Deeply bound pionic atoms from the (γ, p) reaction in nuclei

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In the past decade a search, both theoretical and experimental, for deeply bound states was conducted, which lead to the successful detection of these states in Pb isotopes in [1]. In this paper we study the (γ, p) reaction on ^{208}Pb leading to ^{207}Pb with a bound pion attached to it in the lowest 1s or 2p pionic levels [2], which has not been studied so far. The reaction can be made recoilless to optimize the production cross section but we must choose a bit higher photon energy to overcome the Coulomb barrier in the proton emission. The results for the double differential cross section of the reaction are shown in Figure 1.

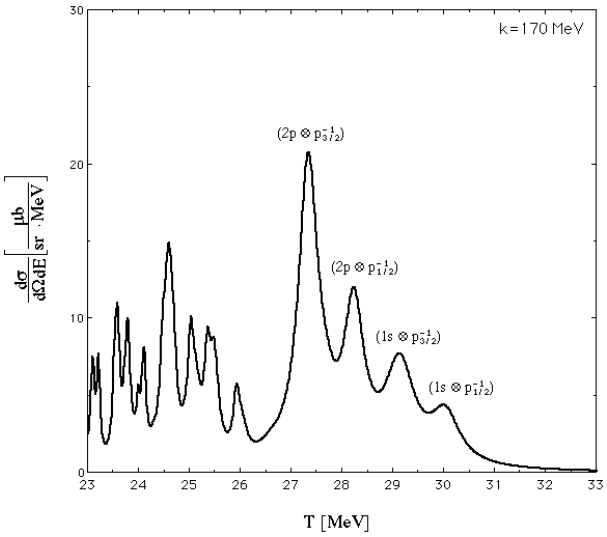

Figure 1: Expected spectra of the ^{208}Pb(γ,p)^{207}Pb$\cdot\pi_b^-$ reaction at the photon energy k=170 MeV as a function of the emitted proton energy. A convolution with the experimental resolution of 50 keV FWHM is implemented in the results.

The cross sections obtained are easily measurable and can be larger than 50 per cent of the background from inclusive (γ,p) [2]. This makes it a clear case for the detection of the pionic atom signals, converting this reaction into a practical tool to produce deeply bound pionic atoms.

References

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