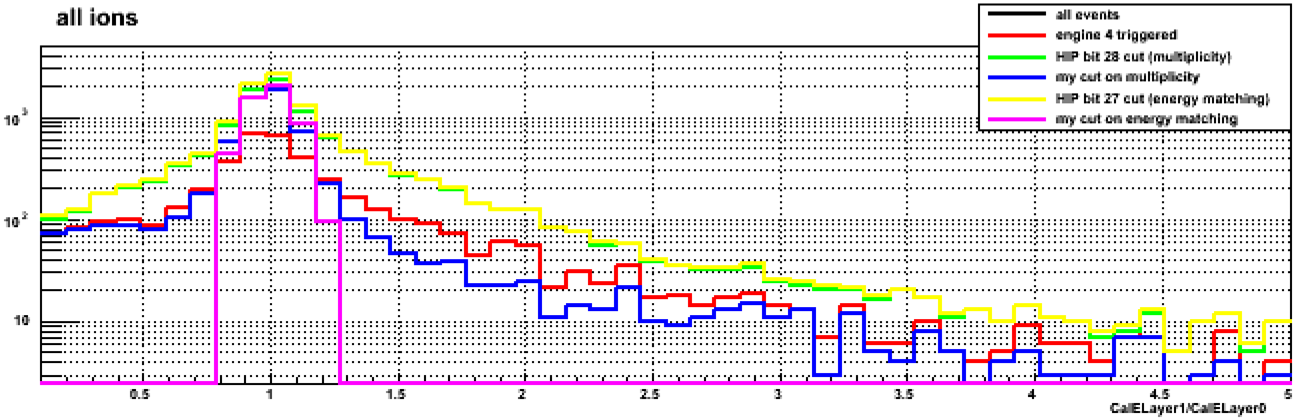
Study of ions in the HIP and GAM filters

- I looped on ~1000 s of big run simulation and analyzed the properties of the ions which pass HIP and GAM filters
  - I used the meritTuple (McCharge, Obf variables, layer energies, etc.), the calTuple (to compute the multiplicity in the CAL first 3 layers)

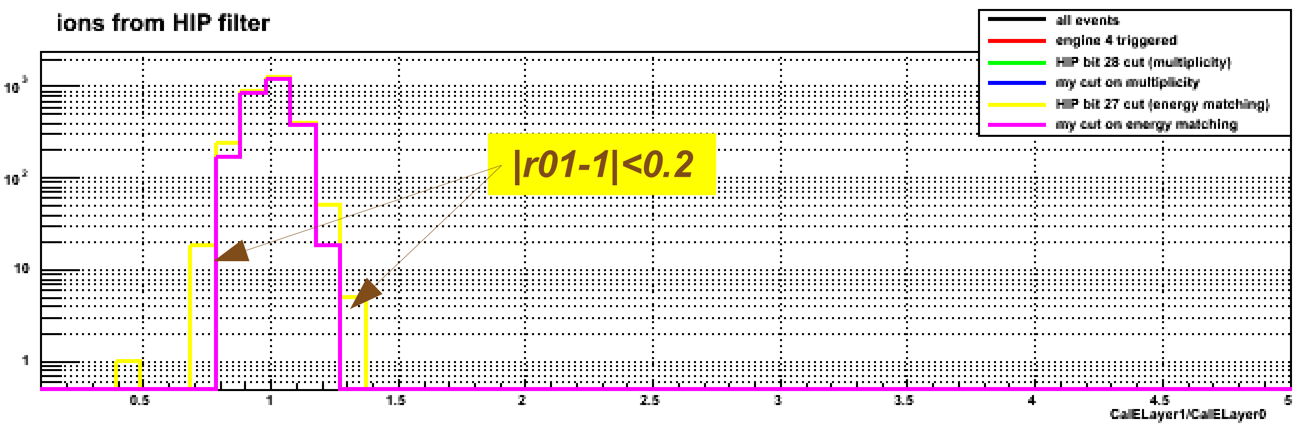
- Each of the 6 following series of plots is for a different variable
  - Layer energy ratios: r01=CalELayer1/CalELayer0 & r12=CalELayer2/CalELayer1
    - Remember that HIP filter bit 27 requires |r01-1|<0.2 && |r12-1|<0.2 (with OB energies...)
  - total multiplicity=sum of number of hits above 50 MeV in CAL first 3 layers
    - Remember that HIP filter bit 28 requires <3 of those hits in each of the CAL first 3 layers
  - McCharge (with a cut on Z>1)
  - CalEnergyRaw & CalELayer0

- For each series of plots, the 1st plots shows the distribution for all events passing any filter, and the 2 other plots are restricted to HIP and GAM events

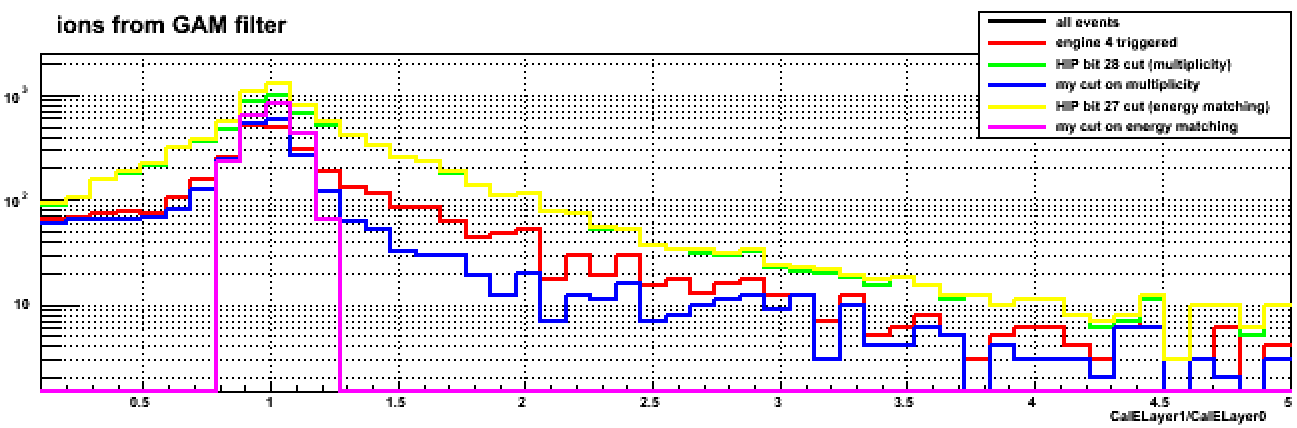
- In each plot (canvas) I superimposed the following distributions:
  - Black: all events
  - Red: events firing trigger engine 4 (red)
  - Green: events with a good multiplicity in each of the CAL first 3 layers (from HIP bit 28)
  - Blue: events passing the cut based on my own computation of bit 28
  - Yellow: events with a good energy marching (within 20%) in each of the CAL first 3 layers (from HIP bit 27)
  - Magenta: events passing the cut based on my own computation of bit 27



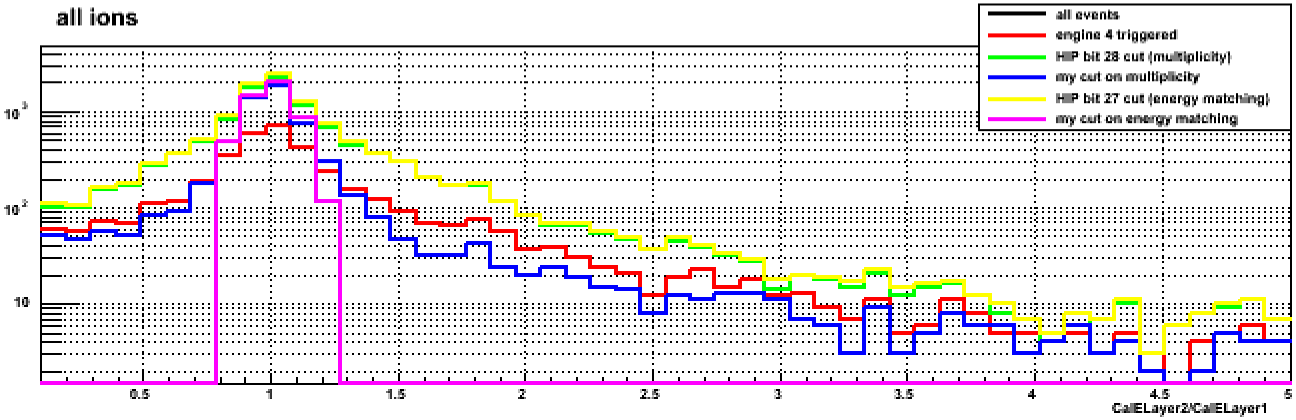
Energy matching (CalELayer1/CalELayer0)



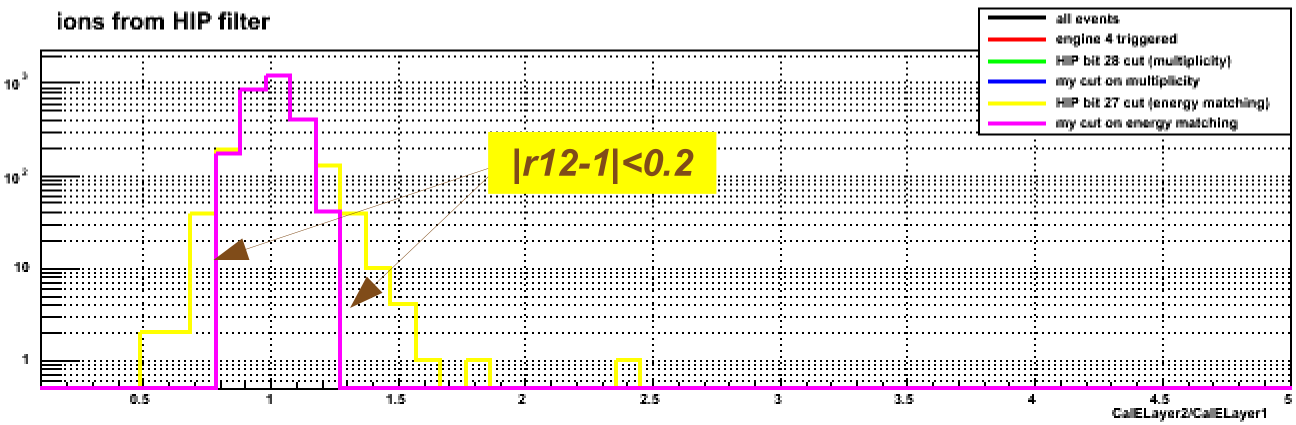
I don't kill many of the HIP events with my own cut - good!



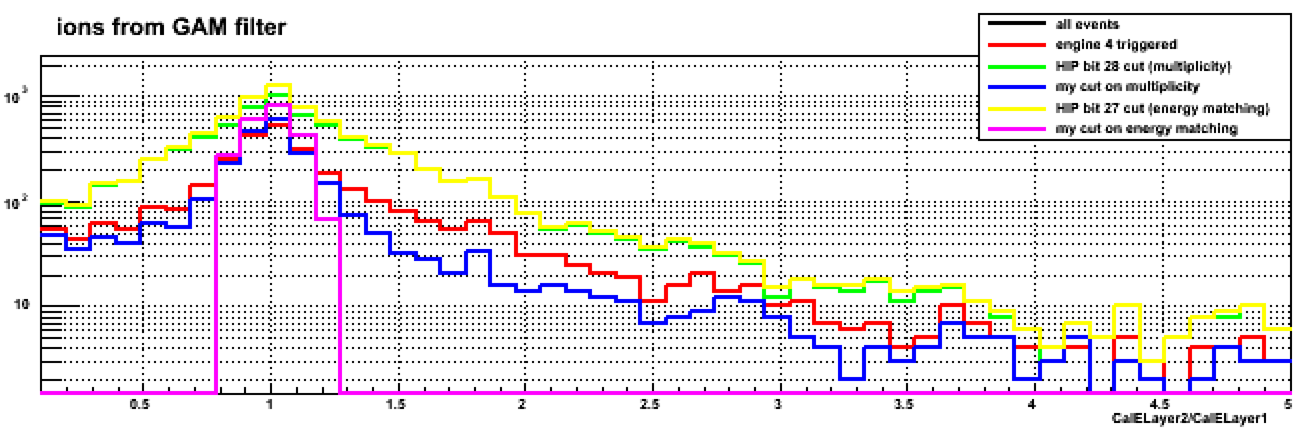
A substantial fraction of Ions in GAM filter with a bad energy matching (r01)



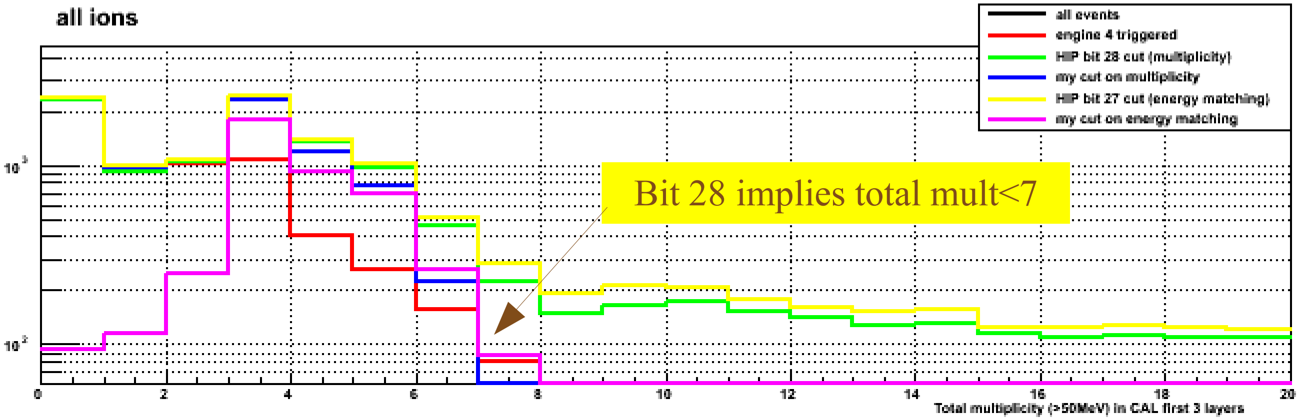
Energy matching (CalELayer2/CalELayer1)



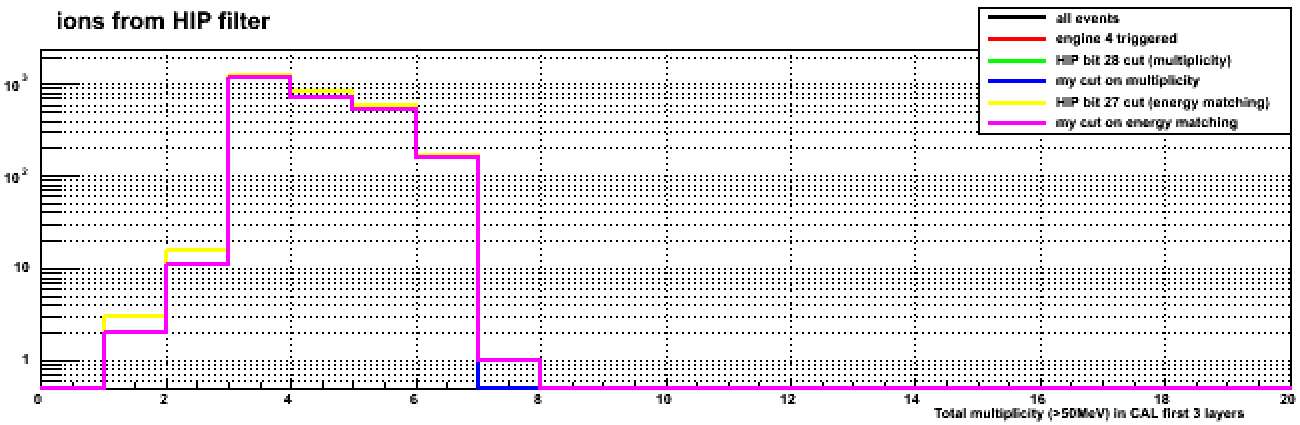
I don't kill many of the HIP events with my own cut - good!



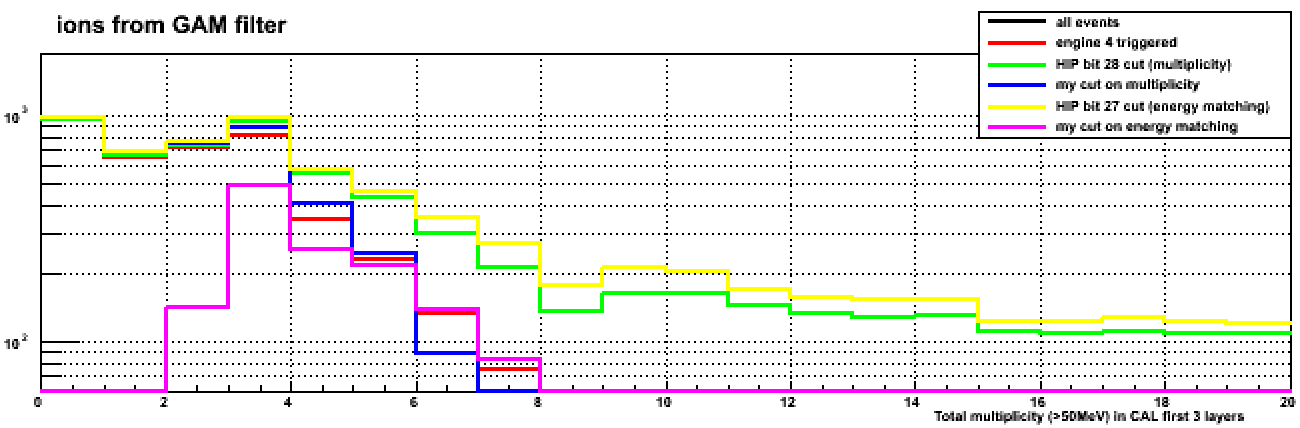
A substantial fraction of Ions in GAM filter with a bad energy matching (r02)



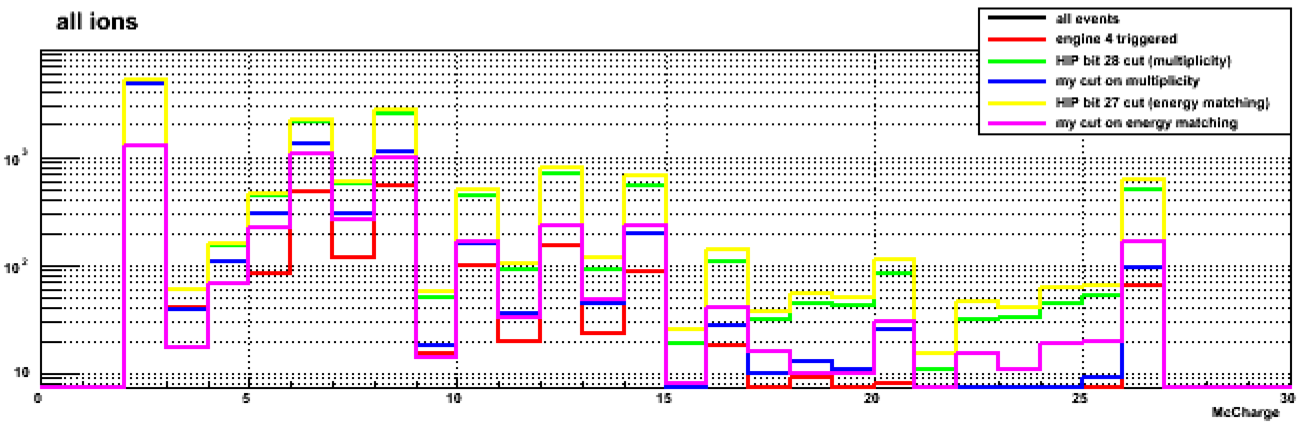
Total multiplicity in first 3 layers. A total multiplicity of 6 is somehow equivalent to a multiplicity of 2 in each of these layers



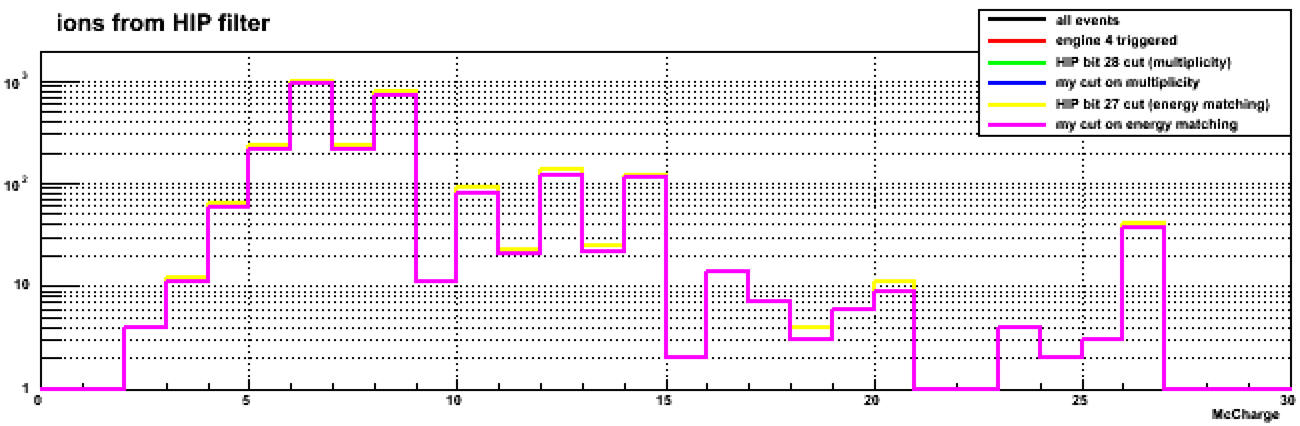
I don't kill many of the HIP events with my own cut - good!



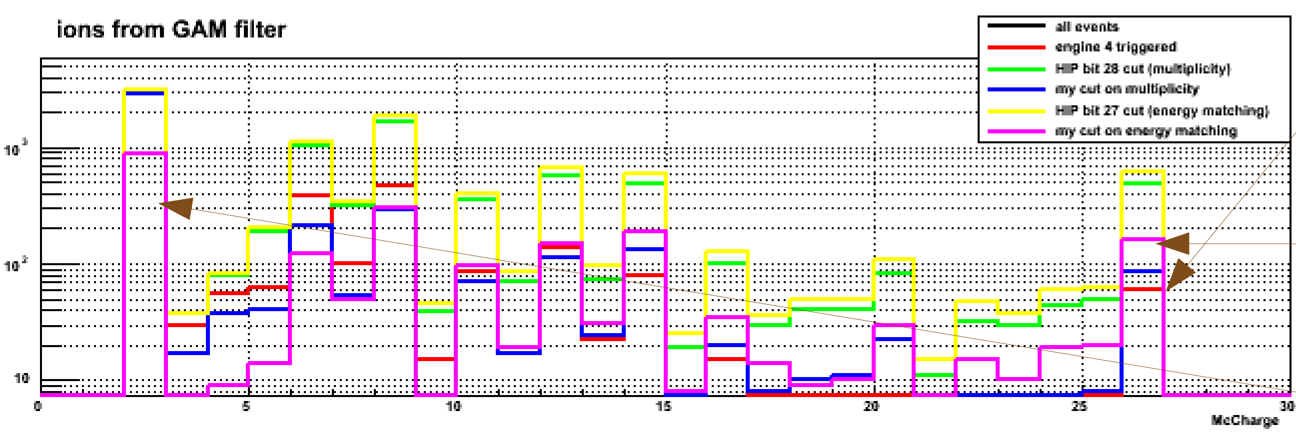
A small fraction of ions in GAM filter with a high mutiplicity, and a large fraction with a low multiplicity (killed by energy matching cut)



McCharge (Z>1)



I don't kill many of the HIP events with my own cut - good!



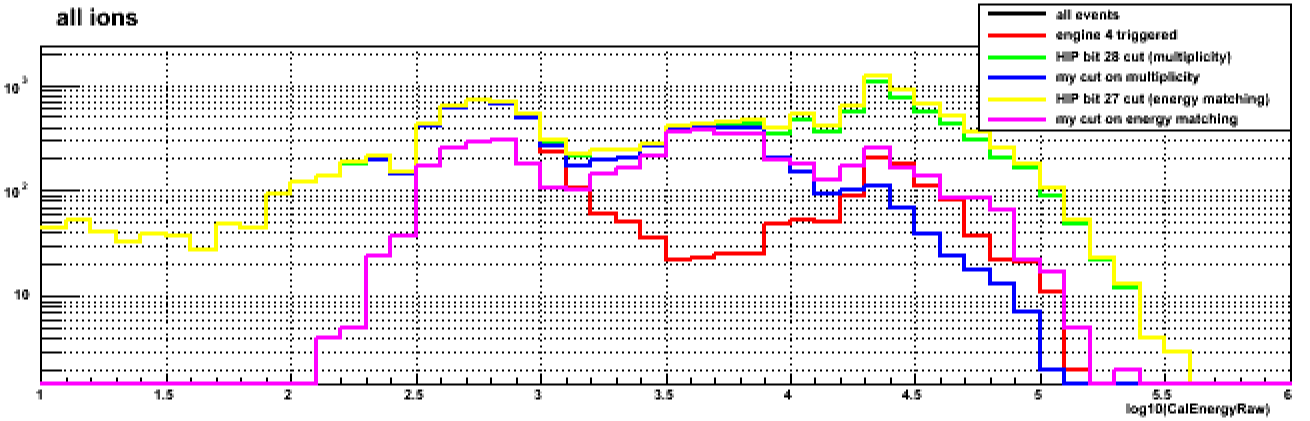
A lot of irons don't trigger engine 4

~0.2 Hz of iron with a good energy matching

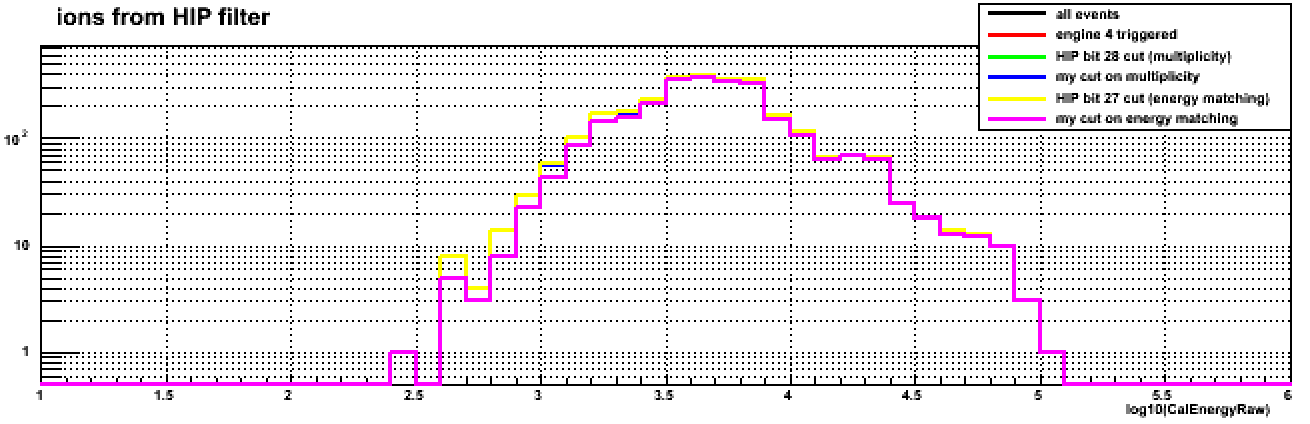
~1Hz of He with a good energy matching

CalEnergyRaw

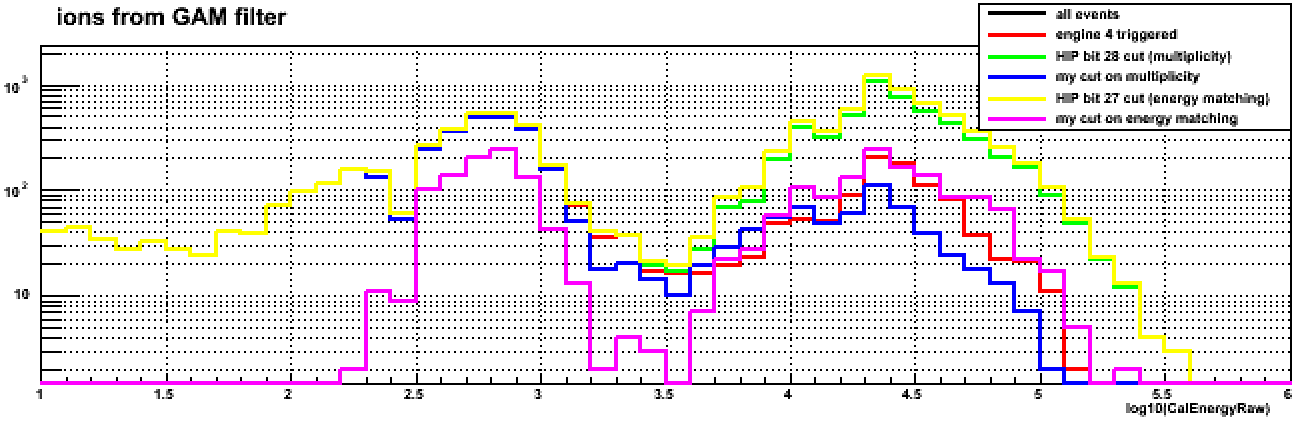
all ions



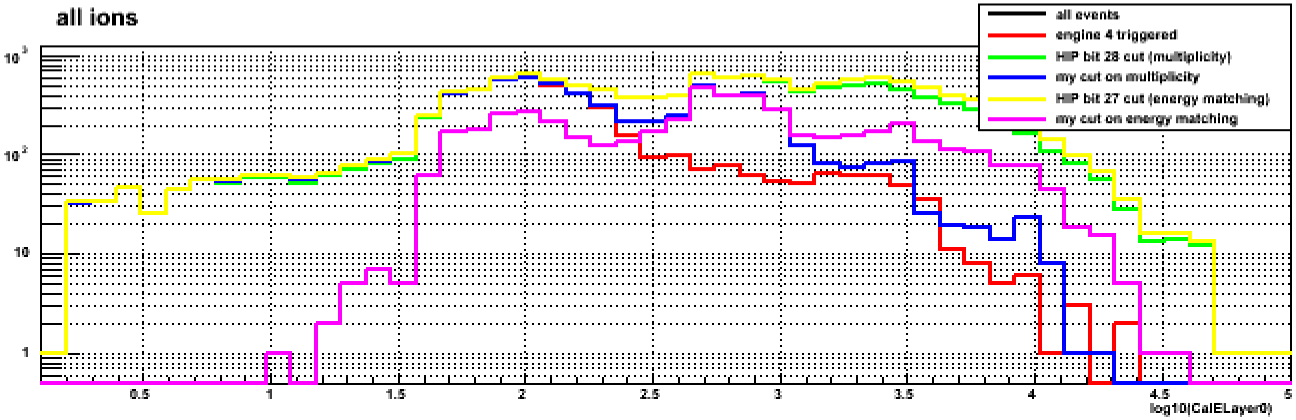
ions from HIP filter



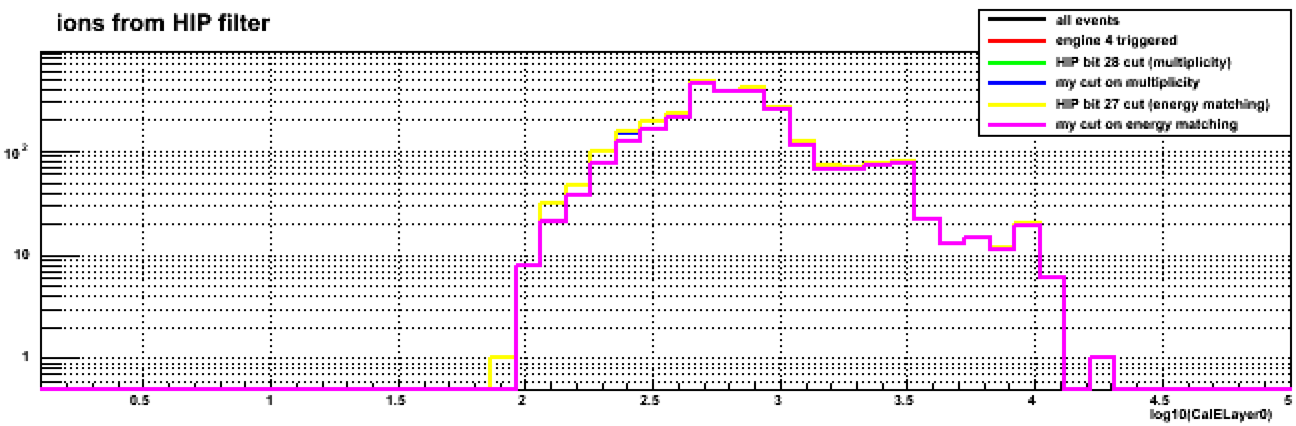
ions from GAM filter



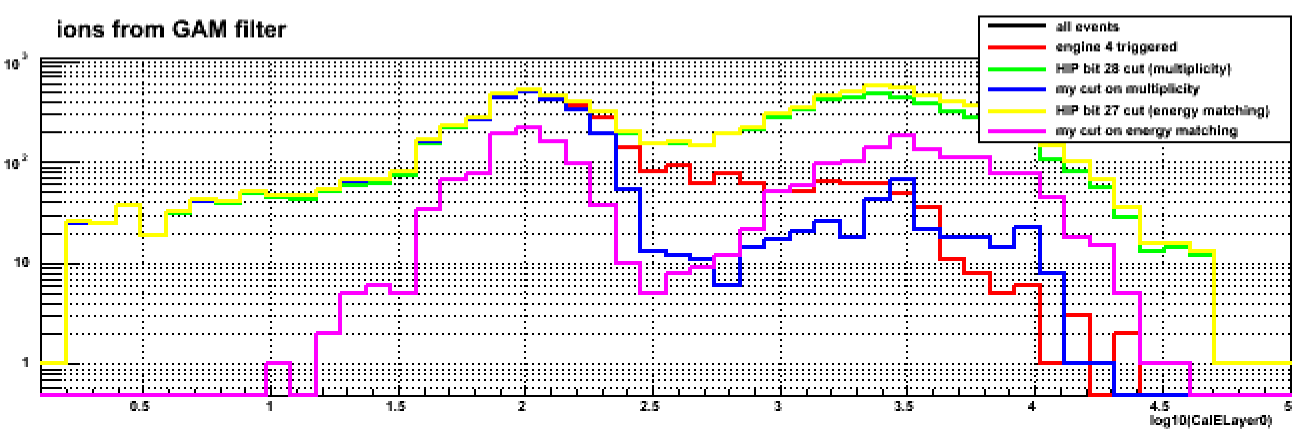
I don't kill many of the HIP events with my own cut - good!



CalELayer0



I don't kill many of the HIP events with my own cut - good!



Conclusions

- GAM filter contains heavy ions wich do not pass HIP filter
  - These ions deposit energy in CAL first 3 layers, with good energy matching
  - They might not pass HIP filter either because they dont trigger engine 4 or because they have a high multiplicity (the 50 MeV threshold is certainly too low for the heaviest ions)

- Further checks:
  - With the full GCRCalib reconstruction (on-going at Lyon CC)
  - Understand why the HIP filter is not efficient for the heaviest ions
    - Use SC1 simulation where all events that trigger an engine are kept (comparison with HIP outputs yields its efficiency)