Beam energy determination
a brief report

Miha Mihovilovic - miham@jlab.org
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Dear Colleagues!

I believe that Simon and I have found the problem, that has been troubling us for the last month. The problem was in the calculation of the electron energy losses in various targets. In my analysis I have taken into account only collisional losses but forgot to consider radiation losses. It turns out that in our energy regime (E0 approx. 360 MeV) radiation losses are much bigger (up to 100 times) that collisional losses and this changes my results dramatically. The table below shows new values of energy losses for our targets at (E0 = 362 MeV) :

Target	S [MeV cm^2/g]	ρ [g /cm^3]	d [cm]	q [g/cm^2]	ΔE [MeV]
Ta	52.71	/	/	0.0202	**1.065**
Al (dummy)	16.23	/	/	0.259	**4.204 (per plate)**
C (optics)	9.989	~2.0	/	0.042	**0.4195 (per plate)**
H (4cm)	10.66	0.0708	4cm	/	3.02 (only H)
Entrance window (Al)	16.23	2.702	0.0127	/	0.557
Exit window (Al)	16.23	2.702	0.0113	/	0.496
				TOTAL	**4.07**
D (4cm)	~5.33	0.162	4cm	/	3.45 (only D)
Entrance window (Al)	16.23	2.702	0.0112	/	0.491
Exit window (Al)	16.23	2.702	0.014	/	0.614
				TOTAL	**4.56**

With these new values for energy losses I have then redone my analysis. I haven't been able to do a complete analysis yet, therefore I would like o show you only some preliminary results of my work. In this analysis I have assumed that in the extended targets (C- optics , H and D) an average path of the particle through the target is approximately one half of the length of the target. Therefore the energy losses of the particle in given target is approximately one half of the value stated in the table above. However, in the thin targets (C and Ta) a particle travels through the whole target and therefore we have to use the whole

values from the table above , to calculate the energy losses of the electrons in these targets. In this analysis I have excluded measurements taken from the Al- Dummy target, because I haven't figured out yet, how to properly consider energy losses in this target.

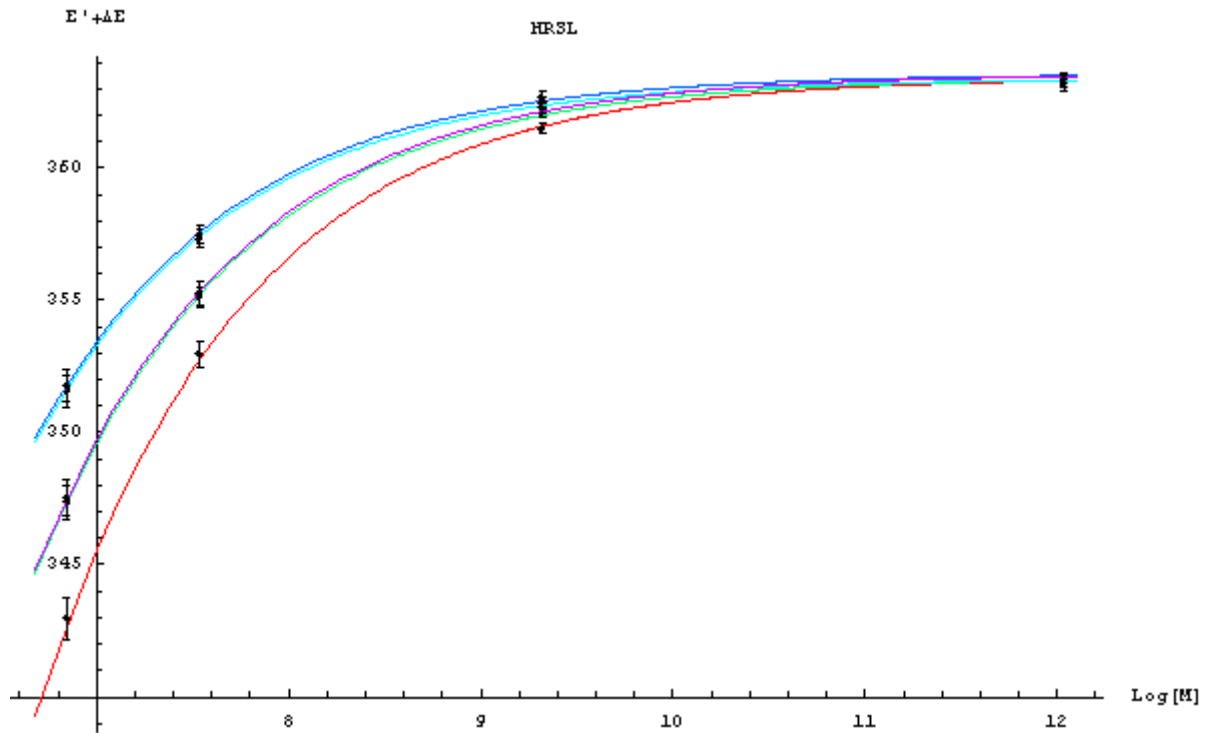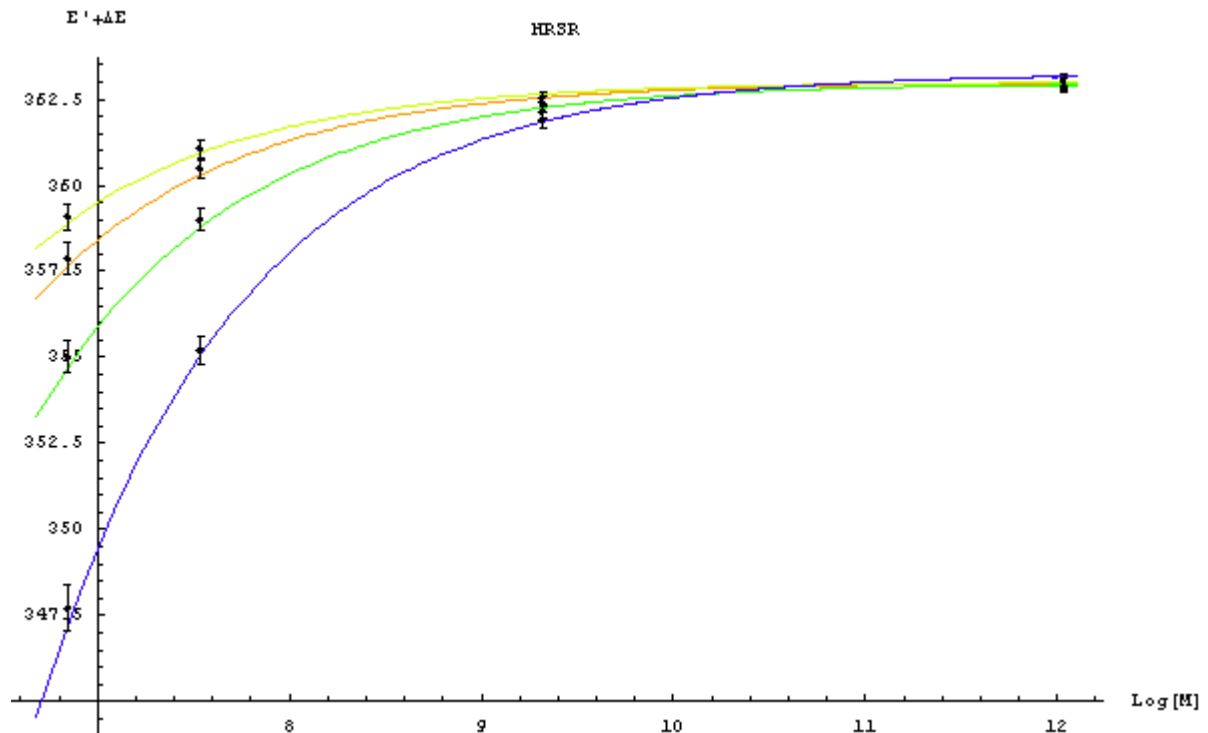The results of my analysis are shown in figures below.

Illustration 1: Graph shows measured values and fits through these points for different kinematics. The red line corresponds to the kinematic point 3 (θ = 32.5deg), the violet and green to the kinematic point 11 (θ = 28.3 deg) and both blue lines to the kinematic point 2 (θ = 24.0 deg)

Illustration 2: Graph shows measured values and fits through these points for different kinematics. The blue line corresponds to the kinematic point 11 (θ = 28.3deg), the green to the kinematic point 2 (θ = 24.0 deg) the orange to the kin. point 1 (θ = 16.0deg) and the yellow to the kin. point 9 (θ = 14.0deg).
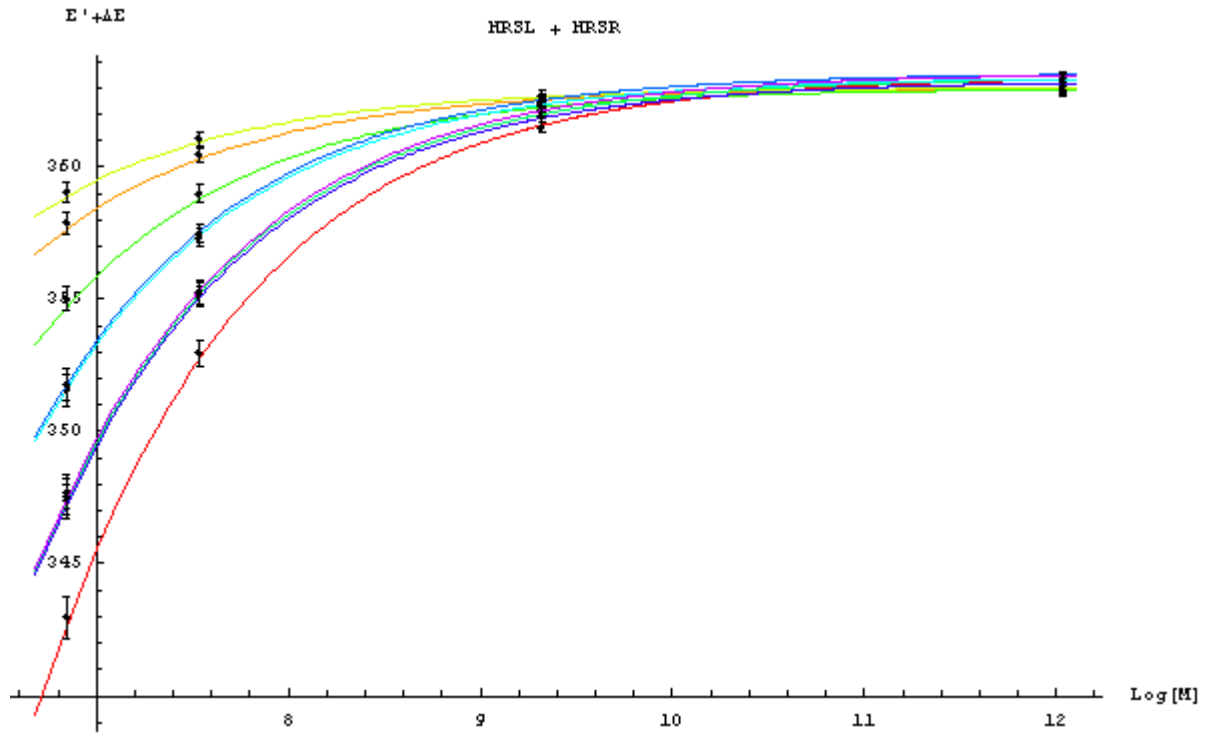
Illustration 3:Graph shows measured values and fits through these points for different kinematics, for both spectrometers together.
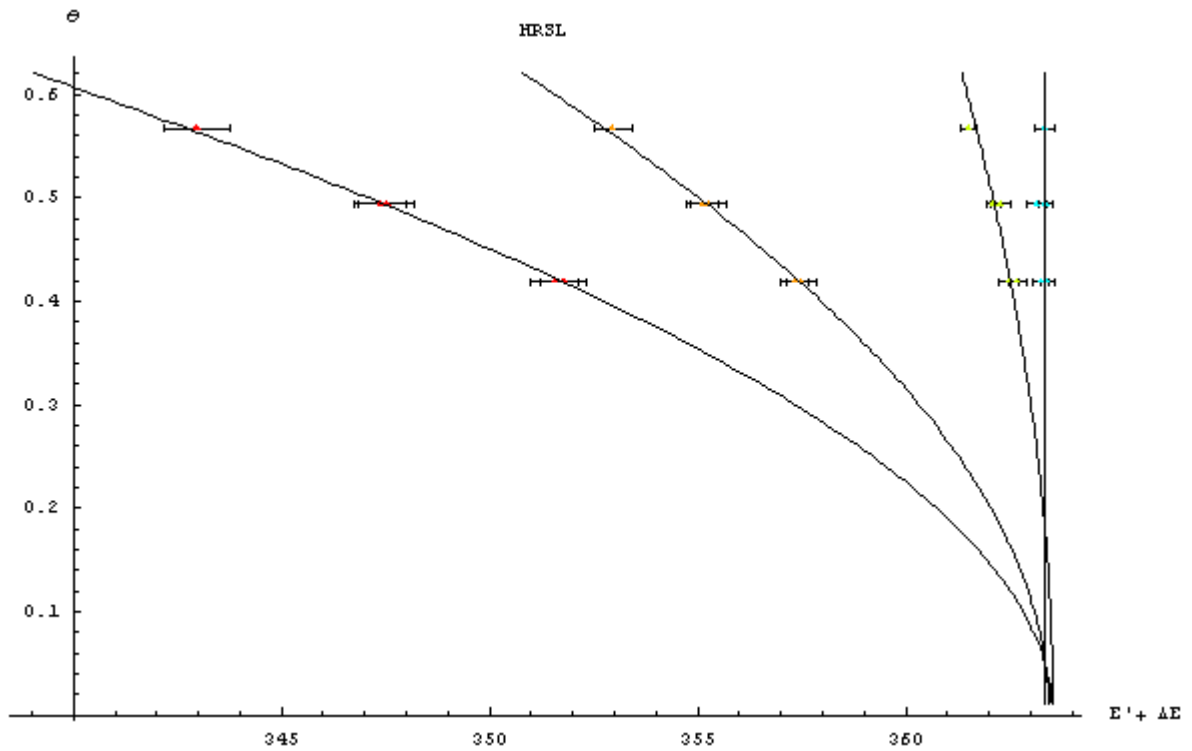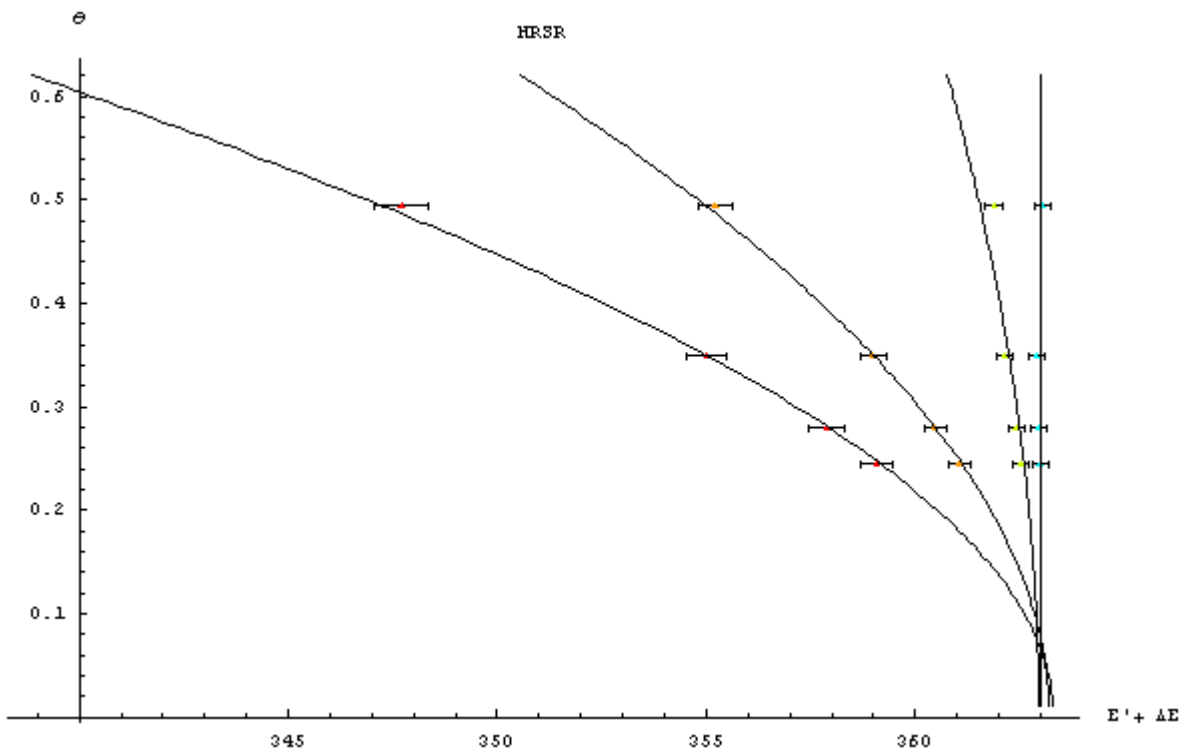

Illustration 4: Graph shows measured points and their fits for different targets (Red – Hydrogen target, Orange- Deuterium, Green - Carbon, Cyan - Tantalum). Points shown in this graph were measured with the HRS-L spectrometer.

Illustration 5: Graph shows measured points and their fits for different targets (Red – Hydrogen target, Orange- Deuterium, Green - Carbon, Cyan - Tantalum). Points shown in this graph were measured with the HRS-R spectrometer.
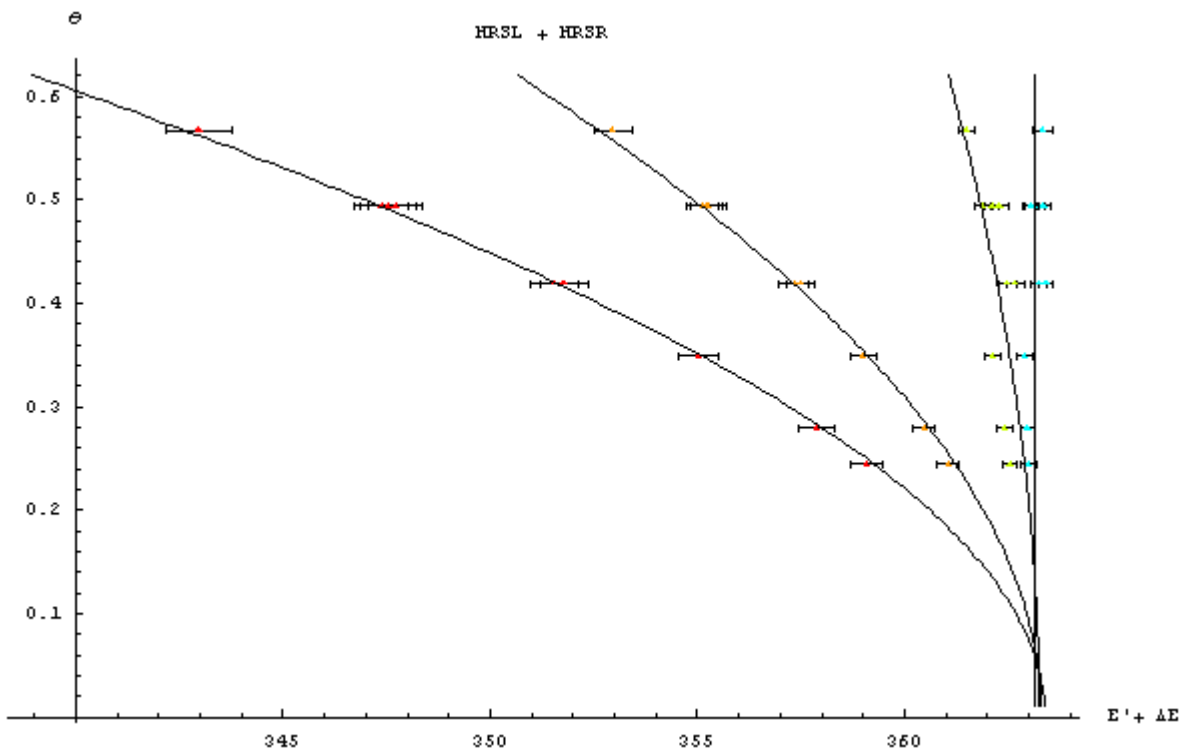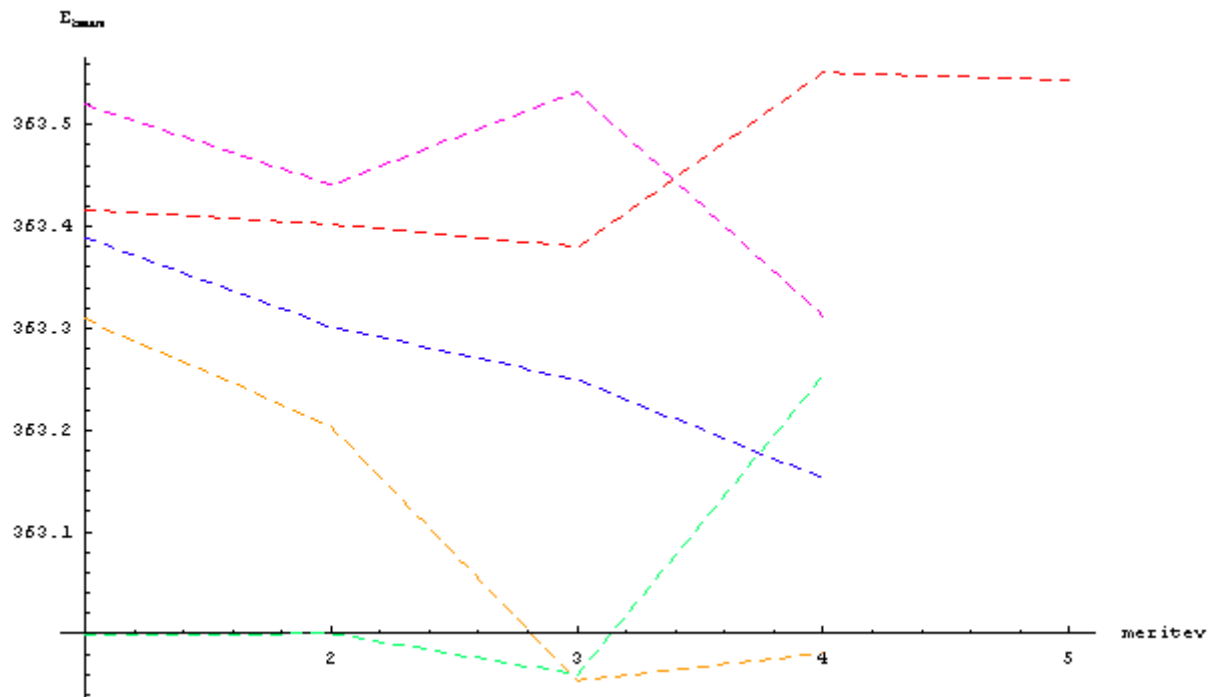

Illustration 6: Graph shows measured points and their fits for different targets (Red – Hydrogen target, Orange- Deuterium, Green - Carbon, Cyan - Tantalum). In this case, we used points from both spectrometers (HRS-L and HRS-R) together to calculate fits.

*Illustration 7: This graph shows the values of beam energy, calculated with both fitting methods (θ(E; Ebeam), E(M; Ebeam)) and with different sets of data. The **red** line corresponds to the beam energies that we get from fits in illustration 1, where we use only data from HRS-L to calculate the beam energy. The **green** line corresponds to the beam energies that we get from fits in illustration 2, where we use only data from HRS-R to calculate the beam energy. The **violet** line corresponds to the beam energies that we get from fits in illustration 4, where we use only data from HRS-L to calculate the beam energy. The **orange** line corresponds to the beam energies that we get from fits in illustration 5, where we use only data from HRS-R to calculate the beam energy. The **blue** line corresponds to the beam energies that we get from fits in illustration 6, where we use both data from HRS-L and HRS-R to calculate the beam energy.*