

Comparison checks of simulation and reconstruction codes

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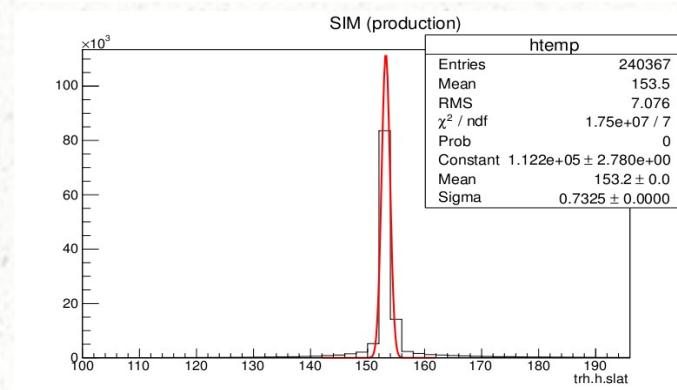
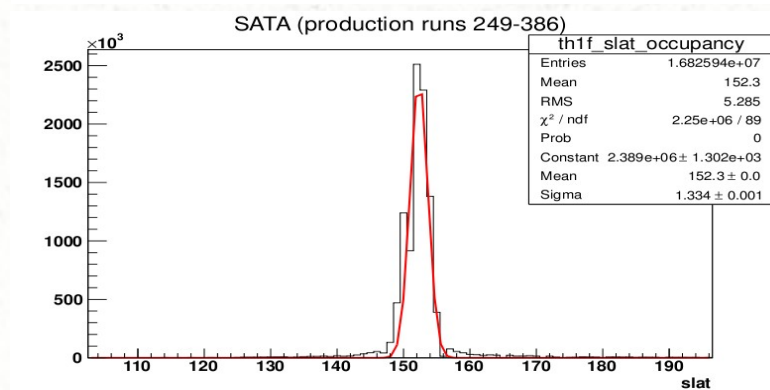
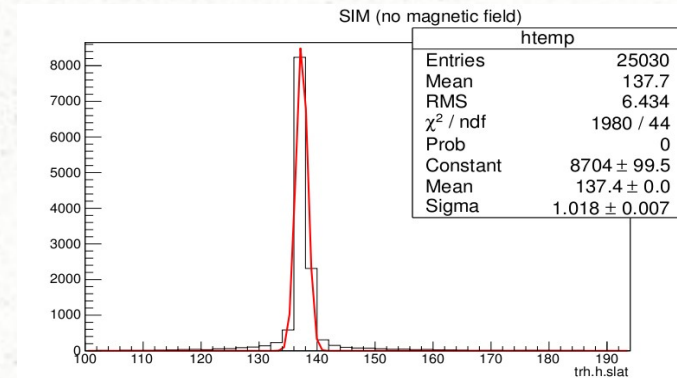
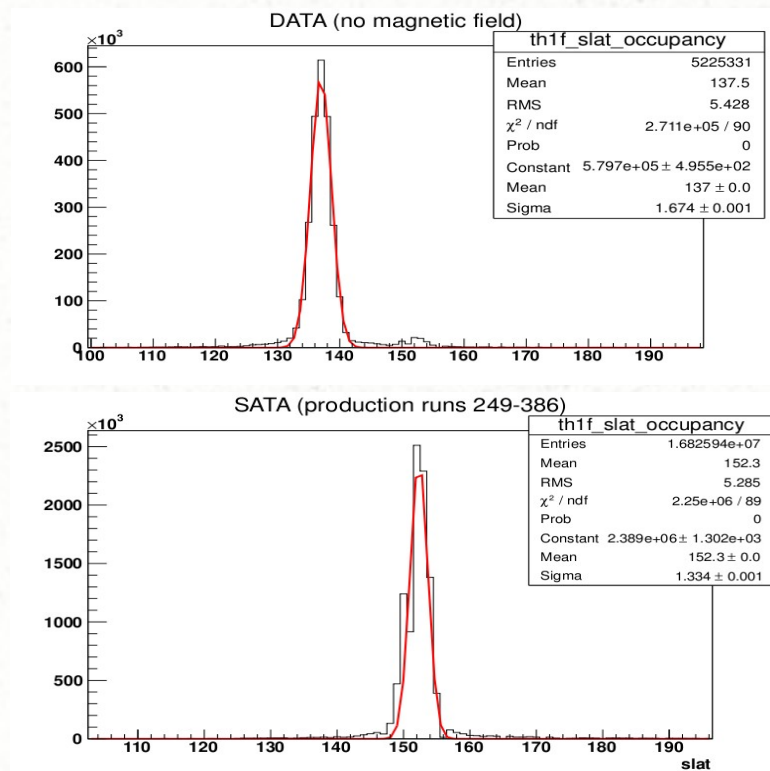
Simulation: geometry/magnetic field

The overall geometry should be the same used in the reconstruction code (tuned on survey measurements).

The magnetic field map and current is the same in the simulation and reconstruction codes (current based on the TOF slats crossed by the C beam with and without magnetic field).

A comparison of the generated and reconstructed momenta using Monte-Carlo events has been done to check the consistency between simulation and reconstruction code.

TOF slat occupancy in production runs and without magnetic field



$\Delta(\text{DATA}) = 15,3 \text{ slats}$

$\Delta(\text{MC}) = 15,7 \text{ slats}$

TOF resolution effects in the simulation

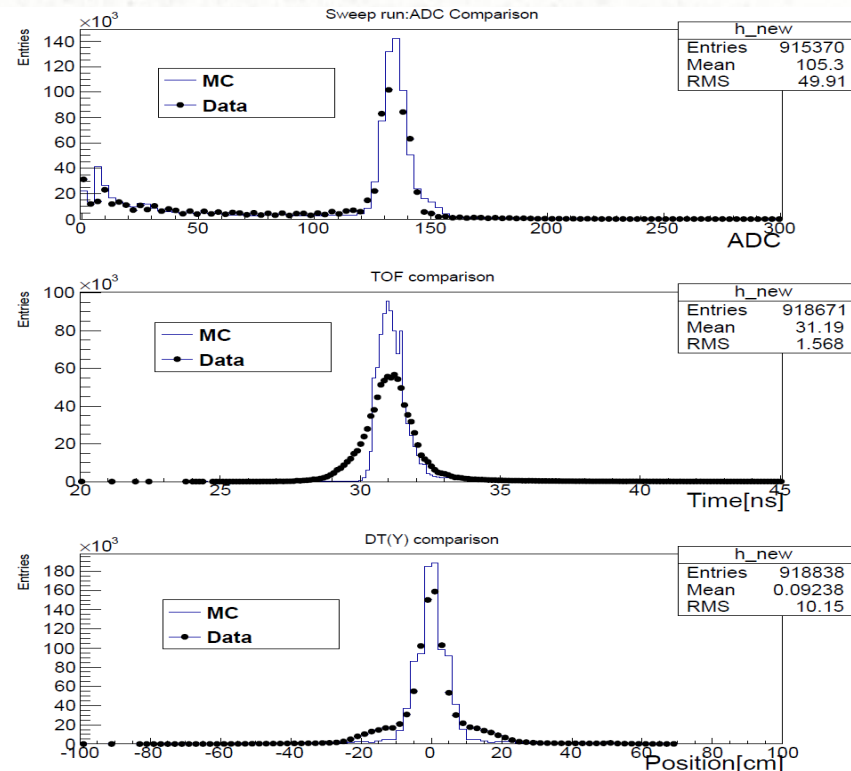
Random gaussian noise added to the energy and time values of the individual channels (top and bottom). based on comparison of MC/data distributions in sweep runs.

$$\sigma(E) = 0,045 E$$

$$\sigma(t) = 0,3 \text{ ns (constant)}$$

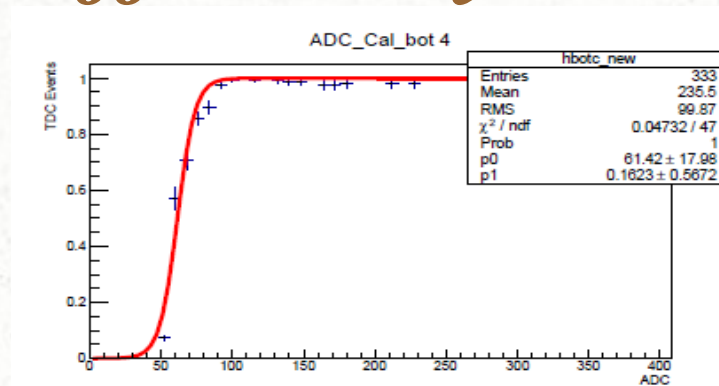
Tails not reproduced and still worse data/MC agreement for production runs, mainly for slat-by-slat behaviour (already reported in July in Catania).

More studies needed to understand the resolutions below the C peak using reconstructed tracks.

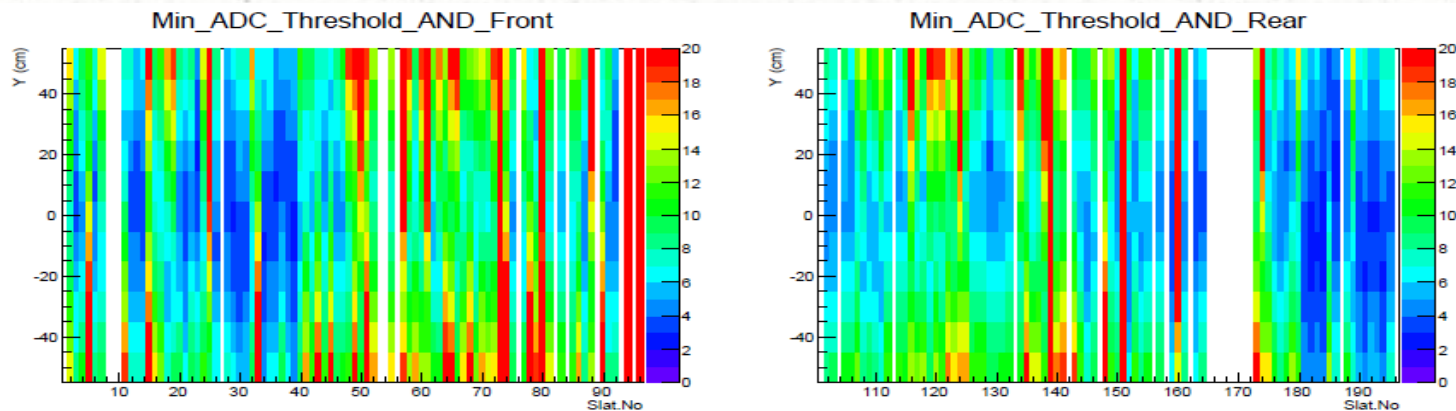


TOF efficiency

Minimum ADC values needed
for a TDC hit found for each
TOF channel.



Effect on the minimum detectable energy (linear energy response assumed)

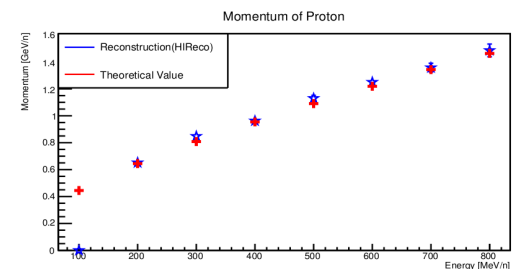
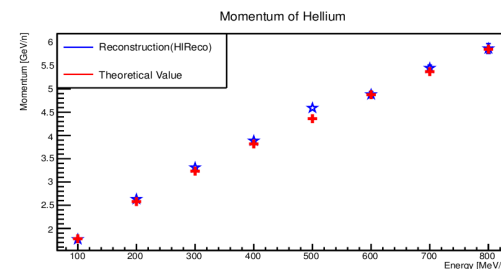
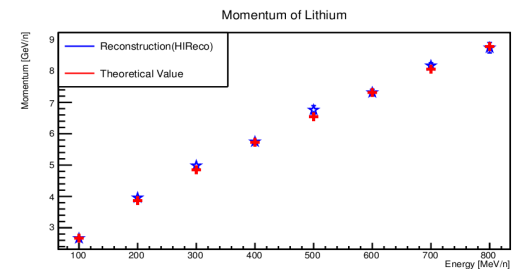
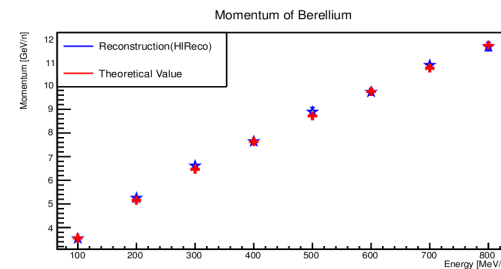
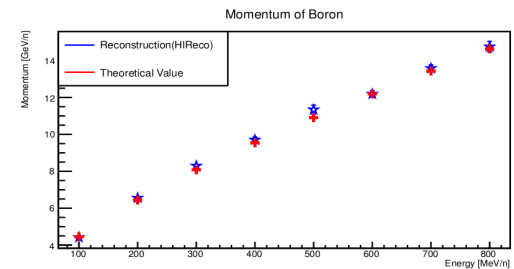
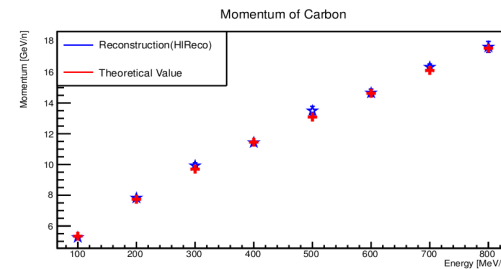


Implemented in the simulation but disabled at the moment.

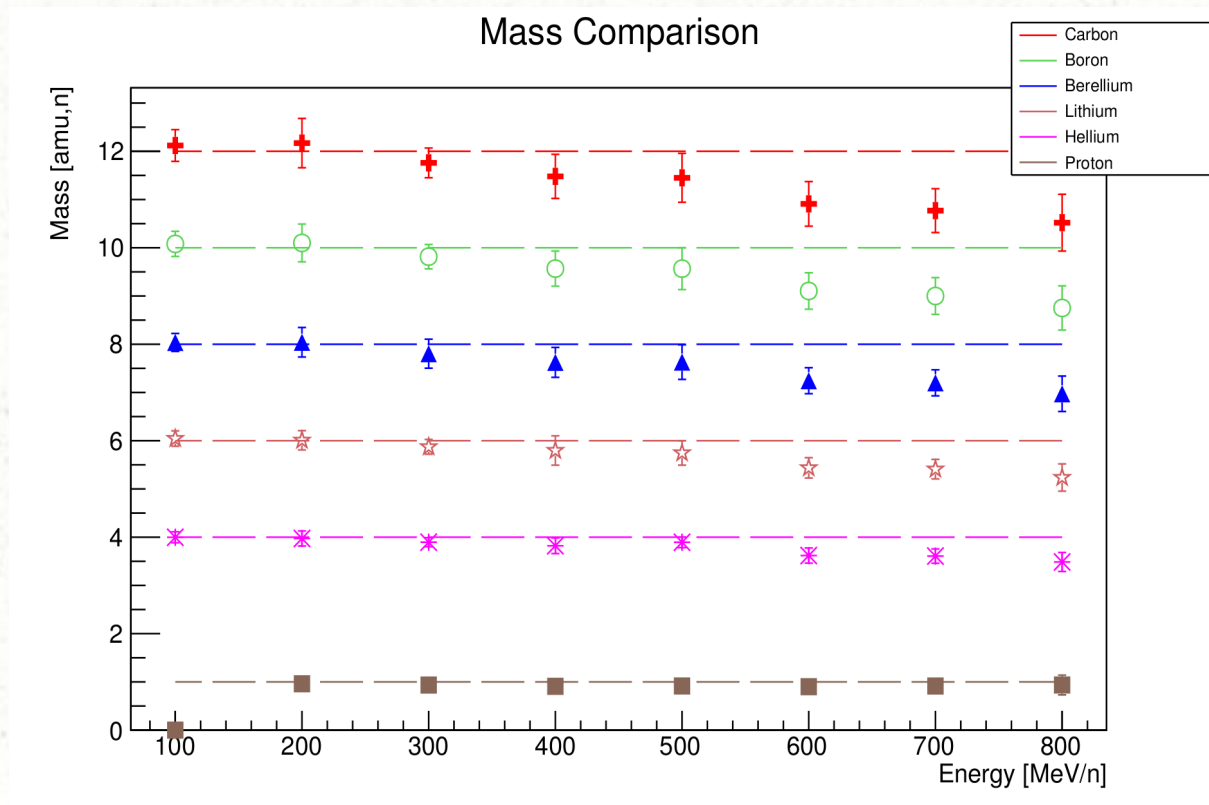
Momentum comparison (1)

Beam particles generated with different charges ($M=2Z$) and different kinetic energies.

Reconstructed momentum converted to kinetic energy and compared with the k.e. of the generated particles.



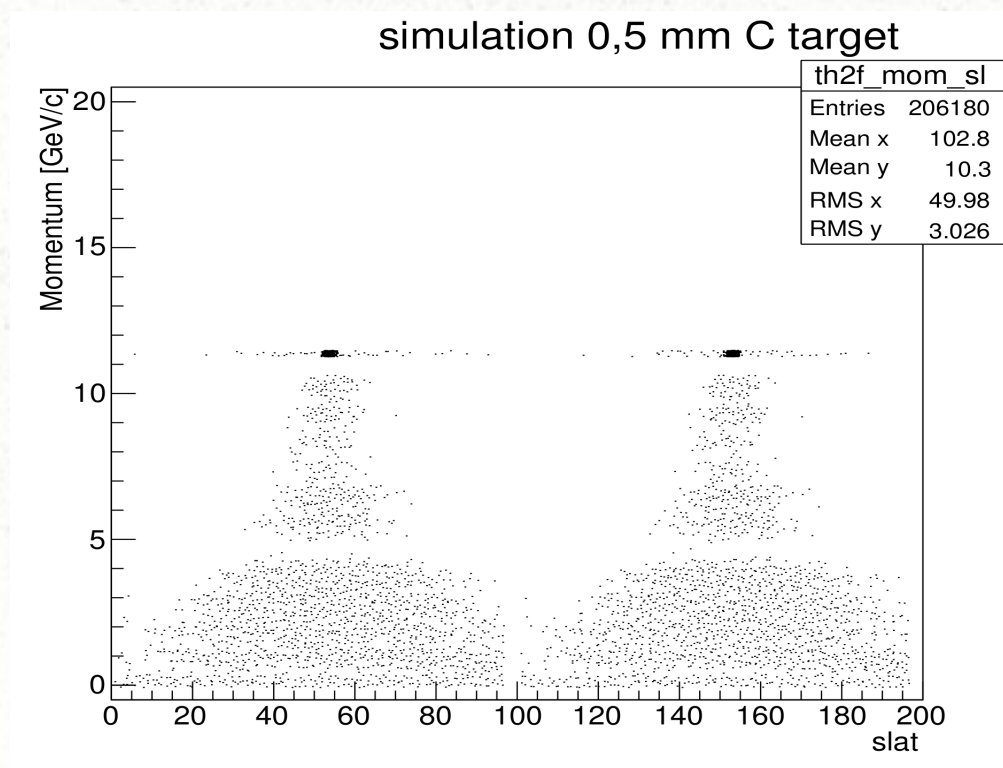
Mass reconstruction (1)



The reconstructed mass is underestimated at high K.E.
(I have not understood this effect yet)

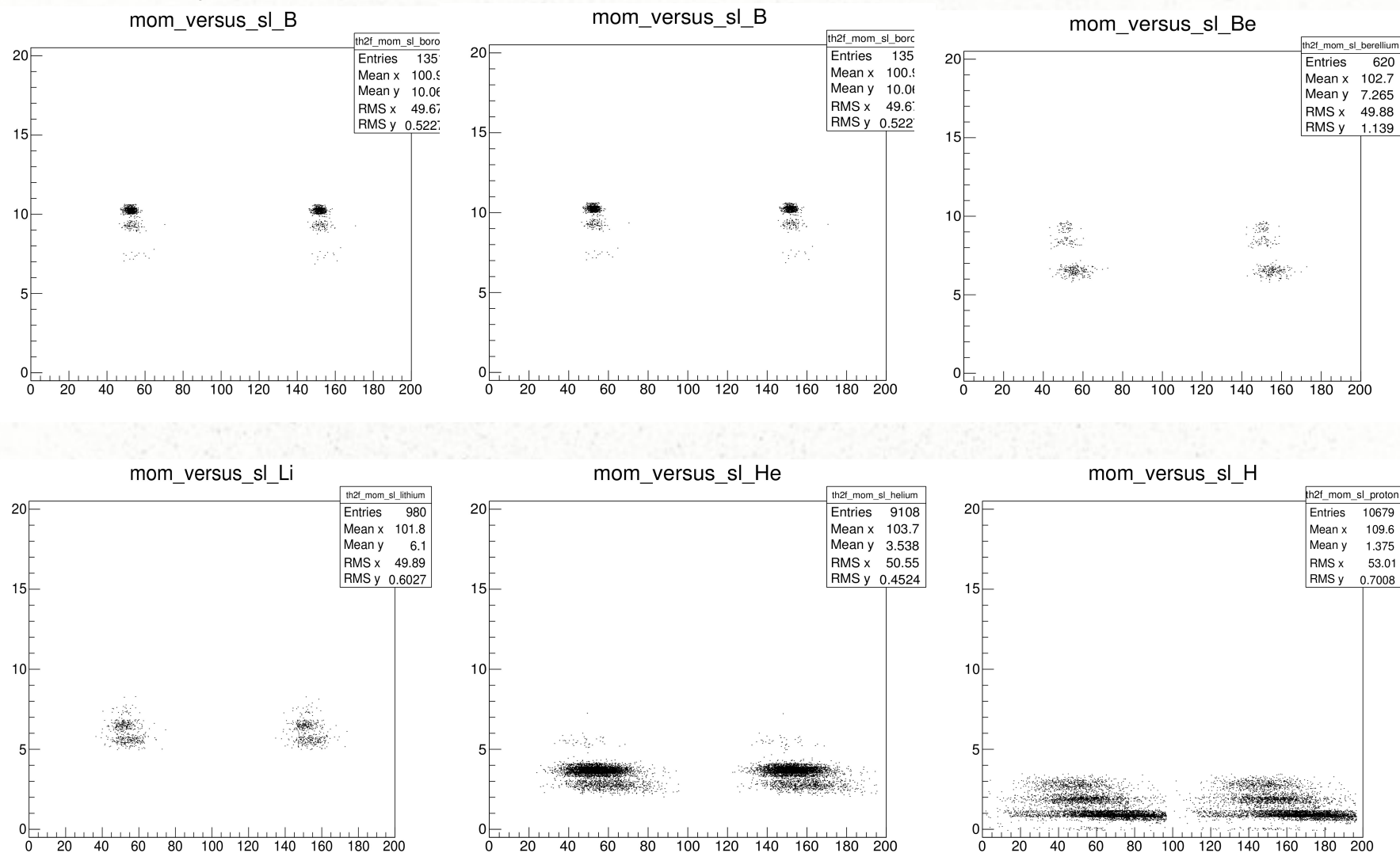
Simulation of a production run

For each TOF hit the Monte Carlo particle chain is navigated backward to find the parent particle produced at the target (it could differ from the particle producing the TOF hit).

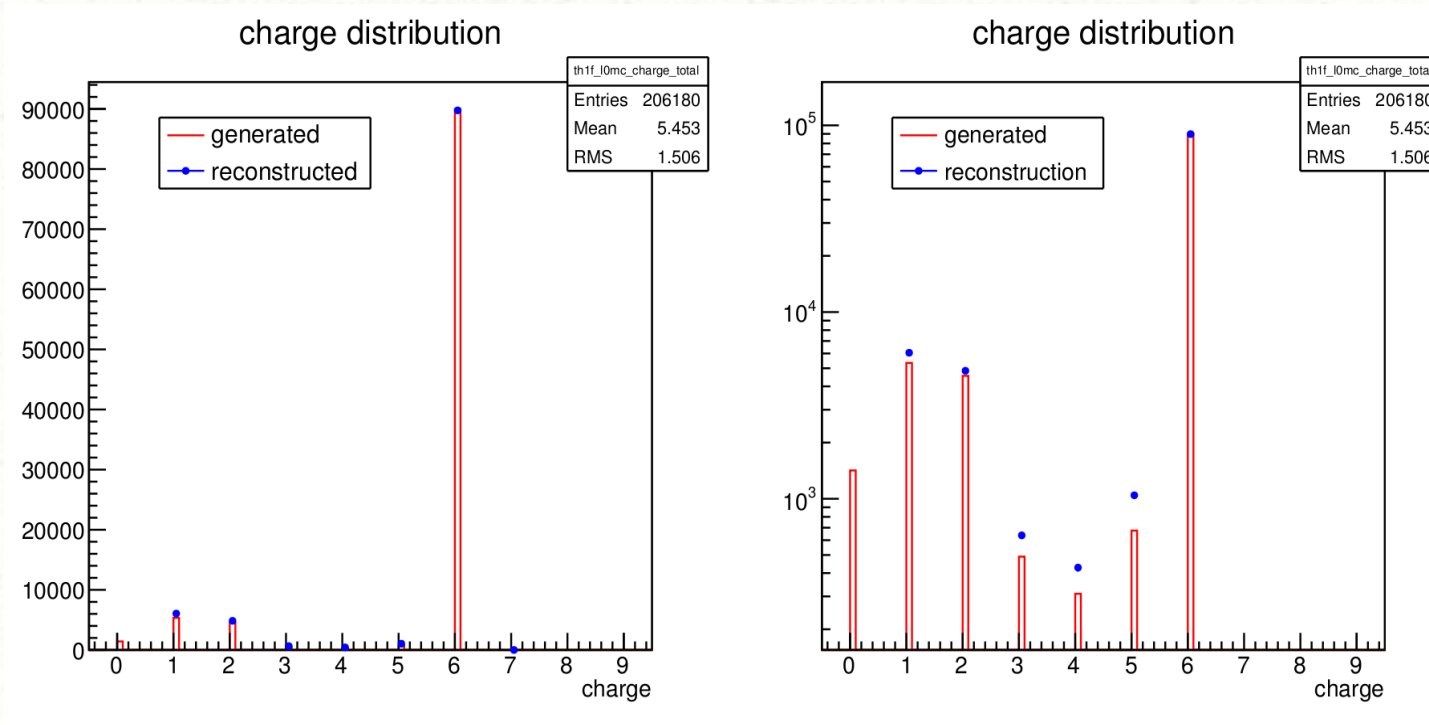


Momentum
at generator level
of the parent particle
just after the target.

Charge and distributions at generator level (particles after the target producing a TOF hit)



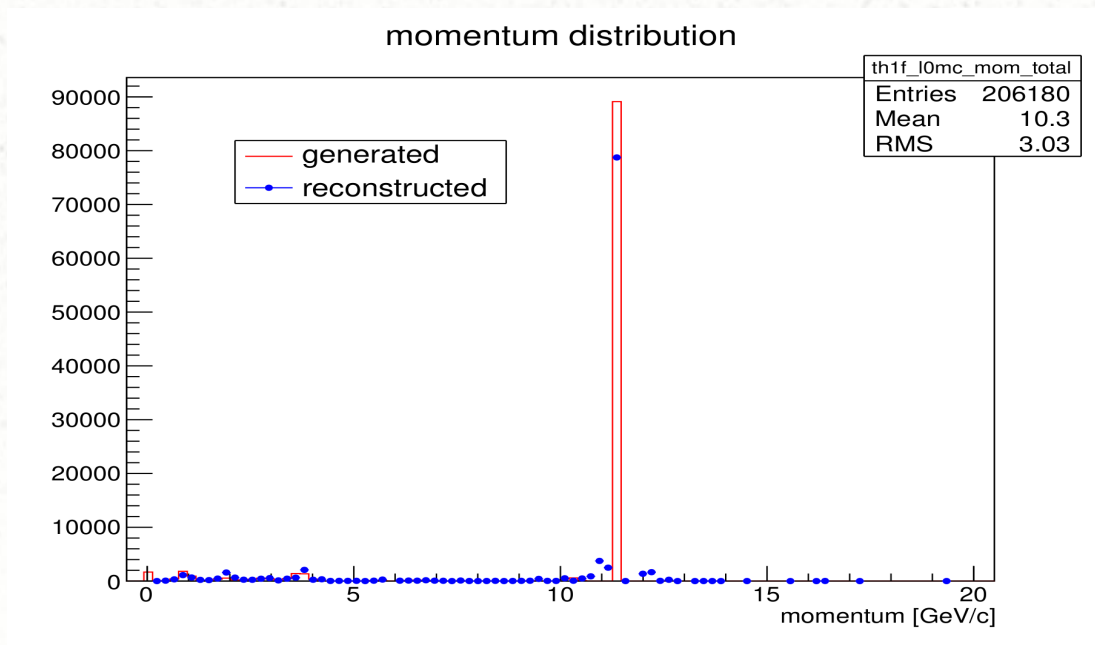
TOF charge from the generator particle releasing more energy in the TOF slat compared with the charge of the parent particle at the target (they could differ for secondary interactions between the target and the TOF wall).



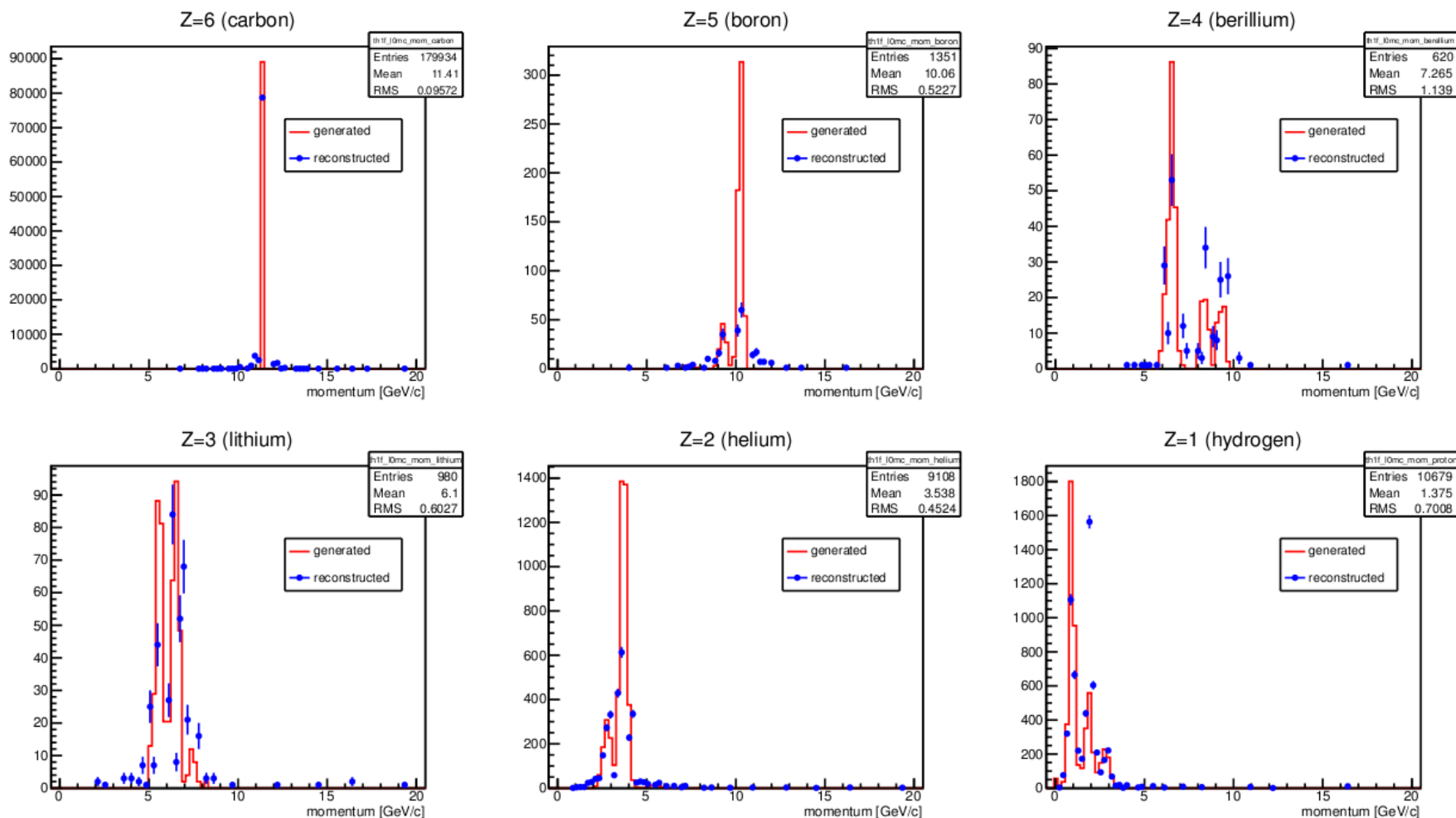
Momentum comparison (2)

To check the momentum reconstruction, the distribution of generated momenta (for particles at the vertex associated to TOF hits) is compared with the distribution of reconstructed momenta. Comparison of distributions, not event by event.

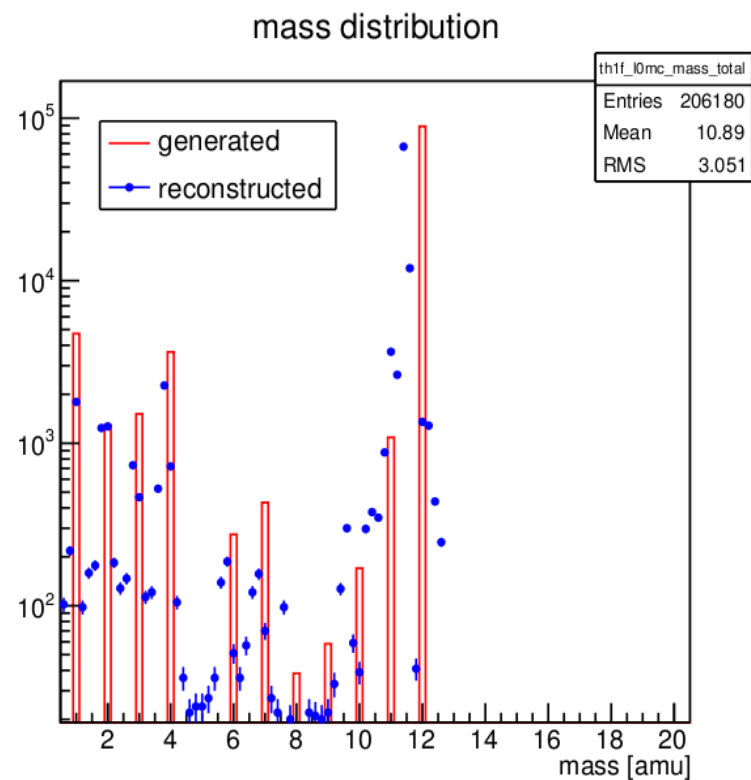
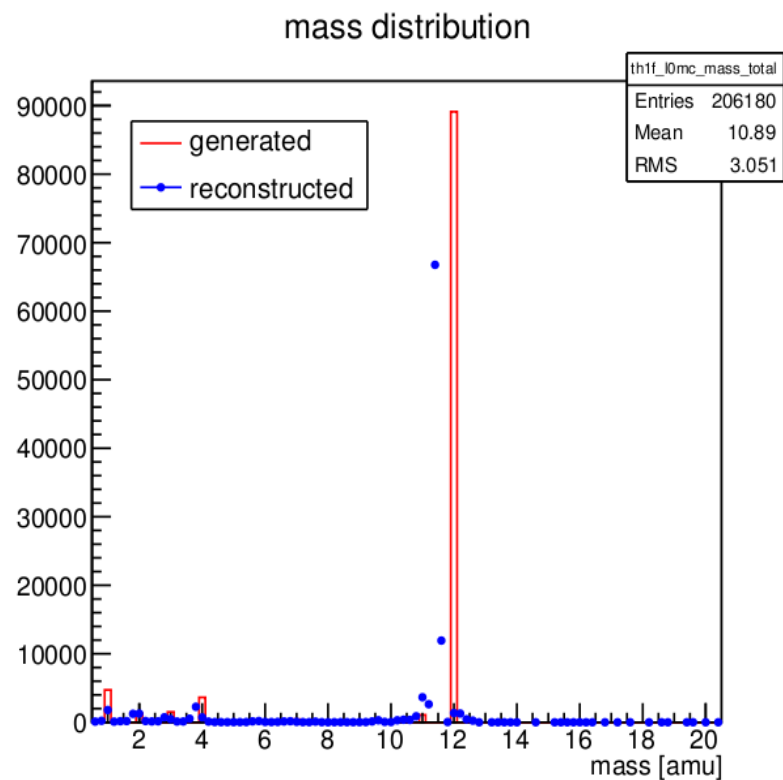
For a more clear check of the reconstruction code, resolution effects of the TOF energy and time are disabled in the simulation.

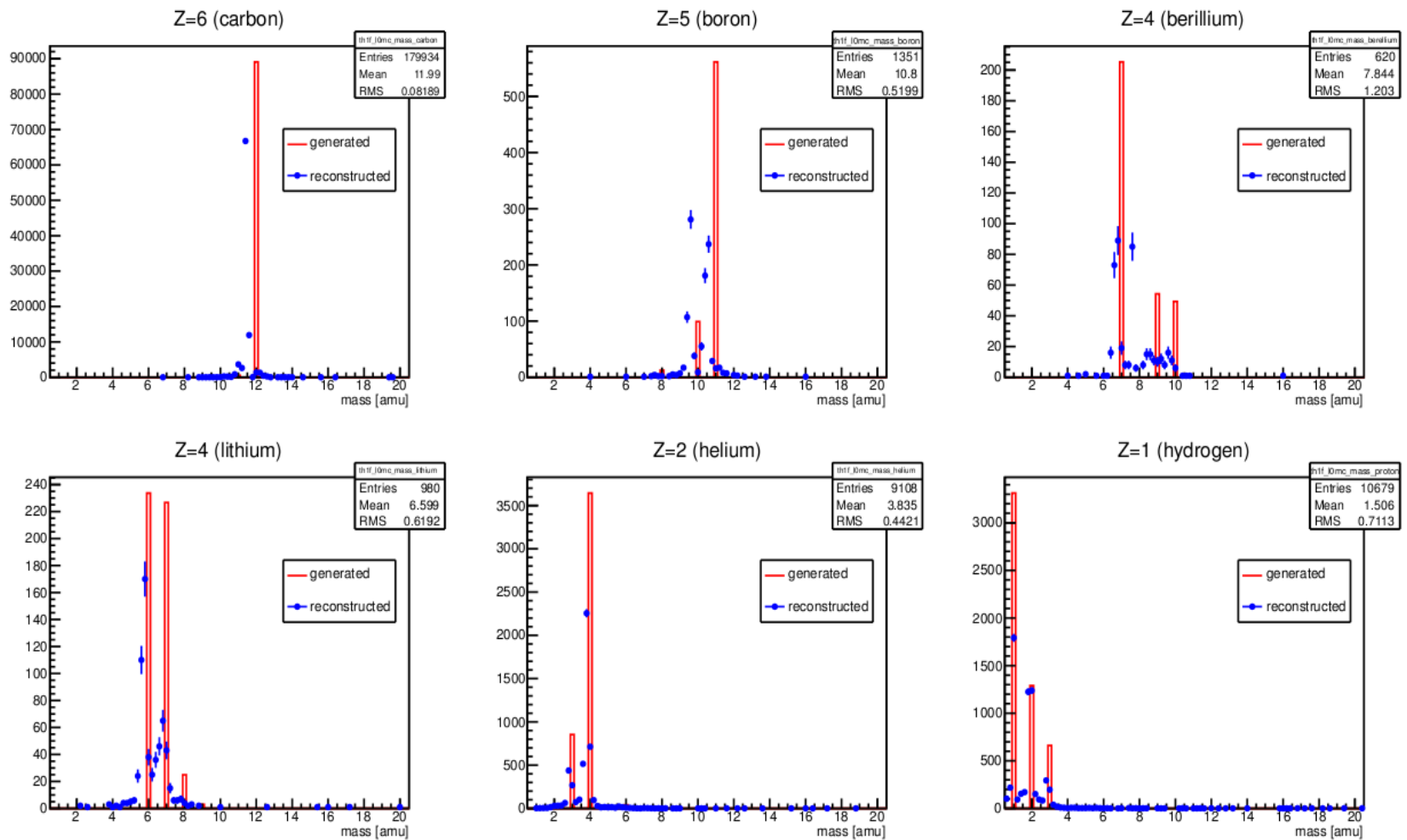


Reconstructed versus generated momentum distribution for different charges (charge of generator level).



Mass comparison (2)

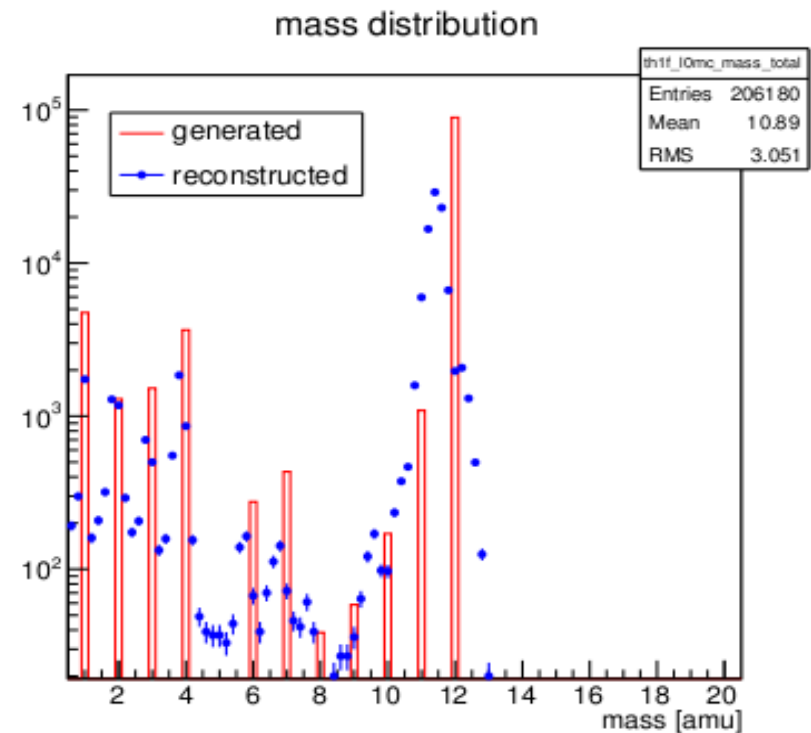
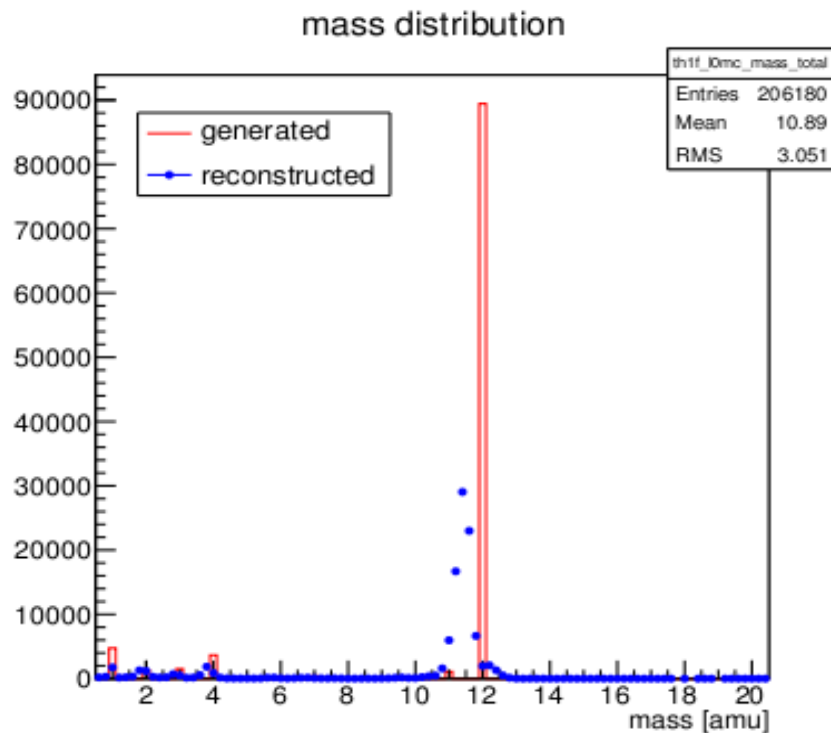




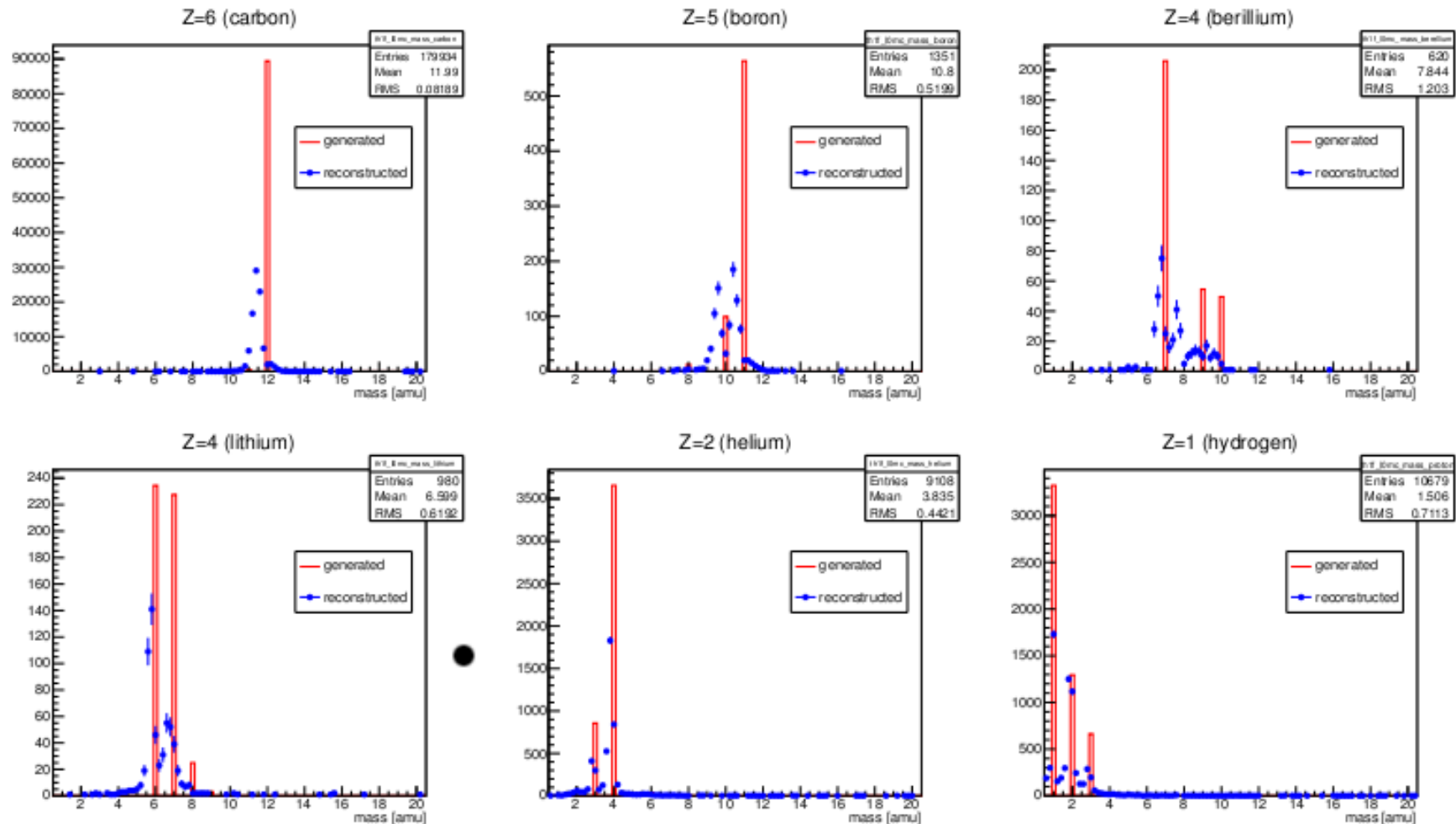
Charge at generator level. Mass underestimated for Z=6 and 5.

Mass comparison (3)

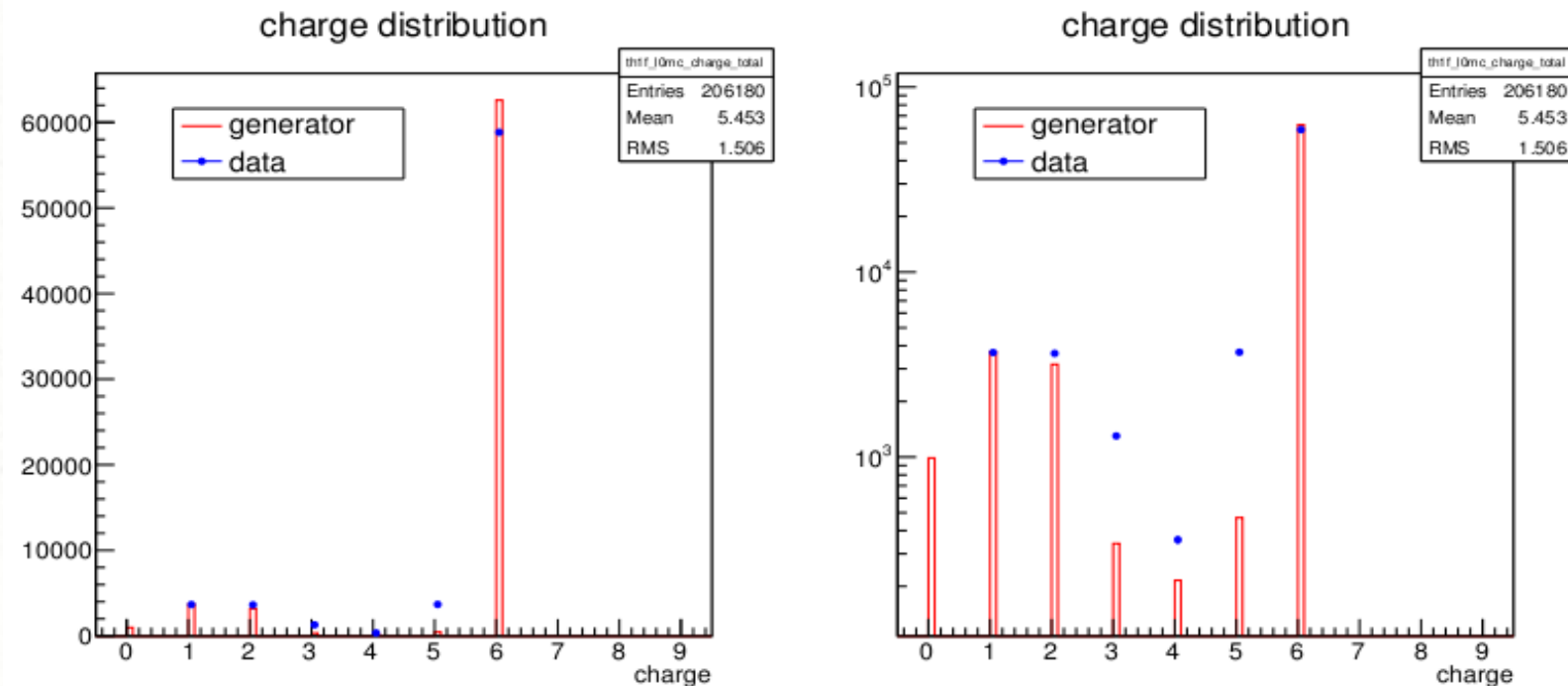
TOF time and energy resolution effects added.
The effect on the momentum reconstruction is negligible.



Comparison of mass distribution at generator level (for parent particles at the target associated with the TOF hit) with reconstructed mass distributions.
Charge at generator level.

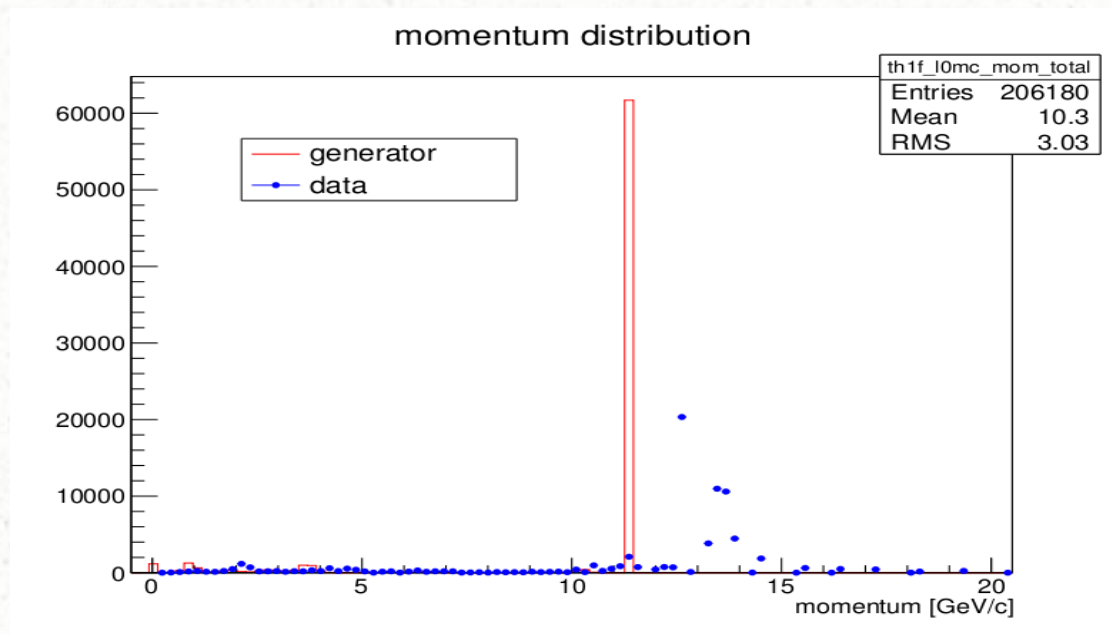


Comparison with data: charge ID



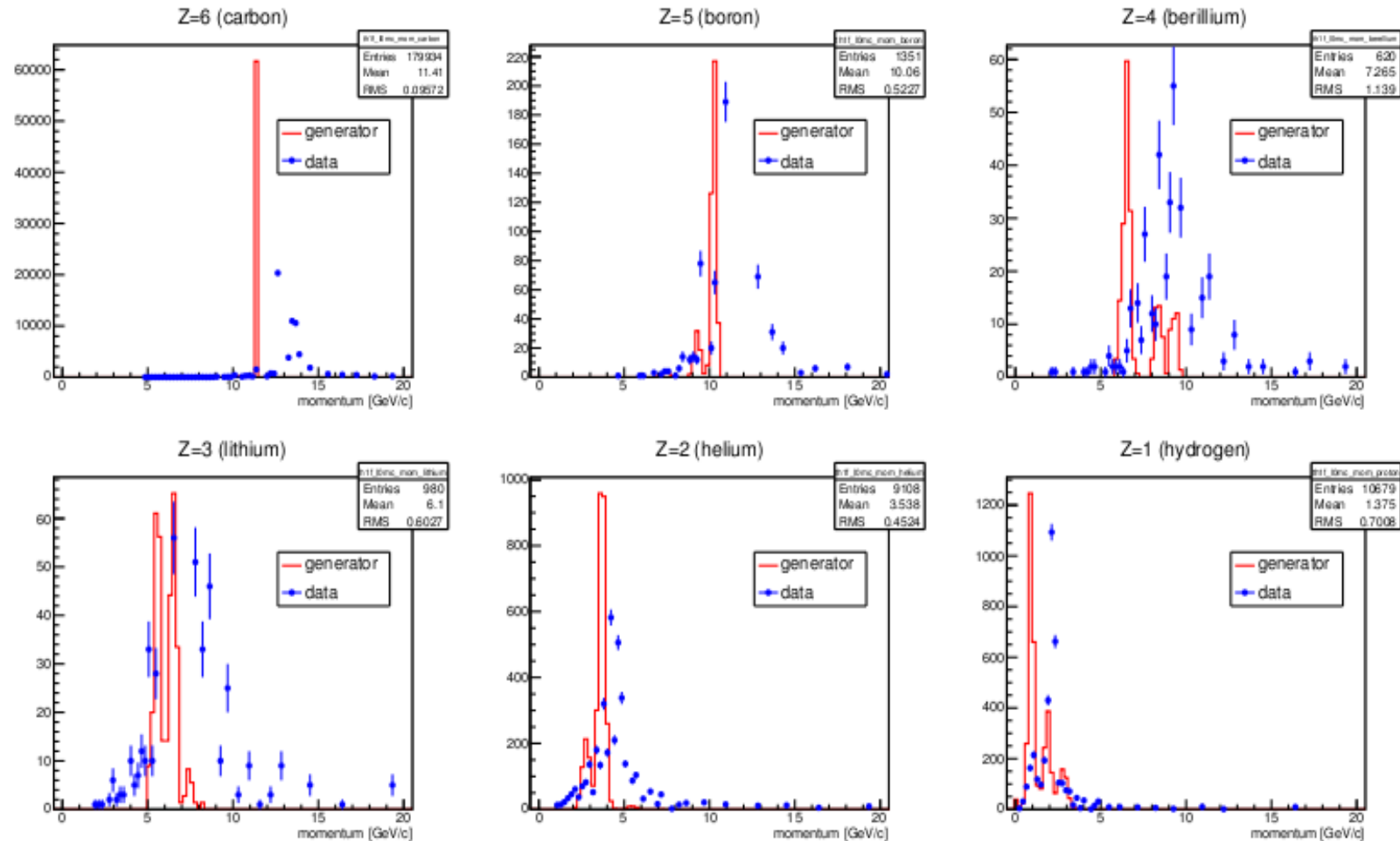
Distributions normalized to the same number of events.
Same fixed normalization factor applied to all the following distributions.

Comparison with data: momentum

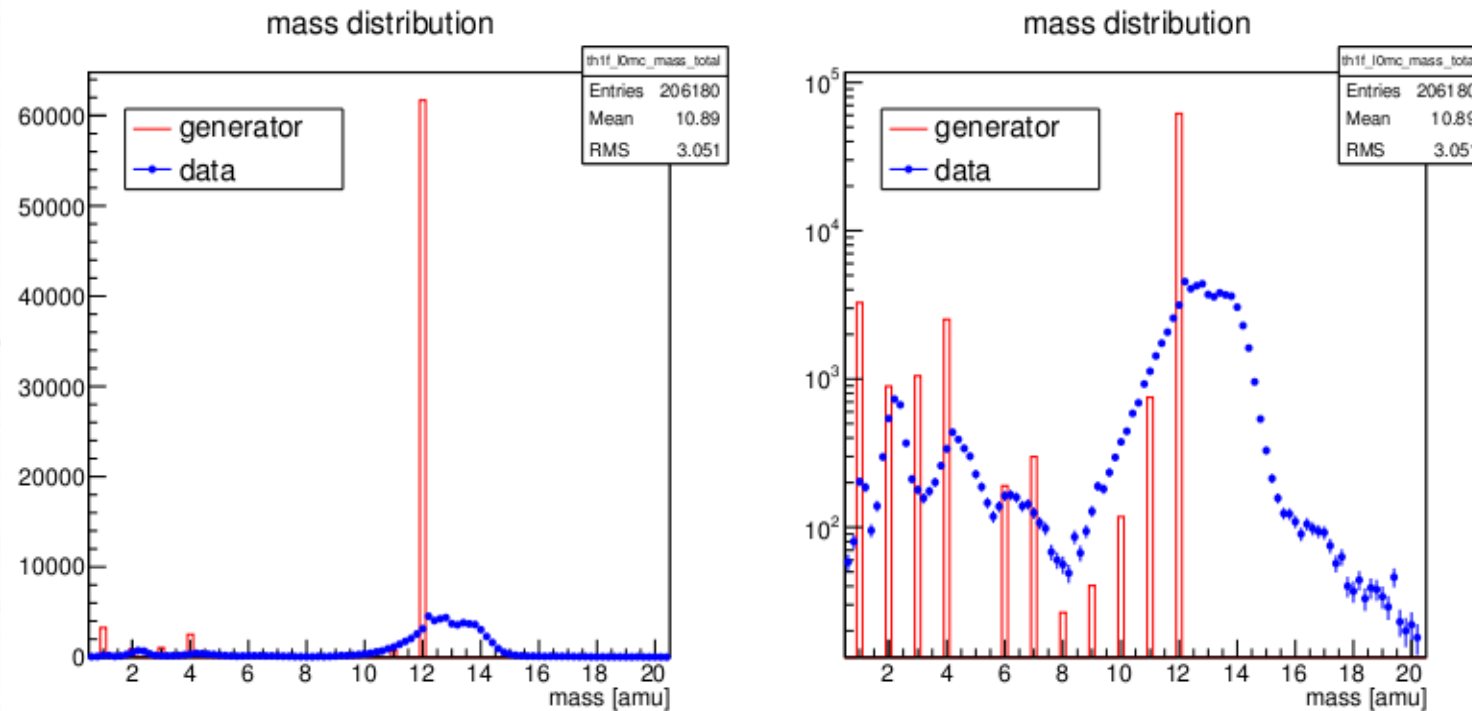


Momentum recostructed with data is too high !

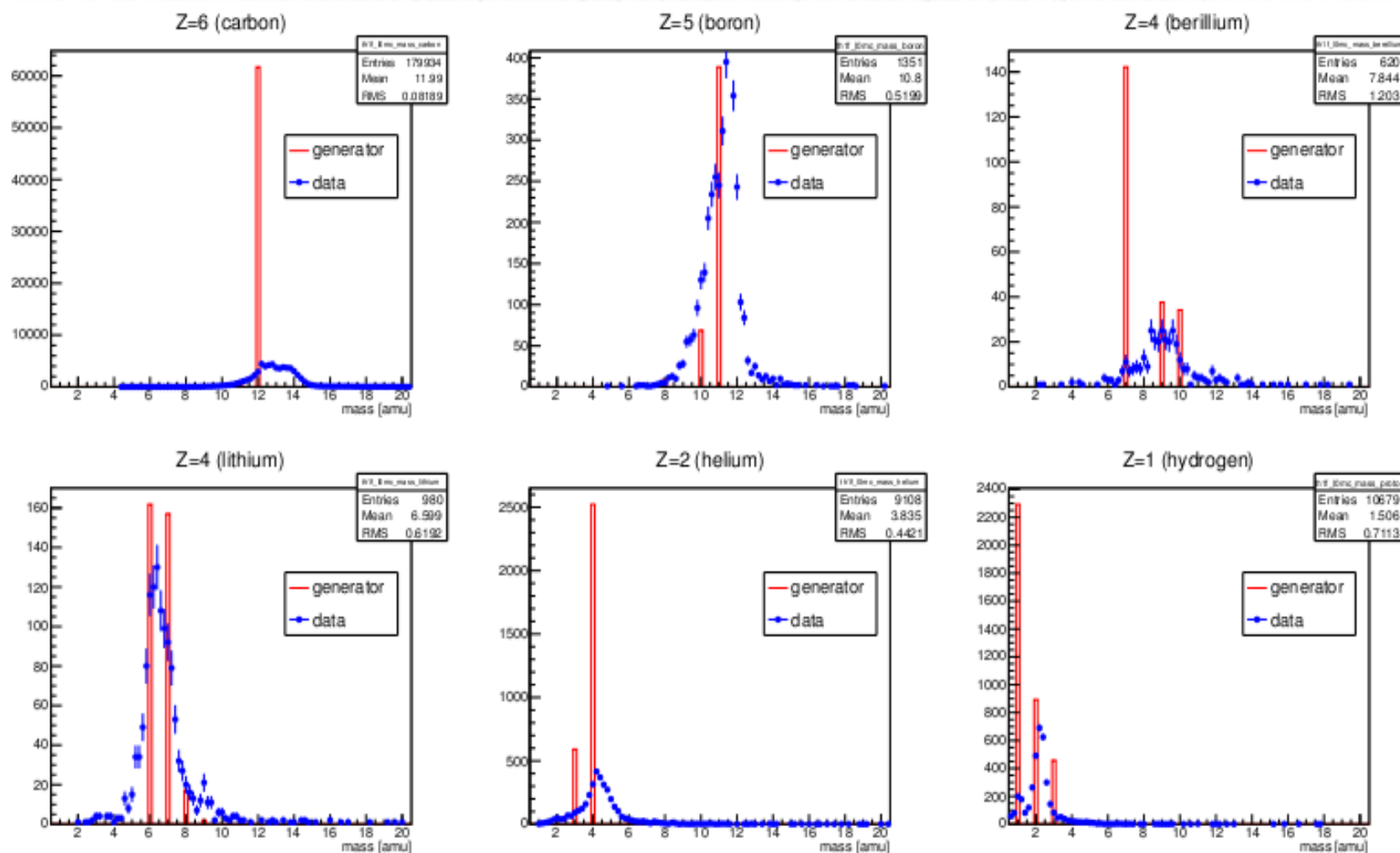
Momentum distributions for different charges: DATA vs generator



Comparison with data: mass



Comparison of mass distributions for different charges: DATA vs generator



Conclusions

The momentum reconstruction with simulated data is in reasonable agreement with the momentum of the generated particles.

This is check of the consistency of the geometry, magnetic field maps and the tracking between the simulation and the reconstruction codes.

The reconstruction underestimates the mass at high energies.

I have the impression it's due to a offset in the time-of-flight (not found yet).

In general the simulation of resolution and efficiency effects should be fine tuned with studied from data.

The momentum and mass reconstruction in the data fails, even if the reconstruction code, magnetic field and geometry is the same used on simulated events, where it works !