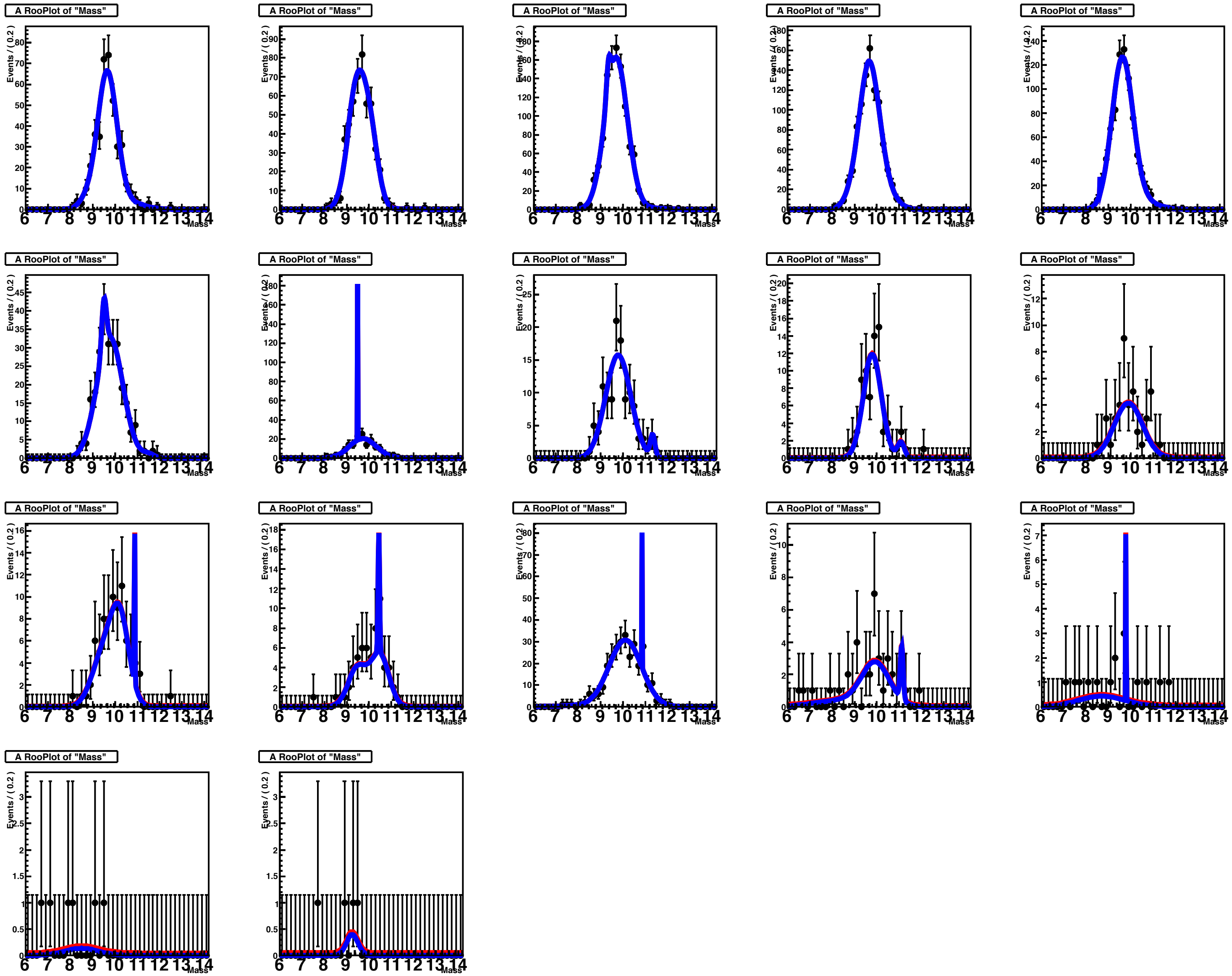
Events / (0.2)
Mass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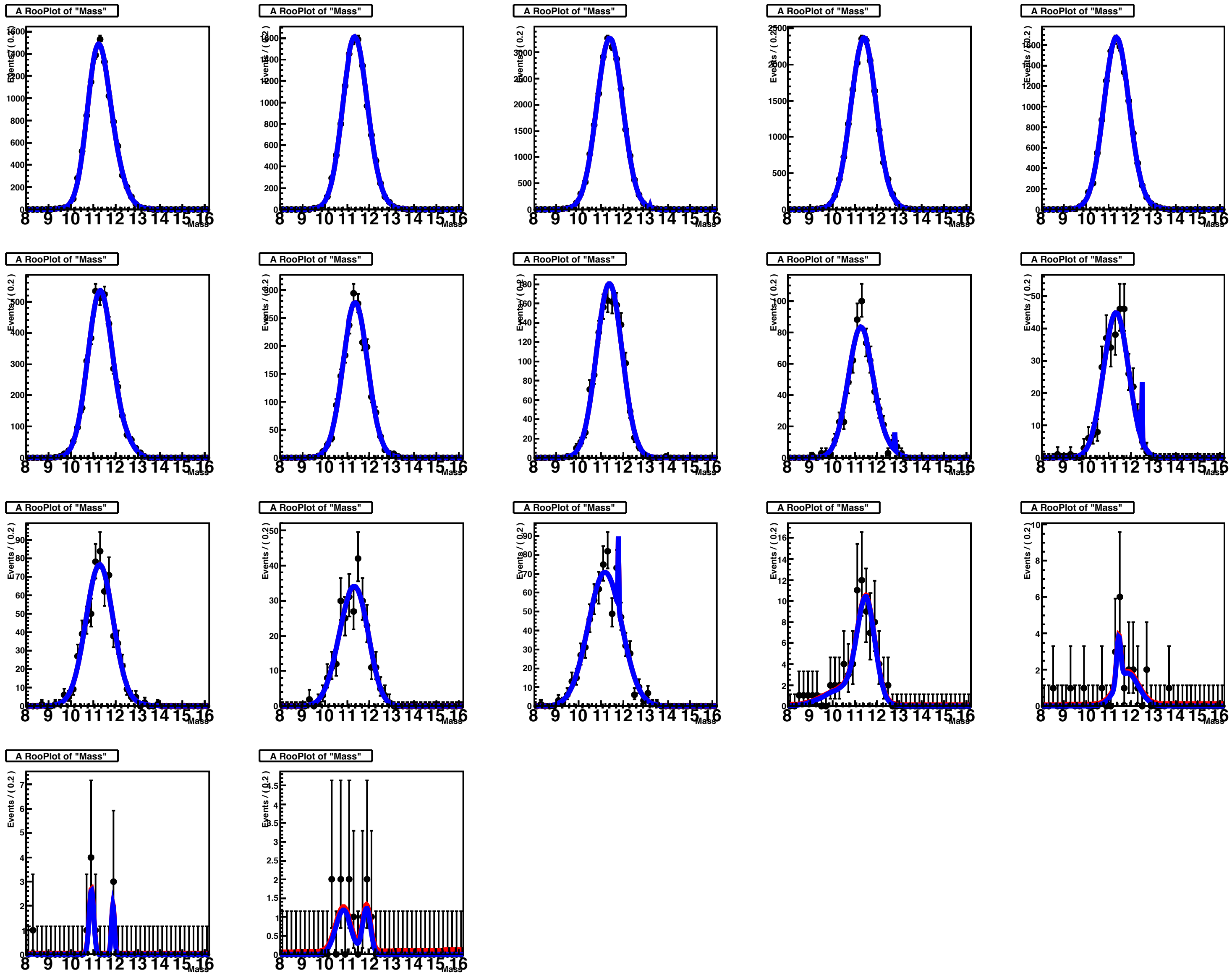
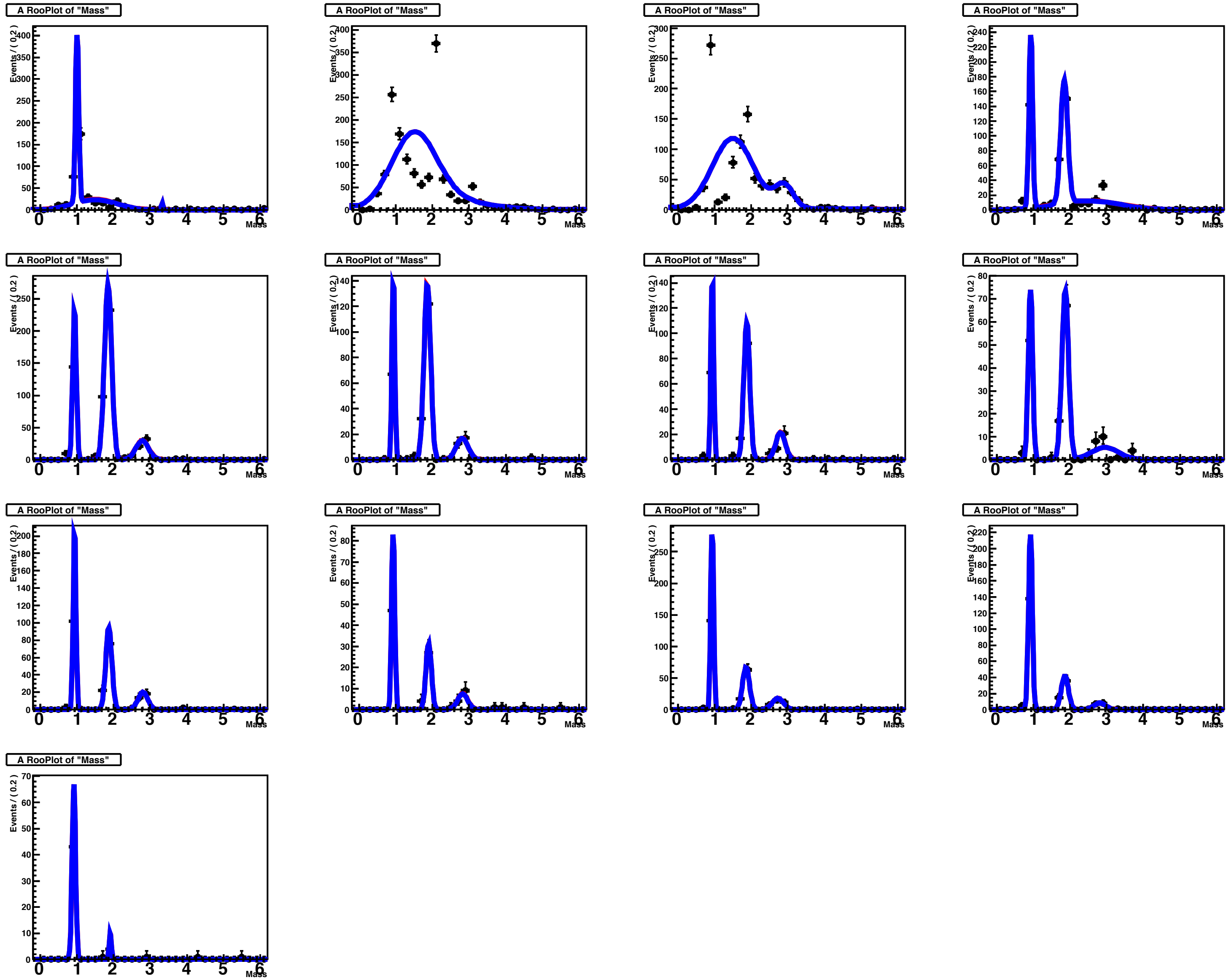
Mass

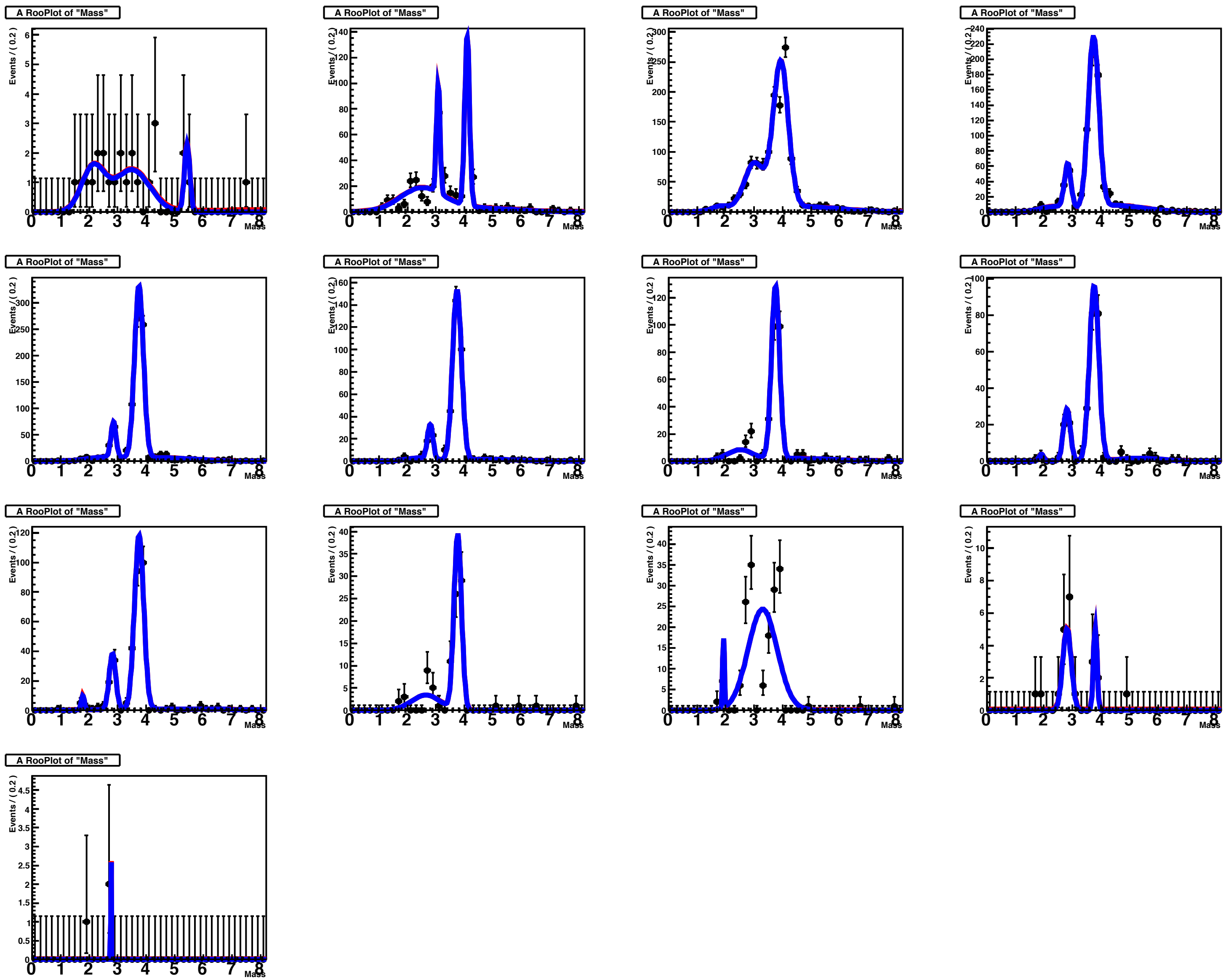

A RooPlot of "Mass"
Events / (0.2)
Mass

MC ekin

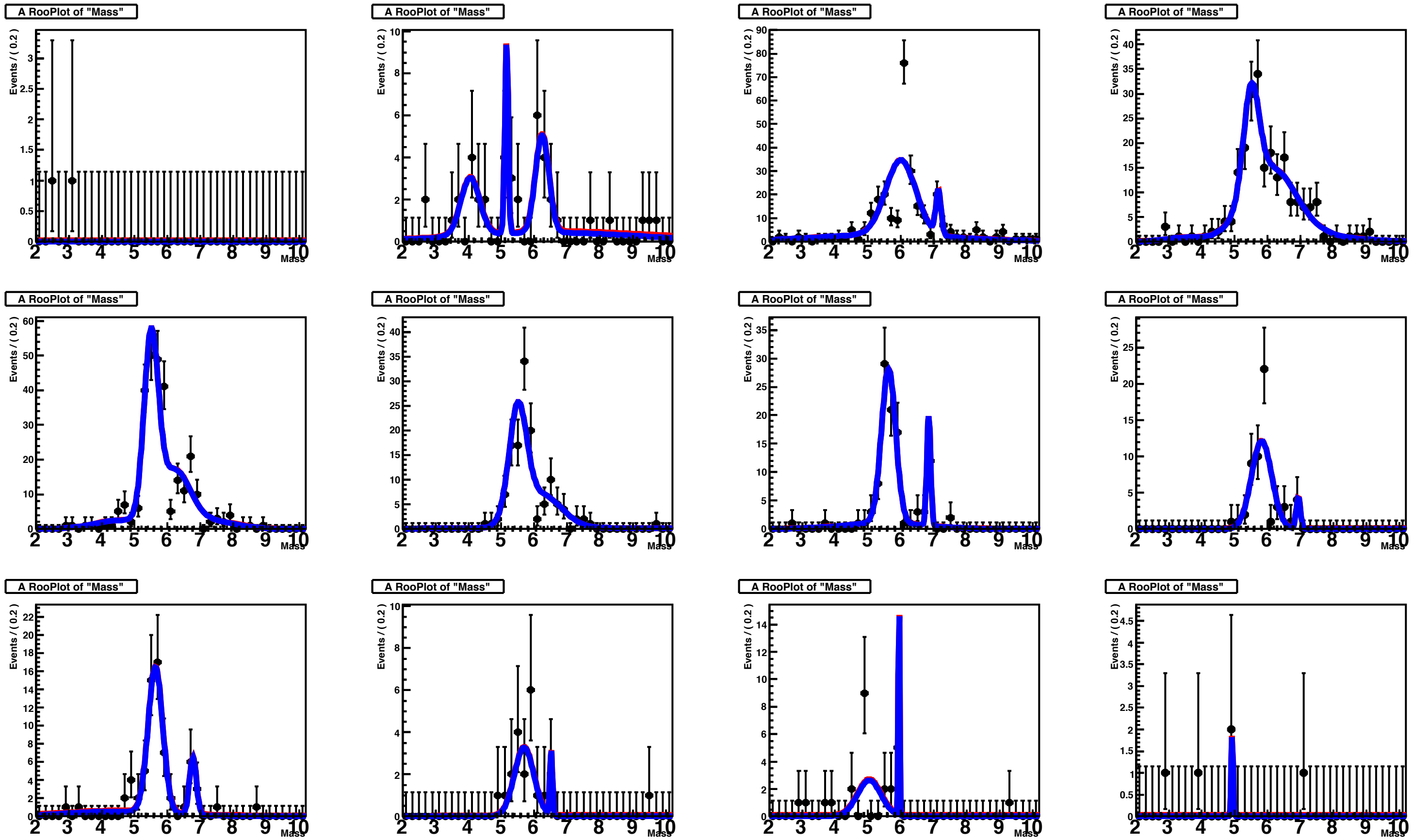
Ekin PR



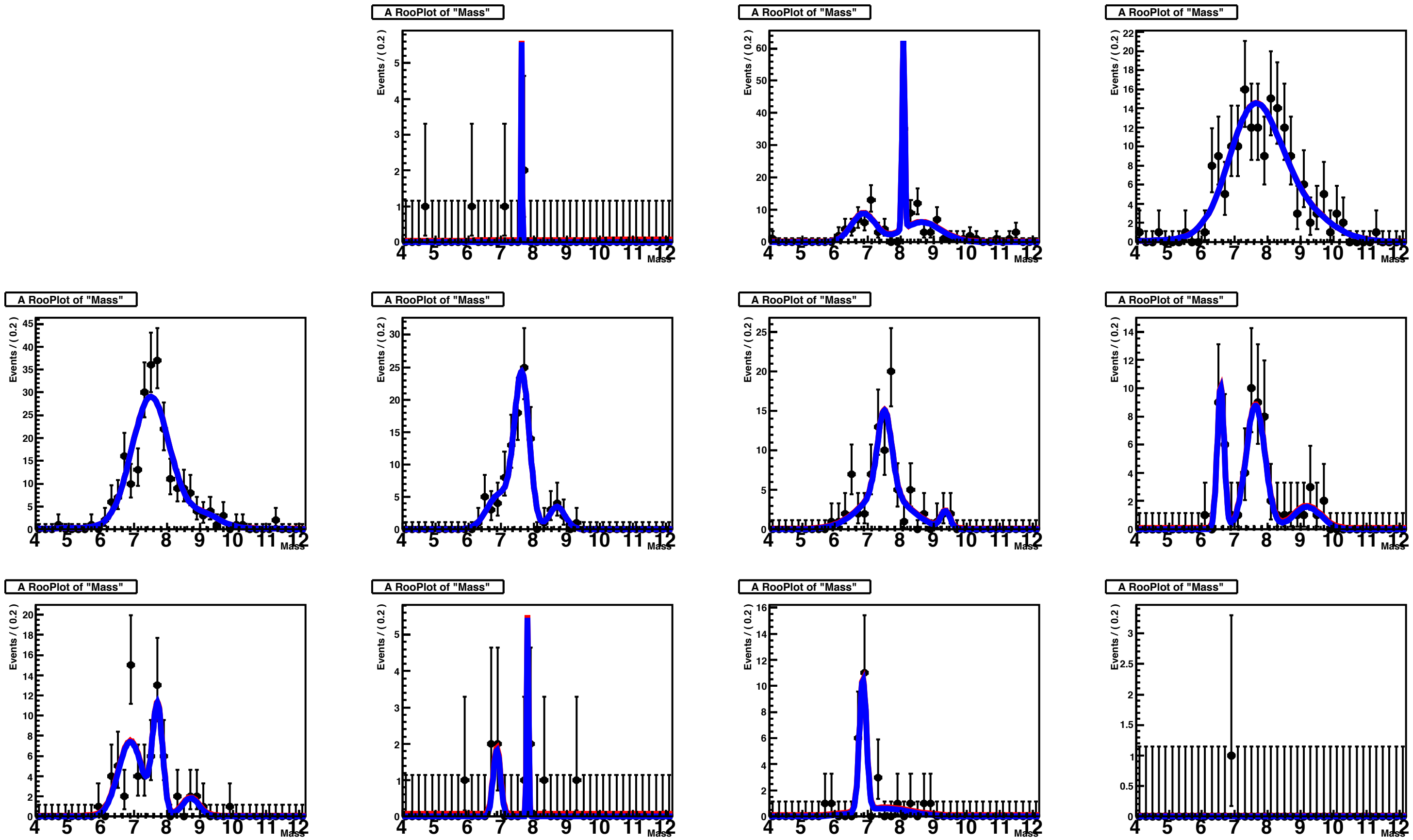
Ekin fits He



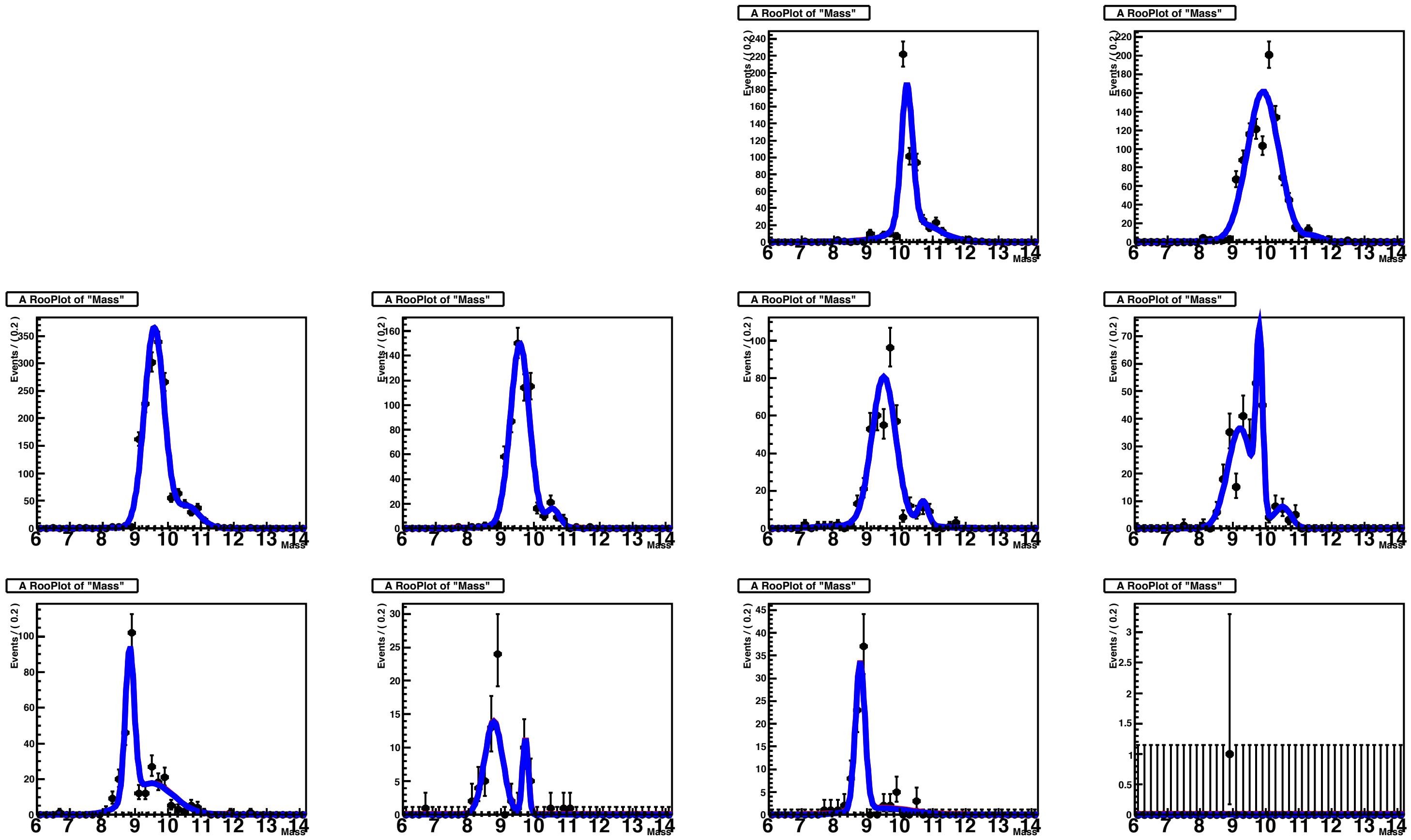
Ekin Li



Ekin Be



Ekin Bo



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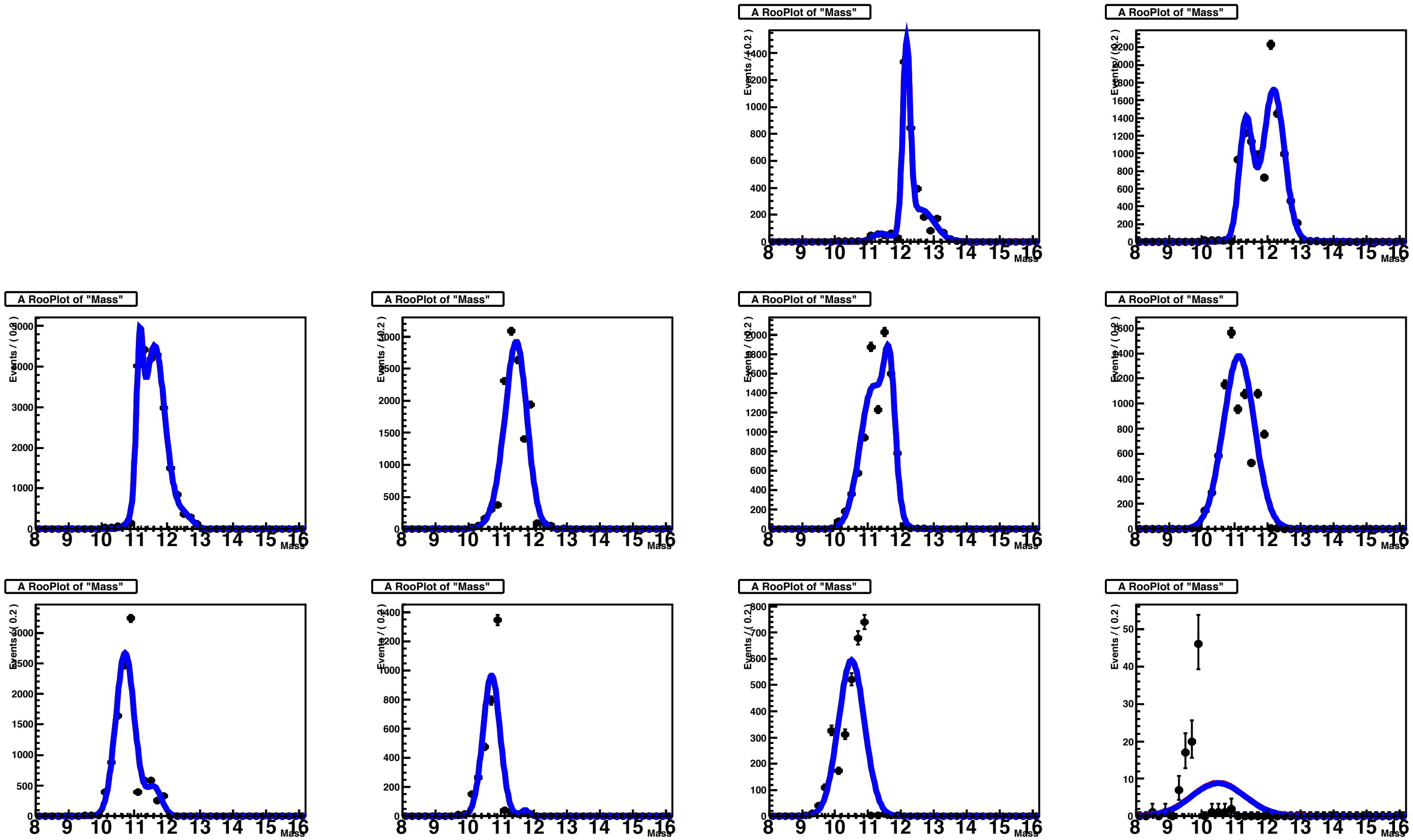

Data theta

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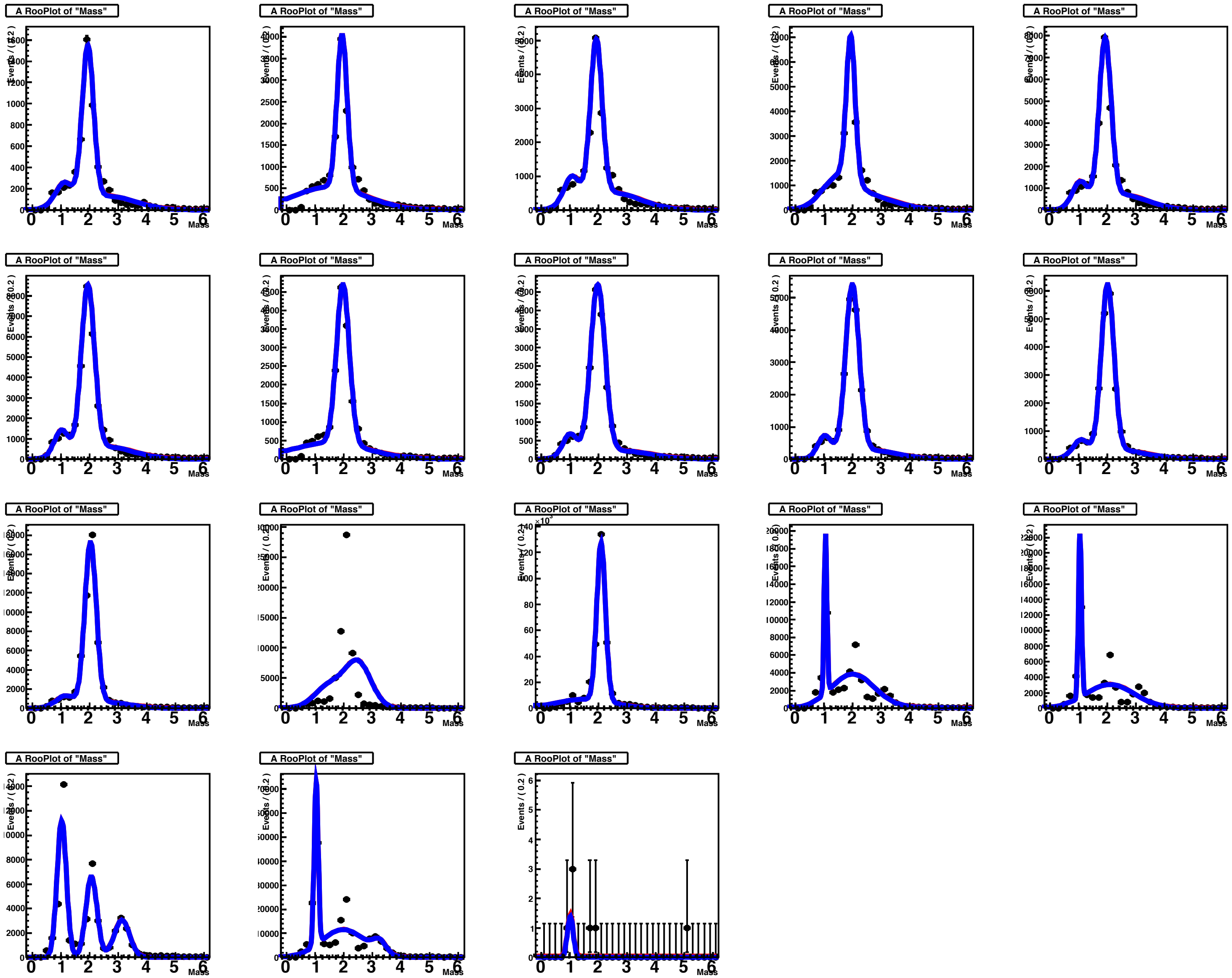

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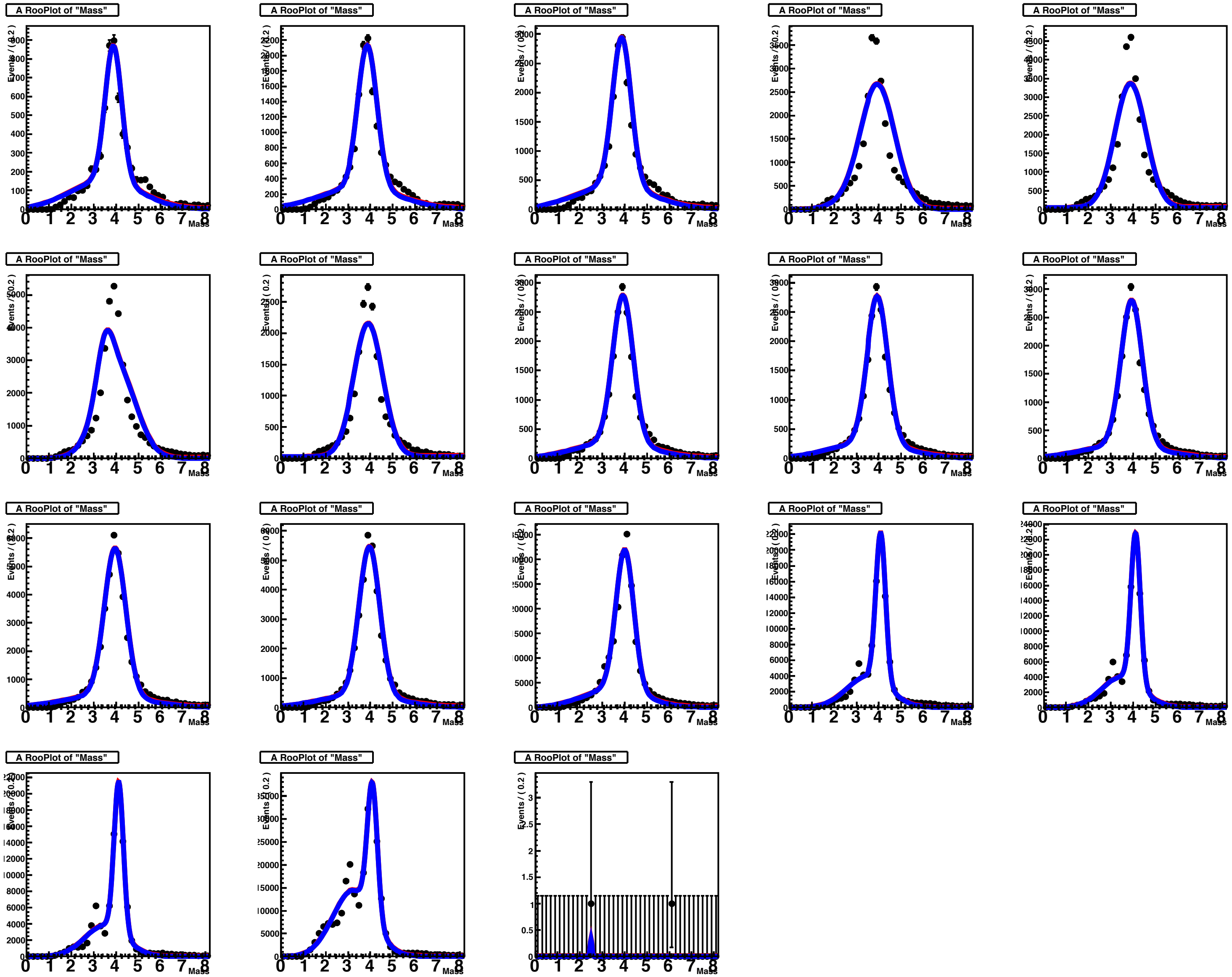

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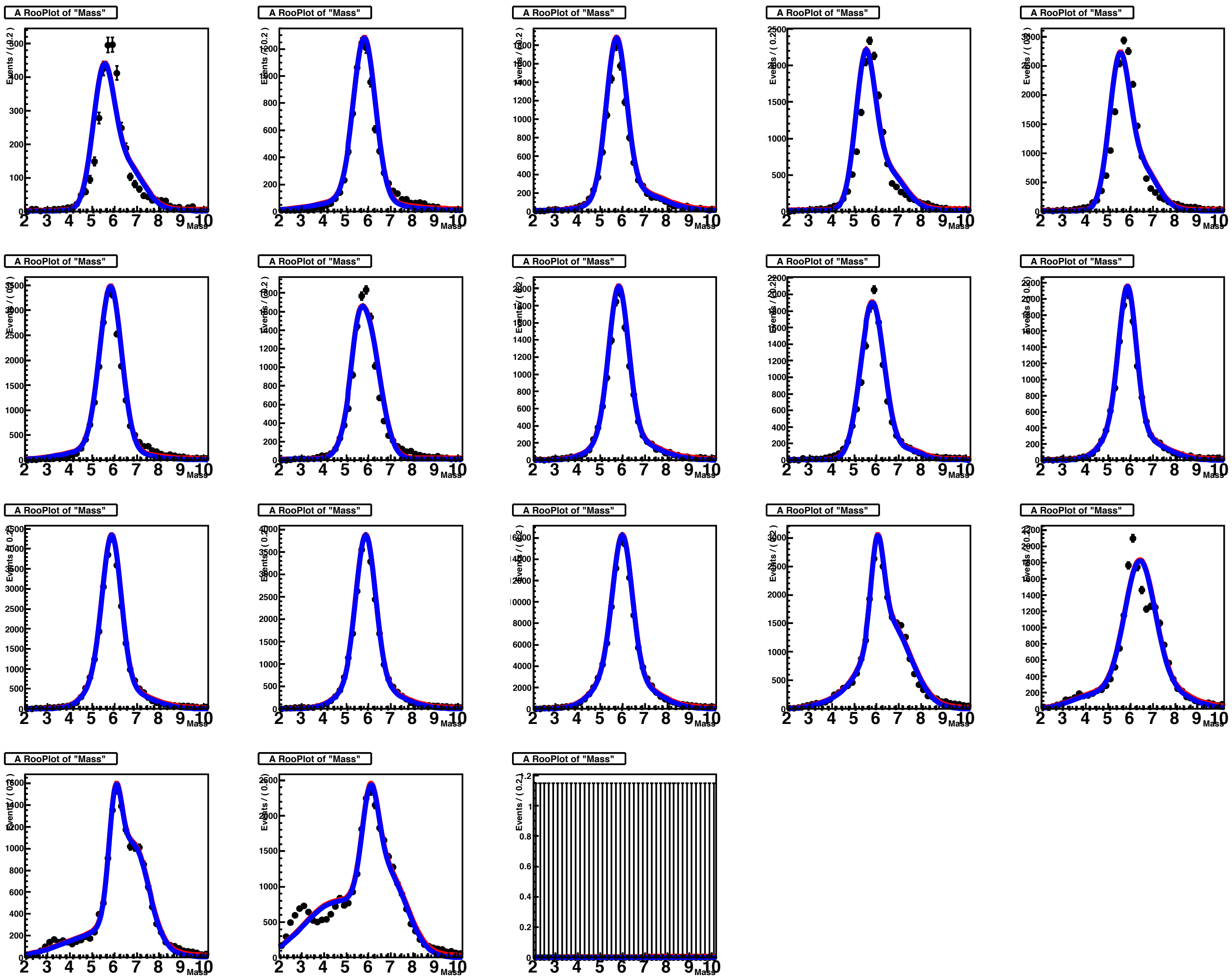

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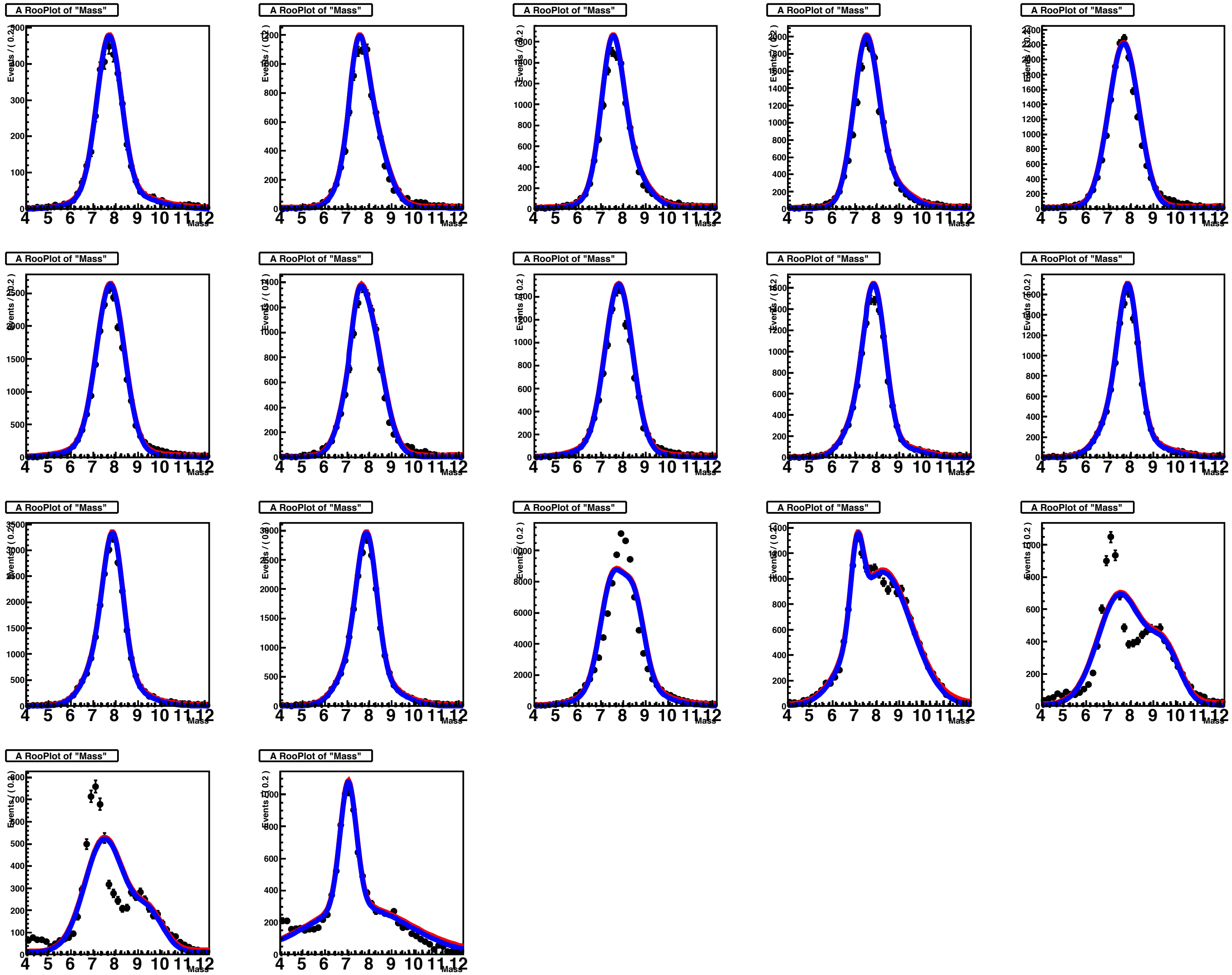
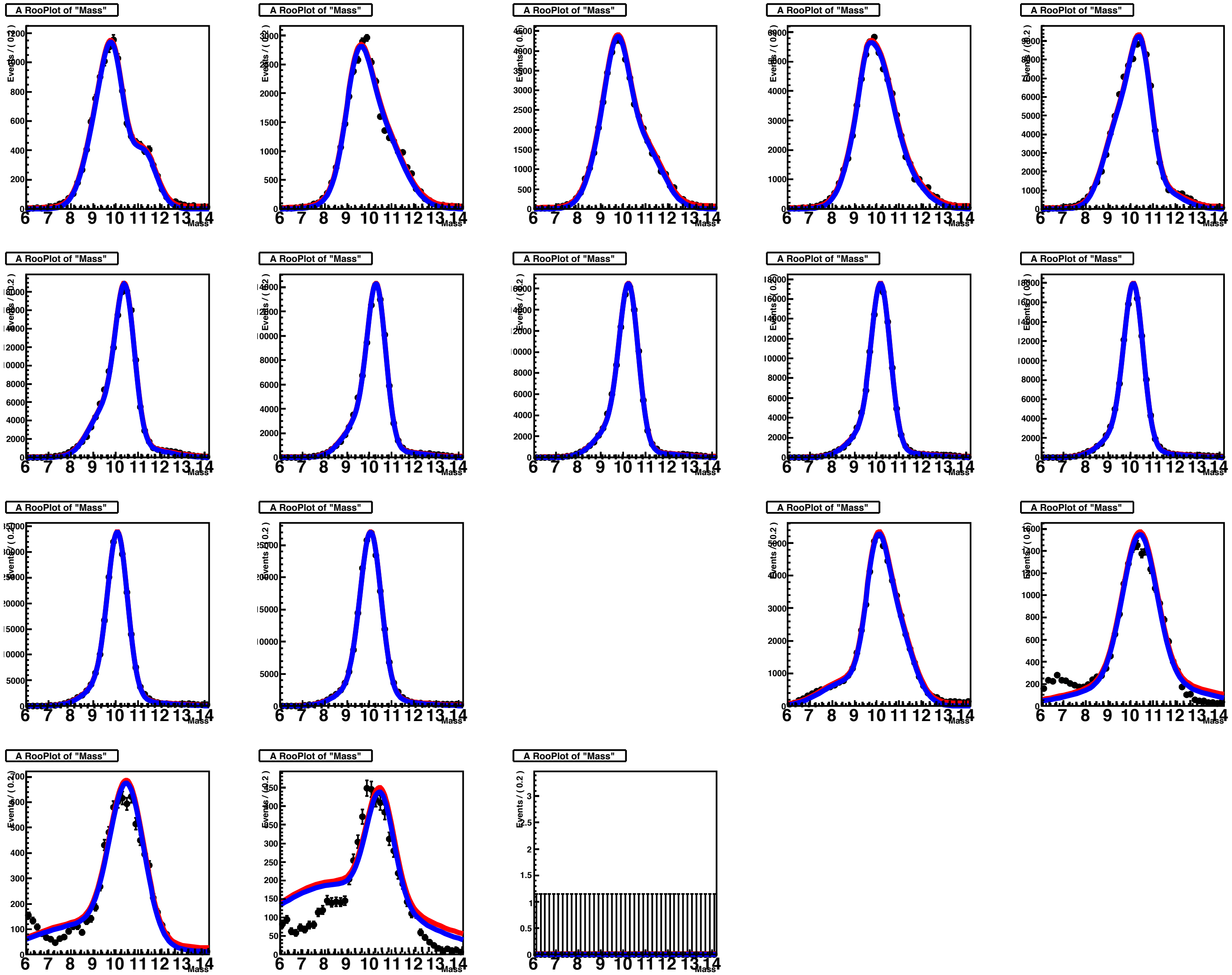
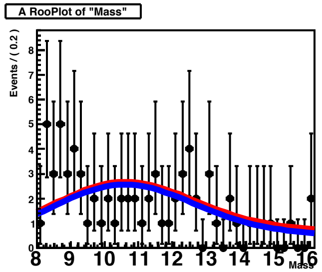
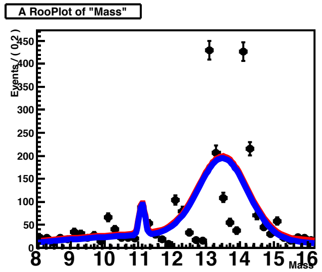



A RooPlot of "Mass"
Mass
6 7 8 9 10 11 12 13 14

OOORGH


A RooPlot of "Mass"
Events / (0.2)
Mass


A RooPlot of "Mass"
Events / (0.2)
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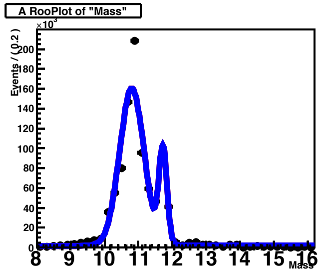
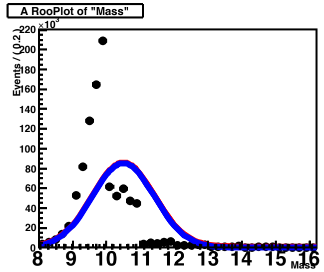

A RooPlot of "Mass"
Events / (0.2)
Mass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Events / (0.2)
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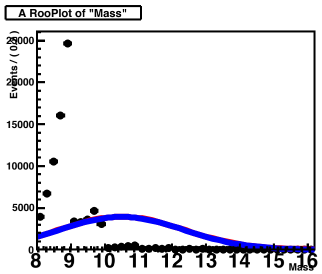
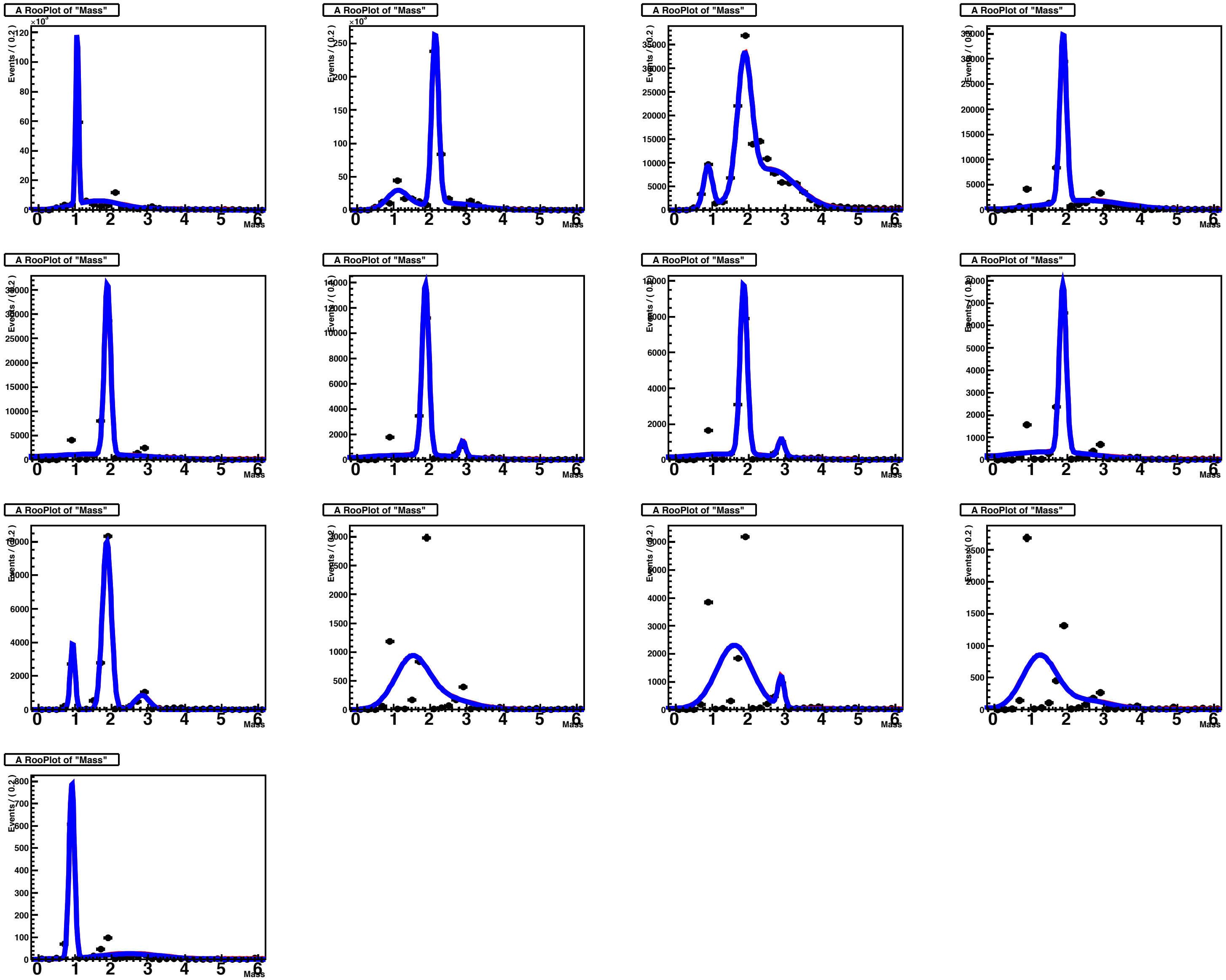

A RooPlot of "Mass"
Events / (0.2)
Mass

Data Ekin

Pr



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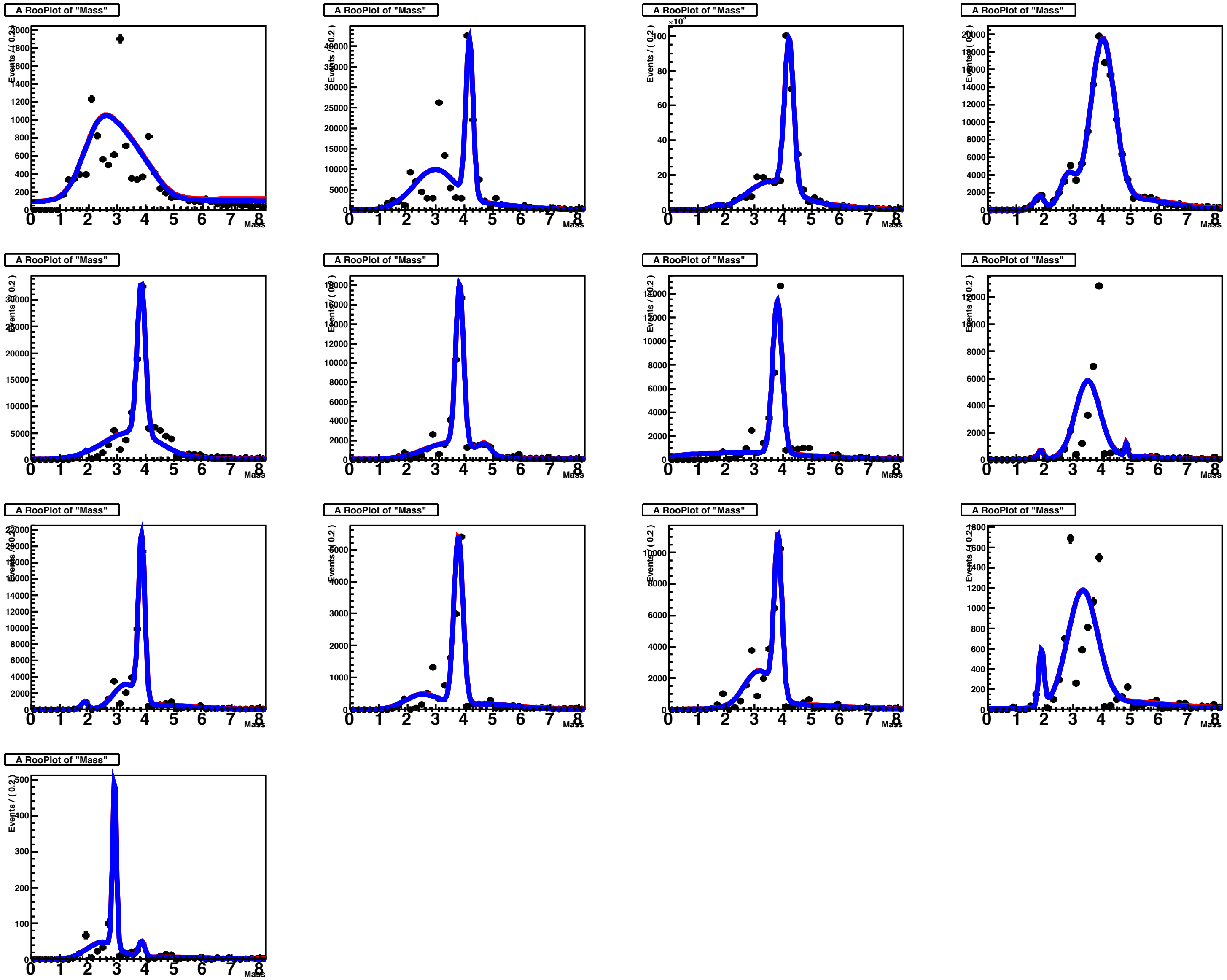

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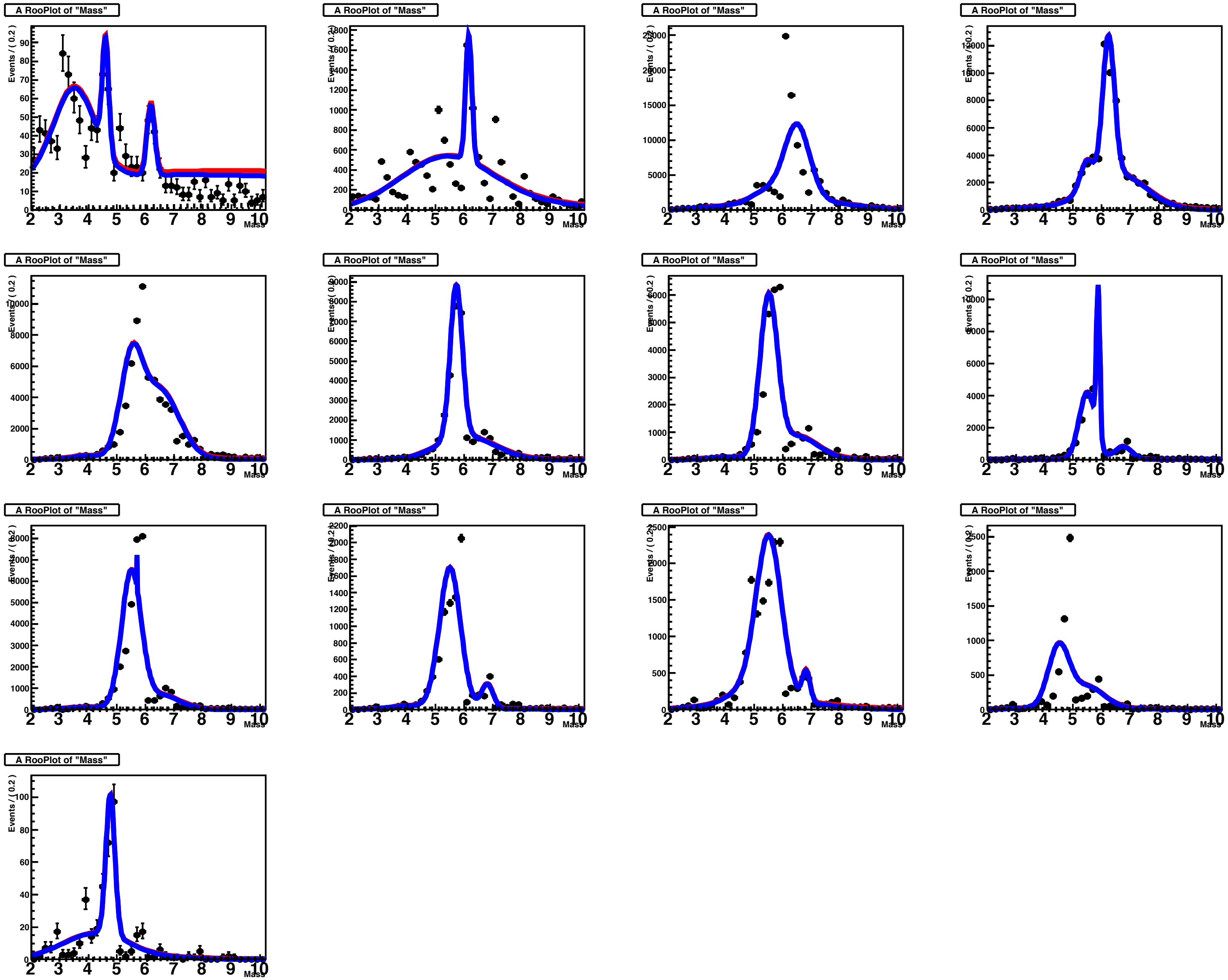

Z_ID performances

- Current best bet:
  - algorithm based on the Bethe Block formula (ToF vs Light) to identify "cutting regions"
  - A "Raw charge ID" algorithm (projecting everything against the Light axis) is compared as well