FOURTH REPORT ON GEANT SIMULATION

by
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1 Introduction

This is the fourth GEANT simulation report. In this report I will again focus on the missing energy resolution. As suggested by Michael Kuss and Arun Saha, I also run the case with 10% of the maximum gas density (0.110 gm/cm^3) just to see the effects of the beam energy spread on the missing energy spectrum. Note that I have not yet implemented the internal bremsstrahlung in the simulation. I believe the internal bremsstrahlung has a small effect on the missing energy spectrum resolution. However, it will affect the measurement of absolute cross sections.

2 Missing Energy Resolution

Figures 1- 3 show the missing energy spectra for full, half, and 10% gas density. In these figures, all the energy loss processes for all particles (e_0, e', p) and the beam energy spread (a square distrubution with a total width of 2×10^{-4} of e_0 is assumed) are included.

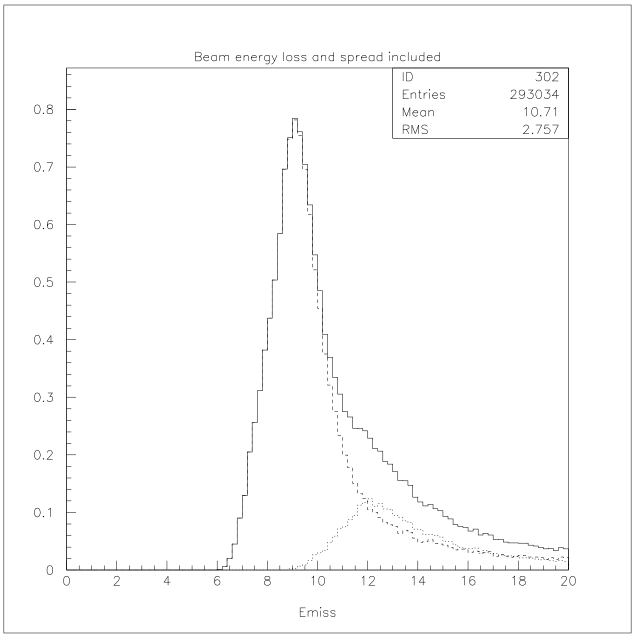

Fig. 1 Plot of the missing energy spectrum for full gas density.

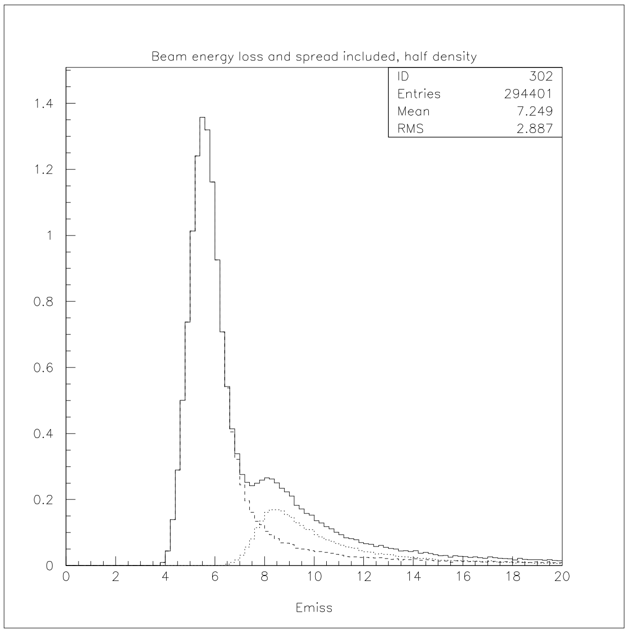

Fig. 2 Plot of the missing energy spectrum for half gas density.

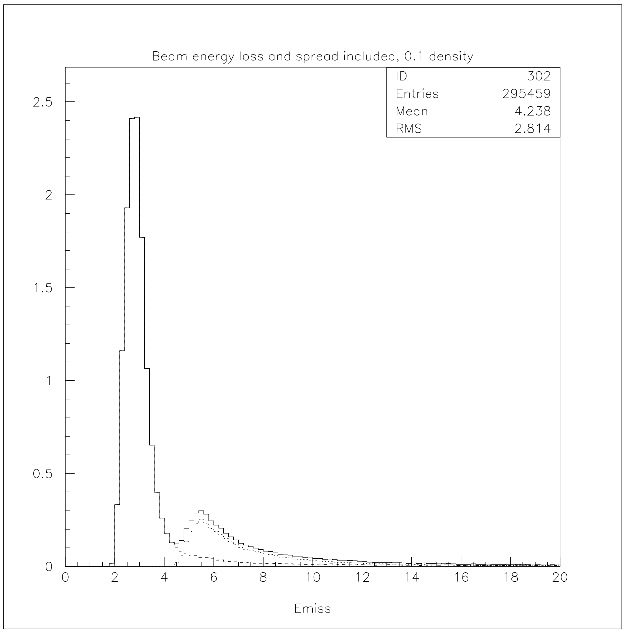

Fig. 3 Plot of the missing energy spectrum for 10% gas density.

The solid lines are for the sum of both the two-body and the continuum, the long dashed lines are for the two-body channel only, and the dotted lines are for the continuum. As one can see, the separation between two-body breakup and the continuum is barely discernible at full gas density and is acceptable at half gas density. The separation is almost complete at 10% gas density.

Figures 4 - 6 show the energy loss for incident electrons, the outgoing electrons and protons, and some of the sums as a function of zc (event location along the beam in the target). As one would expect, the energy loss depends on the path length traversed by the given particle. It is interesting to note that:

- the external bremsstrahlung events are obvious for electrons (upper two panels) and are absent for protons,
- the energy straggling in protons is larger than that in electrons; thus, protons contribute more to the missing energy resolution than electrons, and
- the effect of beam energy spread is seen as a "thick" band in the upper right panel of Fig. 6.

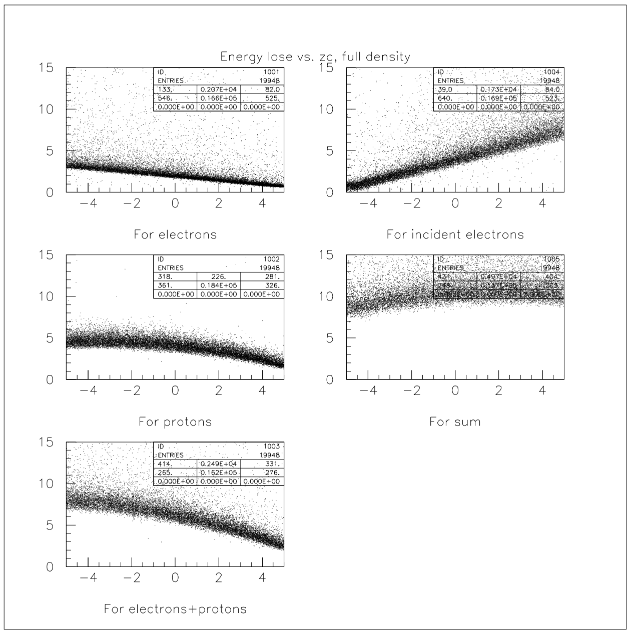

Fig. 4 Plots of electrons and protons energy loss for full gas density as a function of zc.

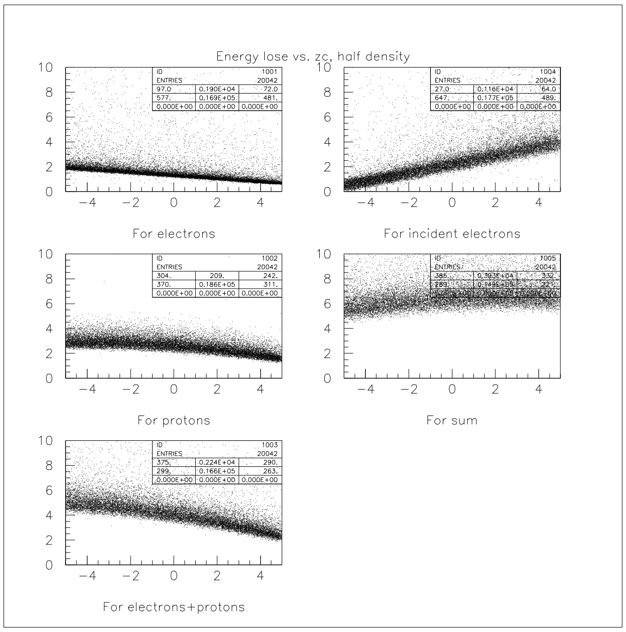

Fig. 5 Plots of electrons and protons energy loss for half gas density as a function of zc.

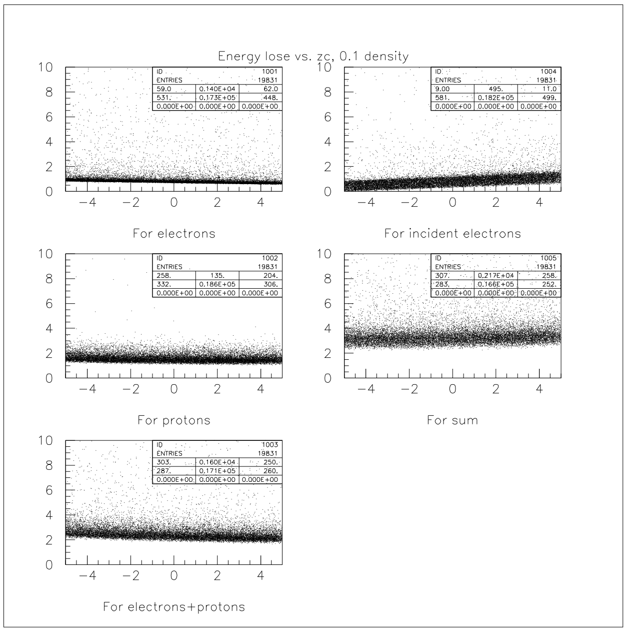

Fig. 6 Plots of electrons and protons energy loss for 0.1% gas density as a function of zc.

To see the effects of beam energy spread on the missing energy resolution, the simulation is repeated with the beam energy resolution (spread) turned off. Figures 7 and 8 show the results similar to those of Figs. 3 and 6. Figure 9 shows the comparison of the missing energy spectrum with and without the beam energy spread included.

As one can see, the peak width for the two-body breakup becomes narrower, although the improvement in the separation between two-body breakup and the continuum is not dramatic.

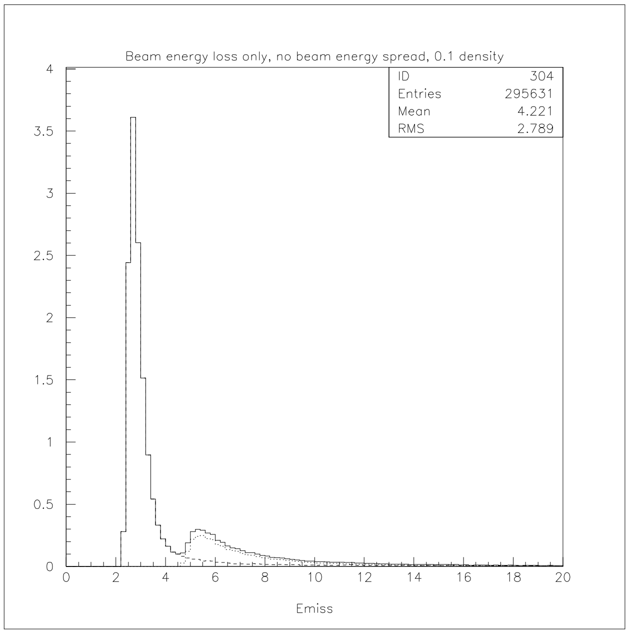

Fig. 7 Plot of the missing energy spectrum for 10% gas density. The beam energy spread is off.

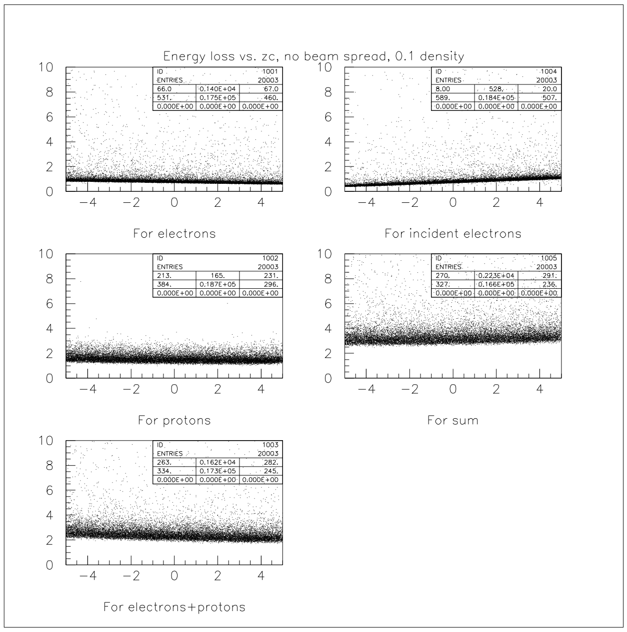

Fig. 8 Plots of electrons and protons energy loss for 0.1% gas density as a function of zc. The beam energy spread is off.

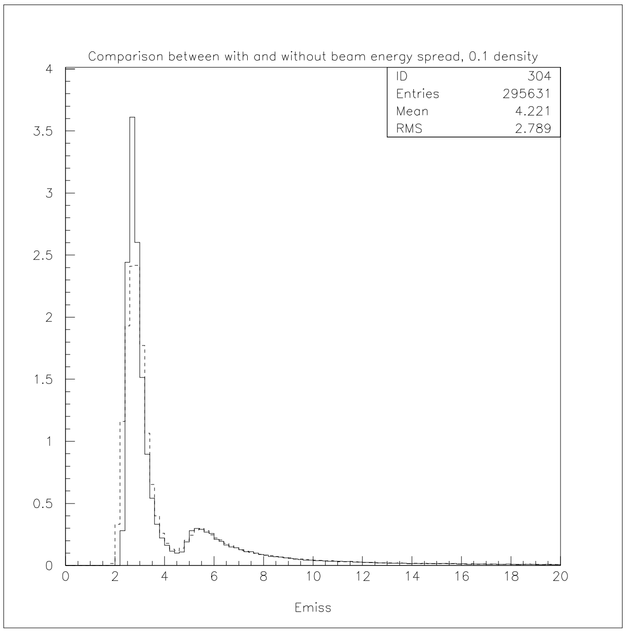

Fig. 9 Comparison of the missing energy spectrum for 10% gas density with and without the beam energy spread included.

Figure 10 shows the missing energy spectrum for half gas density with beam energy spread turned off. This figure is to be compared with Fig. 2 As one can see turning the beam energy spread off improves only slightly the separation between two-body breakup and the continuum; although the two-body peak is narrower. This is because the effects of energy straggling are already larger than the beam energy spread.

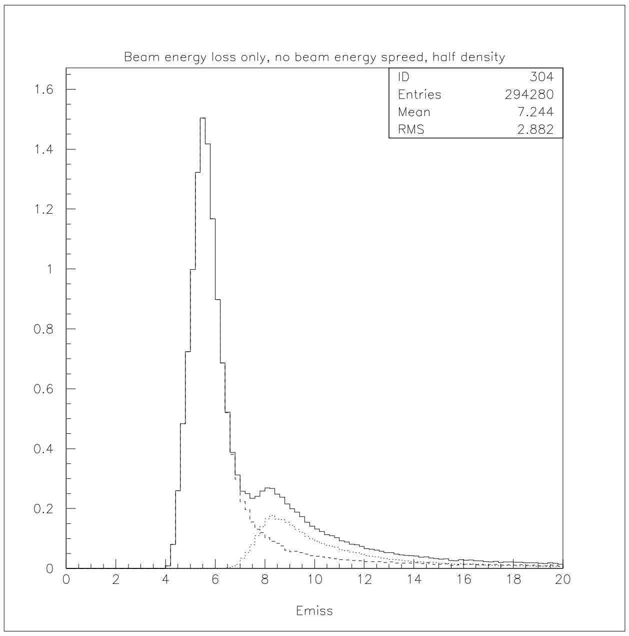

Fig. 10 Plot of the missing energy spectrum for half gas density. The beam energy spread is off.