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FACULDADE DE CIÊNCIAS E TECNOLOGIA
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Study of nuclear reactions producing ^{36}Cl by Micro-AMS

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Objectives

^{36}Cl is one of several short to medium lived isotopes (as compared to the earth age) whose abundances at the earlier solar system may help to clarify its formation process. There are two generally accepted possible models for the production of this radionuclide: it originated from the ejecta of a nearby supernova (where ^{36}Cl was most probably produced in the s-process by neutron irradiation of ^{35}Cl) and/or it was produced by in-situ irradiation of nebular dust by energetic particles (mostly, p, a, ^{3}He -X-wind irradiation model).
The objective of the present work is to measure the cross section of the $^{37}Cl(p,d)^{36}Cl$ and $^{35}Cl(d,p)^{36}Cl$ nuclear reactions using the micro-AMS system at ITN, taking advantage of the very low detection limits of this technique for chlorine measurements. The AgCl targets will be irradiated in the Atomki Lab in Debrecen, Hungary where high energy (>10MeV) proton and deuterium beams are available.

Figure 1: Low-energy side of the Micro-AMS system at ITN

Methodology

With the aim of studying nuclear reactions producing ^{36}Cl, we started by irradiating at the Portuguese National Reactor samples of pure AgCl. This procedure had two purposes: measure the cross section of neutron capture by ^{35}Cl normalizing it to the well known cross section of neutron capture by ^{109}Ag, and to obtain ^{36}Cl standards for the AMS measurement of X-wind relevant reactions, testing also the linearity of the measurement process.
The second part of this work will be to irradiate high purity AgCl targets (produced at ITN) with high energy protons and deuterium. The ^{36}Cl produced in this targets by the high energy particles will be quantified in the ITN lab in Lisbon with the micro-AMS system. This quantification will allow the calculation of the cross section for these two nuclear reactions, for several energies.

Figure 2: High-energy side of the Micro-AMS system at ITN

Expected Results

Most of the work so far has been spent in the developement of the ^{36}Cl measurement capabilities at the ITN system. This required the instalation of offset faraday cups, and extensive precision and reprodutibility tests.
In figure 3, a low energy mass scan is shown, where the peaks corresponding to $^{37}Cl^-$ and $^{35}Cl^-$ isotopes are visible before injection in the accelerator. Figure 4 shows four peaks in a high energy mass scan (mass spectometer positioned after the accelerator) resulting from the injection of $^{35}Cl^-$. The peaks correspond to, from left to right; $^{35}Cl^{5+}$, $^{35}Cl^{4+}$, $^{35}Cl^{3+}$, $^{35}Cl^{2+}$.

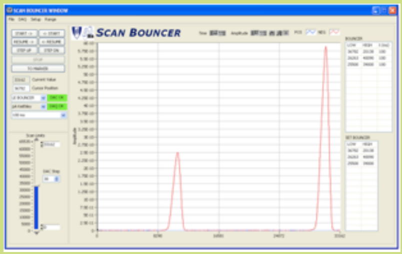

Figure 3: LE Bouncer scan showing the $^{37}Cl^-$ and $^{35}Cl^-$ peaks

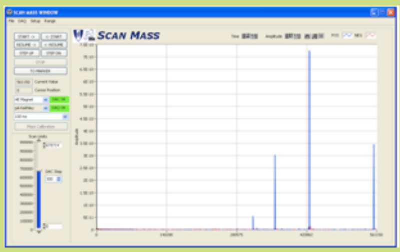

Figure 4: HE Magnet scan showing (left to right) the $^{35}Cl^{5+}$, $^{35}Cl^{4+}$, $^{35}Cl^{3+}$and $^{35}Cl^{2+}$ peaks

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