β-delayed proton decay of ^{27}P

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Indirect methods - a combination of experimental and theoretical analyses - are well established and their use is broad in the field of Nuclear Astrophysics (NA). Information useful to determine the reaction rates of interest in different stellar environments, at very low energies (tens and hundreds of keV), can be obtained by using information obtained in experiments at higher energies. The fact that most of the important nucleosynthesis reactions involve unstable nuclei and taking into consideration the available low-energy reactions, makes the use of direct measurements unsuitable in most cases [1].

The isotope ^{26}Al hold a special place in the big Galaxy picture; with a half-life of $T_{1/2} \approx 0.717$ Myr it is short-lived when compared to the timescale of the Galactic chemical evolution [2]. That is why, its discovery in the interstellar medium in 1982 [3] represented a strong evidence that the nucleosynthesis is an ongoing process. However, there are still uncertainties regarding its production and destruction sites and the reaction rates involved in this processes.

We present here the results of an experiment of β-delayed proton-decay of ^{27}P performed at the Cyclotron Institute, Texas A&M University in which the resonant radiative proton capture on the first excited state of ^{26}Al, ^{26m}Al(p,γ)^{27}Si was investigated with an indirect method and using a gas detector, AstroBox2 [4]. We populated excited states in ^{27}Si through β-decay of ^{27}P, which further emit protons, the same states that would be resonances in the inverse proton capture.

New low-energy proton groups down to 150 keV (FIG 1, left) were found and their branching ratios were extracted. These are the resonances that dominate the ^{26m}Al(p,γ)^{27}Si reaction. Additionally, a more precise half-life for the ^{27}P isotope was determined (FIG 1, right) and the behavior of the reaction rate of the radiative proton capture on ^{26m}Al is explored.

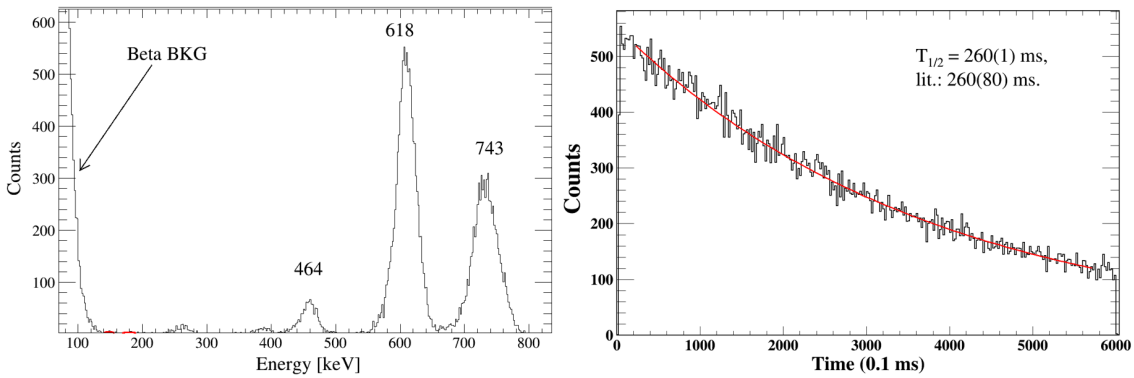

FIG. 1: (left) ^{27}P β-delayed proton spectrum; (right) Decay time spectrum of ^{27}P.

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