Confirmation the existence of the X17 particle

A.J. Krasznahorkay[1], M. Csatlós[1], L. Csige[1], A. Krasznahorkay[2], Á. Nagy[1], N. Sas[1], B.M. Nyakó, J. Timár[1]

[1]*Inst. for Nucl. Res., Hungarian Acad. of Sci., Debrecen, Hungary,*

[2]*CERN, Geneva, Switzerland*

Recently, we used the ^{7}Li(p,e^+e^-)^{8}Be reaction to excite an 18.15 MeV excited state in ^{8}Be and observed its internal pair (e^+e^-) decay to the ground state. An anomaly in the form of peak-like enhancement relative to the internal pair creation was observed at large angles in the angular correlation [1]. It turned out that this could be a first hint for a 17 MeV X-boson (X17), which may connect our visible world with Dark Matter [2]. The possible relation of the X17 to the Dark Matter problem triggered great theoretical and experimental interest in the particle, hadron, nuclear and atomic physics communities. Zhang and Miller discussed in detail whether a possible explanation of nuclear physics origin could be found [3]. They have not found any of such explanation.

Using a significantly modified and improved experimental setup, we reinvestigated the anomaly observed in the e^+e^- angular correlation by using a new tandetron accelerator of our institute. This setup has different efficiency curve as a function of the correlation angle, and different sensitivity to cosmic rays yielding practically independent experimental results. In this experiment, the previous data were reproduced within the error bars.

To confirm the existence of the X17 boson, we conducted a search for similar anomaly in another nuclear transition. The $0^- \rightarrow 0^+$ transition in ^{4}He, which energy is 21.1 MeV, was chosen. If X17 is a vector boson with $J^\pi=1^+$ [2] then the emission can be done with L=1 angular momentum, while in case of the X17 is an axion like particle (ALP) [4] then it can be emitted with L=0. The 21.1 MeV ($J^\pi=0^-$) state is broad, Γ=0.84 MeV, and it overlaps with the first excited state located at E_x=20.21 MeV ($J^\pi=0^+$, Γ=0.50 MeV), but it did not complicate our results.

We used proton resonant capture reaction on ^{3}H target at a beam energy of E_p= 0.90 MeV, and this way, we excited both of the above overlapping states. We observed e^+e^- pairs with an angular correlation characteristic basically to the external pair creation (EPC) of the γ-rays created in the direct capture process of the ^{3}H(p,γ)^{4}He reaction and no contribution from the week $0^+ \rightarrow 0^+$ E0 process. On top of the EPC background a peak at Θ≈115° is clearly visible with larger than 5σ confidence. According to our simulations performed with GEANT4, this peak corresponds to the decay of the X17 boson created in the $0^- \rightarrow 0^+$ transition.

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