LFEUI - Logbook 2

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We arrived at Centro Tecnológico e Nuclear at 9:30 AM in the 9th of December to meet with investigators Rodrigo Mateus and Norberto Catarino.

1 Samples

We started by discussing the samples that we will be using during the day. In the previous session, we had already concluded that there would be two different types of samples: glass samples with lithium in their composition and also implanted samples. The latter consists of a thin layer of lithium implanted in an aluminium substrate. As for the glass samples, they are not available and we will simply use three different samples, each one with a different substance/material whose composition varies from sample to sample.

Samples	Description	Composition
1	Lithium fluoride	LiF
2	Lithium aluminate	$LiAlO_2$
3	Implanted sample	Li implanted in Al

Table 1: Samples used in the experiment

We displayed the samples in a sample holder with the given order: in the lowest position the implanted sample, followed by lithium aluminate ($LiAlO_2$) and finally lithium fluoride (LiF). From top to bottom, we have samples 1 to 3 in the sample holder.

2 Experimental Procedure

First of all, we assembled the source holder like it is described in the previous section. So that we can do a calibration from the number of counts per channel to energy, we put an additional americium-241 source on the holder. Using a pachymeter, we measured the distance between the samples. We put the sample holder on a support and afterwards both of them inside the chamber. The vacuum machine was connected to the accelerator to reduce the pressure inside the accelerator (measured from the top of the container).

Samples	Distance [cm]
Americium	1.5
LiF	3.3
LiAlO2	4.8
Implanted Li-7 in Al	6.0

Table 2: Distance between the samples in the sample holder

Afterwards, we started the procedure to turn on the TANDEM accelerator, according to the manuals provided. This was a very time consuming step that took all morning. We had to start the high voltage supply, start the vacuum in the first chamber of the accelerator and then extend it to the accelerator as a whole and gradually increase all the accelerator parameters to the standards used in previous logbooks.

In the afternoon, we fisrtly turned on the H^+ duoplasmatron source of the accelerator as well as the magnets and lenses. Then, we opened the valves to propagate the vacuum throughout the entirety of the tubes.

In the control panel, we adjusted the angles of the lenses and the magnets current according to the manual, so that the beam would reach the samples.

The electromagnets were set with the following currents: - low energy switch magnet current - 1.5 A; - high energy switch 90° magnet current - 13.1 A; - second high energy switch magnet current - 13.9 A;

Then we turned on the camera next to the samples to observe if it was well adjusted. The beam wasn't rightly centred so we adjusted the angles and positions of the lenses until it was in the correct position using electrostatic steering. Finally, we used a collimator with a 2mm radius to collimate the beam.

The angle between the top two detectors was 165°, a value used in the proposal to get an estimate for the energy used for the beam. The final energy reached by the tandem accelerator was 650 keV, or 1300 keV total (as the tandem accelerator has 2 tubes).

We used a computer program to obtain the spectra of the different sources. To start, we obtained the spectrum of americium-241 in order to do a calibration subsequently. Then we changed the acquisition mode from time to charge to obtain the spectra of the different sources, as the time mode is only used for calibrations. The multichannel analyser (MCA) utilised to acquire data was gradually set to 70 V.

After obtaining the lithium spectra, we obtained a spectrum with borum by aiming the detector at the middle of the encapsulated sources (approximately 5.4 cm from the top), since their encapsulation is made of boric acid.

We obtained 8 files with our spectra, all with 1024 channels: from TT_20 to TT_27. In those files we were only interested in the unfiltered spectra of channels 0, 1 and 2 - channel 2 corresponded to the detector under the sample holder.

TT_20 was a very short calibration that shall not be used.

TT_21 was the used calibration and it took 5 minutes to acquire.

TT_22 was our first acquisition of the top sample (LiF). Max charge was set to 2 micro Coulombs.

TT_23 was the acquisition of the same sample but with with a max charge of 2 micro Coulombs.

TT_24 was the acquisition of LiAlO2 with a max charge of 2 micro Coulombs.

TT_25 had the spectrum of the implanted sample with a 2 micro Coulombs max charge.

TT_26 was the same sample but with a max charge of 20 micro Coulombs as the implanted lithium was had very small peaks.

TT_27 we were aiming at the middle of the sources to obtain a spectrum with borum. Max charge of 20 micro Coulombs.

At the end of the acquisition we had to gradually reduce the current and voltage of the accelerator in order to turn it off. Basically doing the inverse procedure we did in the morning.

We left CTN at around 4:45 PM.

References

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