β-decay proton emission studies with the Active Target Time Projection Chamber (AT-TPC)

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We have investigated the β-delayed proton emission in the neutron-rich nucleus ^{11}Be. Due to the neutron halo nature of this particular isotope, some exotic decay channels are open. In particular, the emission of protons after β decay is energetically possible, with a very low branching ratio of 10^{-5}. This is a counterintuitive process because ^{11}Be has 4 protons and 7 neutrons, and therefore its neutron separation energy (0.5 MeV) is much smaller than the proton one (20 MeV). Because of the very low Q-value of this reaction channel, protons are emitted with an average kinetic energy of 200 keV, which makes its detection extremely challenging. Moreover, protons have to be distinguished from particles emitted in other decay channels with much larger probability (namely ^{11}Be->^{7}Li+^{4}He).

We performed an implantation-decay experiment at TRIUMF (Canada) using the AT-TPC, a time projection chamber equipped with Multilayer Thick GEM and Micromegas. We directly observed for the first time the emission of protons from ^{11}Be and we deduced its energy spectrum. We will present the experiment and the data analysis, including the particle identification method using the characteristic Bragg curve of each detected particle. We will also discuss our R&D program to improve the detection capabilities of our setup.