Discussion with Doug

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1 Ratios between the central momenta of the spectometer

My basic formula for fitting data:

$$(1+\delta)\,E_c + \Delta E_{Loss} = \frac{E_0}{1+\frac{E_0}{M}(1-\cos\theta)} \tag{1}$$

To stabilize my fits I have decided to calculate the ratios between the central momenta of the spectrometer, using the Tantalum data from different kinematics:

$$\frac{\left(1+\delta^1\right)E_c^1 + \Delta E_{Loss}}{\left(1+\delta^i\right)E_c^i + \Delta E_{Loss}} = \frac{\frac{E_0}{1+\frac{E_0}{M}(1-\cos\theta^1)}}{\frac{E_0}{1+\frac{E_0}{M}(1-\cos\theta^i)}} \approx 1, \tag{2}$$

where $i = 2, 3, 4, ...$ and denotes characterizes different kinematics. Assuming that right side of the equation is approximately 1, we get:

$$\left(1+\delta^1\right)E_c^1 + \Delta E_{Loss} = \left(1+\delta^i\right)E_c^i + \Delta E_{Loss} \tag{3}$$

Because energy losses are same on both sides of the equation, we can eliminate them and finally get:

$$\frac{\left(1+\delta^1\right)}{\left(1+\delta^i\right)} = \frac{E_c^i}{E_c^1} \tag{4}$$

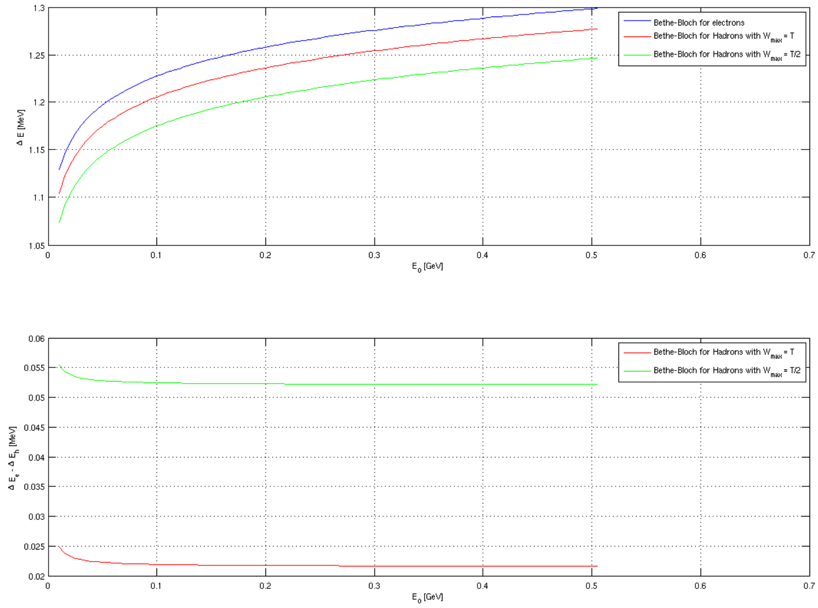
I have used these ratios in my fitting functions. When I calculate these ratios I get the following values:

Ratio $\frac{E_c^i}{E_c^1}$	Scat.Angle	Value
HRSL-2	24.0	1.0
HRSL-3	28.3	0.99388
HRSL-4	28.3	0.99388
HRSL-5	32.5	0.98695
HRSL-6	16.0	1.0
HRSR-All	All Angles	0.990914

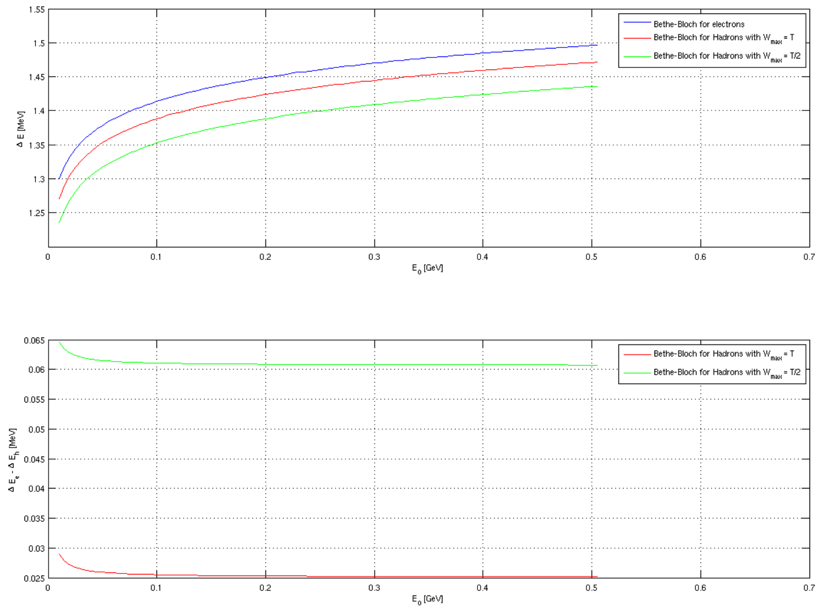
2 Energy Loss calculation

To calculate the energy losses of the electrons Mceep uses the Bethe-Bloch equation which should be used only for heavy ions and not for electrons. I have examined what is the difference between the energy losses calculated with the Electron-Bethe-Bloch formula and Hadron-Bethe-Bloch formula. The results of my simulation are shown in the graphs 1-4. From these results we can conclude that difference between these two formulas is very small. Therefore it is all the same which formula we use to calculate the energy losses. I have decided to use the same formula as Mr. Ulmer did and got the following results:

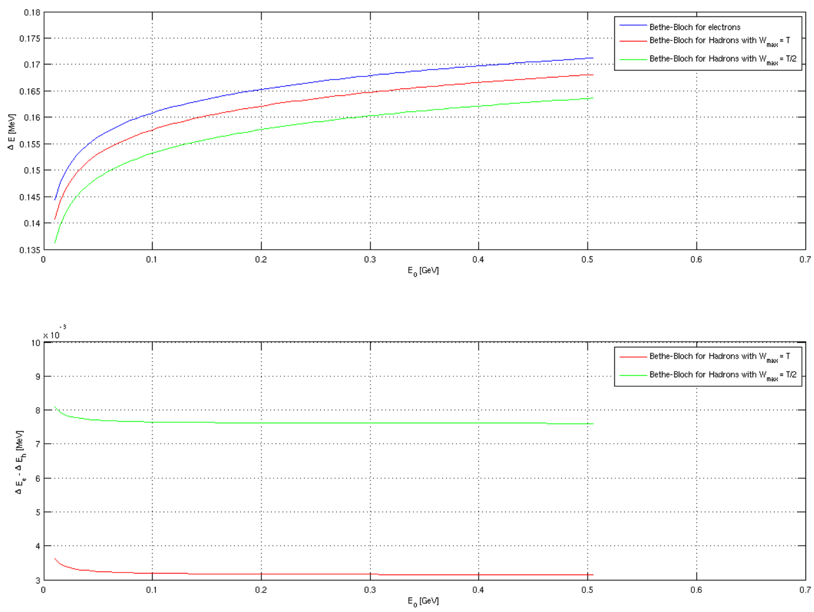
Target	E_0 without energy losses	E_0 with energy losses	ΔE_{Loss}
LH_2	348.442	347.181	1.261
LD_2	354.1237	352.709	1.4147
^12C-single foil	359.000	358.569	0.431
^12C-optics	359.000	358.462	0.538
Ta	359.934	359.587	0.347



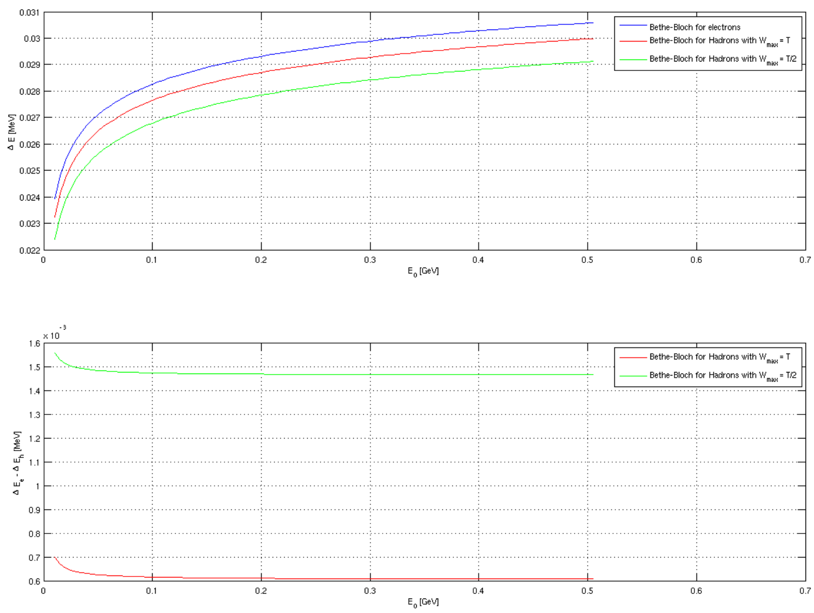
Slika 1: Energy losses for the Hydrogen target



Slika 2: Energy losses for the Deuterium target



Slika 3: Energy losses for the Carbon target



Slika 4: Energy losses for the Tantalum target

3 Results - Fitting only H and Ta

When I fit my fitting function only to the H and Ta data, I get the following results:

$$E_c^1 = 356.415 \text{ MeV} \tag{5}$$
$$E_0^{HRSL} = 362.917 \pm 0.117 \text{ MeV} \tag{6}$$
$$E_0^{HRSR} = 362.925 \pm 0.100 \text{ MeV} \tag{7}$$

4 Results - Fitting all data points

When I use all data to fit my function, I get the following results:

$$E_c^1 = 356.56 \text{ MeV} \tag{8}$$
$$E_0^{HRSL} = 363.059 \pm 0.105 \text{ MeV} \tag{9}$$
$$E_0^{HRSR} = 363.06 \pm 0.082 \text{ MeV} \tag{10}$$