Combining Energy loss and Rutherford Scattering experiments

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Currently, students currently perform the same task, that of measuring the thickness of a thin foil, using two different methods in the Part II labs:

**Energy Loss** By measuring the energy loss of α particles in the foil;

**Rutherford Scattering** From fitting the known Rutherford cross section to measured data.

The first experiment has the added advantage of the students making their own foil of Al by evaporation and then measuring that thickness of foil by energy loss. The second experiment suffers from a lack of time: the count rate is such that only 3 or 4 points may be collected over the course of the two days with any useful statistics. Good students will have also been able to calculate the theoretical cross section, using Excel, in order to fit the thickness of the Au foil.

This proposal serves to combine the two experiments and exploit the two weeks available in order to expand on the themes already introduced. The purpose of the experiment is to measure the thickness of a sample of Al foil that the students create by evaporation in the lab. This foil, however, is a little more ambitious than the one created. It must be large enough, and hopefully uniform enough, in order to fit over a blank target (to be constructed) for the Rutherford apparatus. There must also be enough left over to utilise in the Energy loss Apparatus.

The students will then use the Rutherford apparatus to measure Rutherford scattering from that mounted foil for a number of angles with sufficient statistics over the course of the two weeks. One or two points a day will
suffice. During that time, they will also use the left-over piece to measure the thickness of the foil using the Energy Loss system.

After having done the latter, they may use Excel to calculate the expected Rutherford cross section using the measured thickness. They will have the luxury of time to do the job properly without rushing as is currently the case. Alternatively, they could fit the Rutherford cross section to the large data set and find the thickness to compare to that found earlier. At the end they should have an accurate determination of the thickness, and appreciate the utility of using Rutherford scattering as a measurement tool as is done in most accelerator labs when thickness of targets must be known. If we could redesign the Rutherford apparatus, I would opt also for RBS...

**Alternative:** The students could opt for using Au instead of Al. This would require that we supply them with the energy loss function (Ziegler tables) which they could use accordingly. That may be better (even for Al) given that one would need to do some numerical work for use in the analysis.