Investigation of the quenching effect in CsI with GSI data

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This short note summarizes the analysis done using the GSI data taken in November 2006 in order to measure the quenching factors. All results are based on the parameters saved in the SvacTuples.

1 Analysis using Carbon data

For this analysis, most runs taken before the Xe runs with a beam angle of 0° were accumulated in order to get more statistics (runs 2528, 2530, 2531, 2532, 2533 and 2534). The different steps of the procedure are the following :

- The number of crystal hit is calculated using a threshold energy cut of 0.01*CalEneSum. Only the relevant crystals are taken into account (namely tower 2). This contrasts with the equivalent variable in the MeritTuple which concerns ALL TOWERS.
- Carbon data are cleaned up by using two cuts : one on the number of tracks in the tracker (only events with one single track -TkrNumTracks=1- are kept) and one on the number of hits in the calorimeter (8 hits are required).
- The energy of each event passing the cuts is estimated by using the average of the energies measured at the two ends of each crystal.
- For each layer, the ionisation-energy peaks are fitted with Gaussian functions (Fig. 2).
- The resulting mean energies obtained are then compared with those extracted from the GEANT4 simulations in a similar way.
- The quenching factor is then extracted as $\frac{E_{measured}}{E_{expected}}$

Fig. 1 shows the energy deposited in the first layer of tower 2 when no cut is applied (solid line)and after applying the cuts described above (dashed line). We clearly see the energy deposition from non interacting particles which demonstrates the rejection power of the cuts. The number of counts is dramatically reduced but the goal here was to have no remaining background.

As illustrated in Fig. 3, the measured energies for each layer are found higher than the calculated energies by 23%. This anti-quenching effect confirms the previous result obtained by Benoît Lott and Frederic Piron in 2004 (see Fig. 5 from [1]). The evolution of the anti-quenching effect with the time interval between two events was also performed : no significant effect was observed as shown in Fig. 4.

Références

[1] B. Lott, F. Piron et al, NIM **A560**(2006)395-404

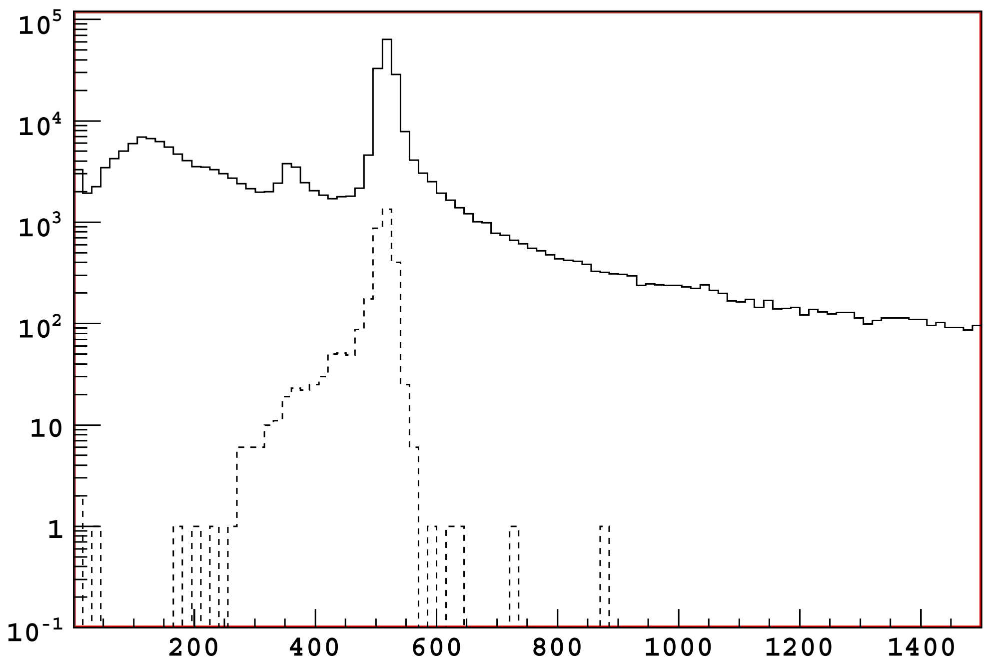

FIG. 1 – Deposited energy in the first layer for 1.5 GeV/nucleon Carbon ions. Solid line corresponds to raw data, the dashed line histogram is after the cuts as described in the text.

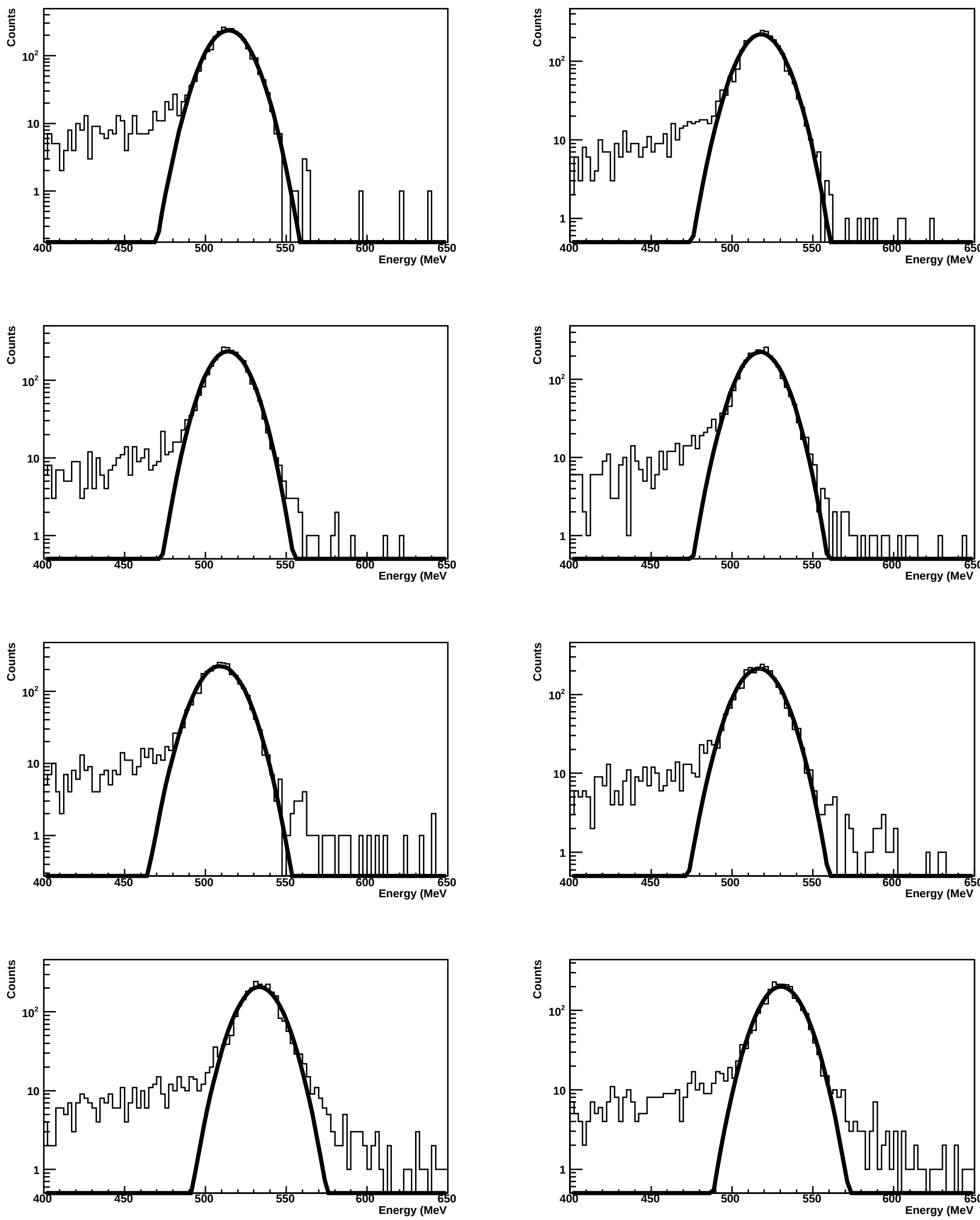

Fig. 2 – Deposited energy distributions measured in the eight layers of the CsI calorimeter for 1.5 GeV/nucleon Carbon ions. The solid black curves correspond to the gaussian fits of the ionization peaks.

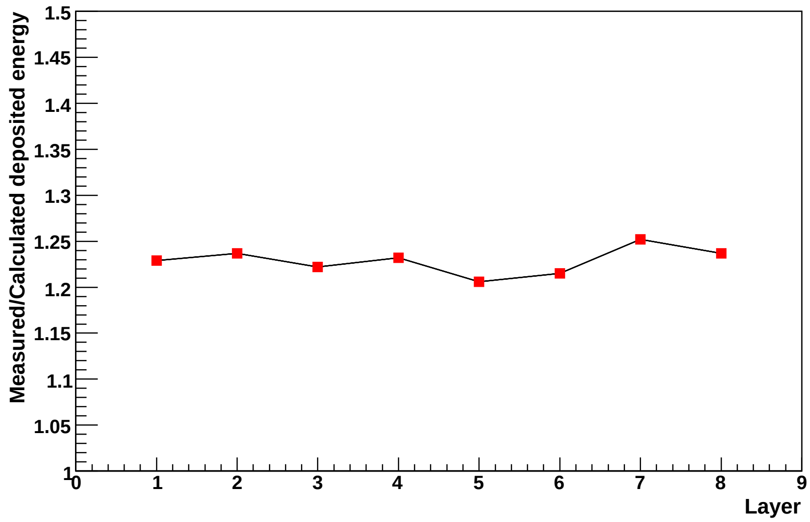

FIG. 3 – Ratio of the mean energy measured over the calculated deposited energy (i.e quenching factor) in the eight EM layers for 1.5 GeV/nucleon Carbon ions.

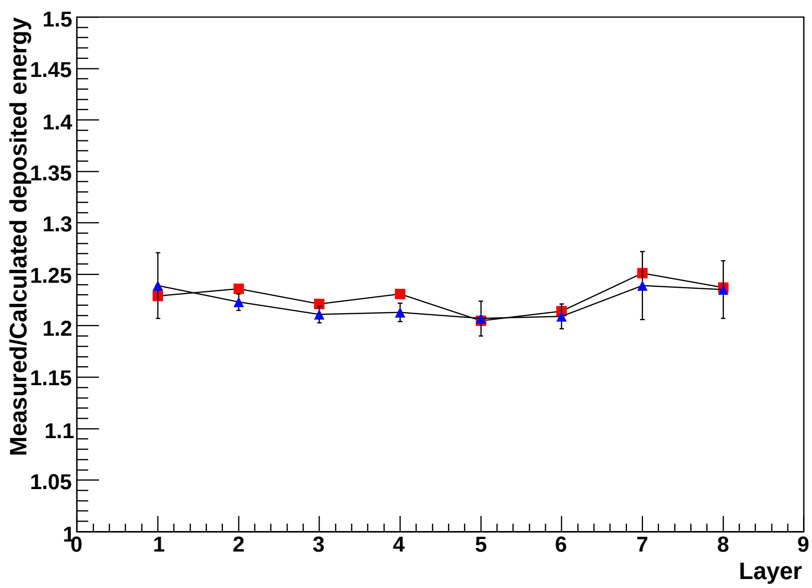

FIG. 4 – Ratio of the mean energy measured over the calculated deposited energy (i.e quenching factor) in the eight EM layers for 1.5 GeV/nucleon Carbon ions for events with $\Delta t < 5 \times 10^{-4}$s in red squares and events with $\Delta t > 4 \times 10^{-2}$s in blue triangles.

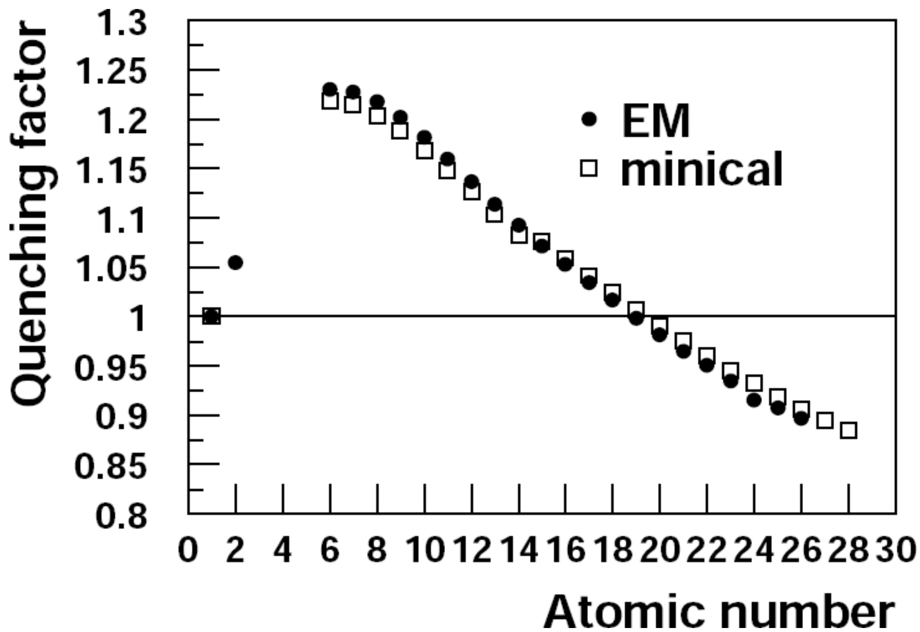

Fig. 5 – Quenching factor for several ions at 1.7 GeV/nucleon kinetic energy. From [1]