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Measurement of the bound-state beta decay of bare 205-Thallium and its nuclear astrophysical implications

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We report on the first direct measurement of the bound-state beta decay [1] of 205 Tl⁸¹⁺ ions, an exotic decay mode, in which an electron is directly created in one of the empty atomic orbitals instead of being emitted into the continuum. One of the most awaited and pioneering experiments was realized in the spring beamtime at GSI, Darmstadt in 2020, wherein the entire accelerator chain was employed. 205 Tl⁸¹⁺ ions (with no electron) were produced with the projectile fragmentation of 206 Pb primary beam on 9 Be target, separated in the fragment separator (FRS), accumulated, cooled, and stored for different storage times (up to 10 hours) in the experimental storage ring (ESR). The experimentally measured half-life value [2] draws a 4.7 σ [3] and 7 σ [4] tension with the theoretically predicted values, which could influence our understanding of the abundance of chemical elements in the early universe. In this contribution, the authors aim to present the s-process motivation and a preliminary value of the 205 Tl⁸¹⁺ half-life.

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