**Online commissioning of the AstroBox2 detector**

A. Saastamoinen, B.T. Roeder, A. Spiridon, R. Chycz, M. Dag, R.E. Tribble, E. Pollaco,[1]
L. Trache,[2] G. Pascovici,[2] and M.R.D. Rodrigues[3]
[1] *IRFU, CEA Saclay, Gif-sur-Yvette, France*
[2] *National Institute of Physics and Nuclear Engineering, Bucharest-Magurele, Romania*
[3] *Instituto de Física, Universidade de São Paulo, São Paulo, Brazil*

In past years we have done several studies of beta-delayed proton emitters of astrophysical interest by implantation technique [1-5]. It was realized rather soon that shrinking the physical detection volume of elements in Si detector did not reduce the beta-background enough to create background free spectrum in the typical energy range of astrophysically interesting decays
($E_p$ ~ few hundred keV). To further reduce the beta-background a novel detector, AstroBox, based on Micro Pattern Gas Amplifier Detector (MPGAD) was developed [6]. Recently we have built an upgraded version of the detector, called AstroBox2 [7]. The construction of the detector and the offline commissioning of the first Micromegas detector element is described in the previous annual reports [8,9].

We have tested the first AstroBox2 Micromegas detector with 128 μm amplification gap in online conditions with beta-decays of and $^{25}$Si, $^{20}$Na, and $^{23}$Al. The beams were produced through deep-inelastic fragmentation ($^{25}$Si), or fusion evaporation ($^{20}$Na, $^{23}$Al) reactions, in inverse-kinematics at energies of 40-45 MeV/u and separated with Momentum Achromat Recoil Separator (MARS) before being implanted into the gas volume of the detector.

Good overall production rate of $^{25}$Si (~5 ions/nC), in combination with the high branching ratio for low energy beta-delayed proton emission (4.75(32)% absolute intensity for 401 keV proton [10)], makes it an ideal case to test and optimize various parameters of the setup. A sample spectrum from decay of $^{25}$Si, with a comparison to GEANT4 simulation, is shown in Fig. 1. We have optimized our

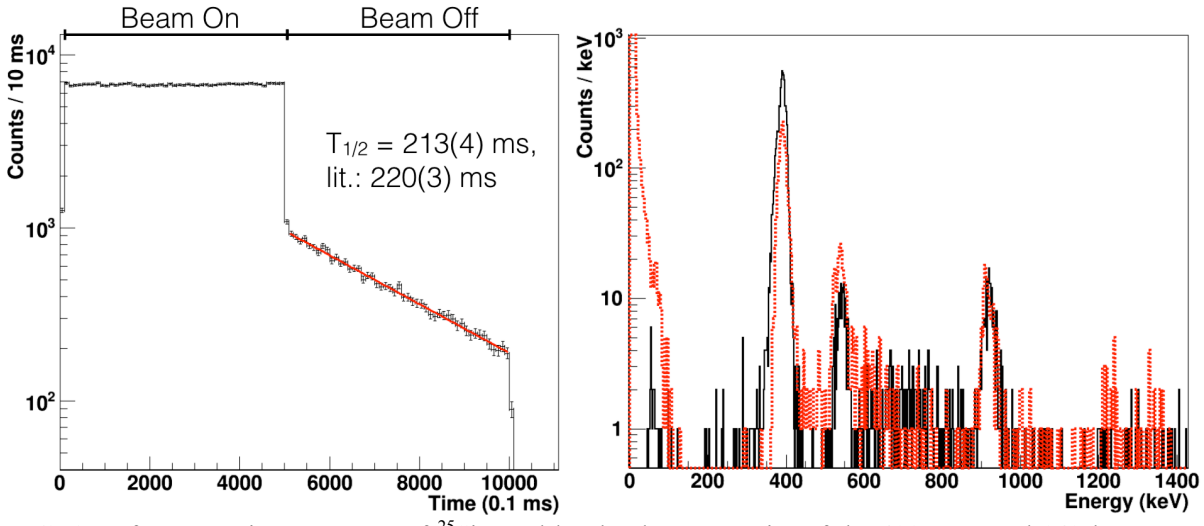


**FIG. 1.** Left: Decay time spectrum of $^{25}$Si gated by the decay energies of the 401, 555, and 943 keV proton peaks. Right: Measured beta-delayed proton spectrum of $^{25}$Si (black, solid) compared to a GEANT4 simulation (red, dashed) when decays are confined into one pad active volume. Resolution of the 401 keV proton group is ~4%. The data was collected during beam off period of a pulsed beam with a cycle of 500 ms on and 500 ms off.

implantation efficiency by reducing the distance from the beam energy degrader to the window separating the gas volume from the beam line vacuum. At the moment more than 50% of the activity produced, as measured with MARS target detector, is implanted inside AstroBox2 and contained over the centermost readout pads. The remaining losses are most likely due to MARS target detector ladder and the zero length reduced coupling the setup to the MARS target detector chamber. This implantation activity rate of $^{25}$Si allows thorough calibration of the detector in about one shift, making the detector in its present stage fully functional for decay studies. However, we are studying possible optimizations in form of new mesh technologies, better gas mixtures, and improved gating grid structures that should improve and push the performance beyond the present capabilities.


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