# Bound-state beta-decay of bare $^{205}$Tl ions at the ESR

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Beta decay of highly charged ions has attracted much attention in recent years. An obvious motivation for this research is that stellar nucleosynthesis proceeds at high temperatures where the involved atoms are highly ionized. Another important reason is addressing decays of well-defined quantum-mechanical systems, such as one-electron ions where all interactions with other electrons are excluded. The largest modifications of nuclear half-lives with respect to neutral atoms have been observed in beta decay of highly charged ions. These studies can be performed solely at ion storage rings and ion traps, because there high atomic charge states can be preserved for extended periods of time (up to several hours).

The occurrence of the bound-state beta-decay ($\beta_b$) accompanied by the emission of a monochromatic antineutrino, was first predicted by Daudel et al [1] in 1947 and then quantitatively discussed in detail by Bahcall [2]. The first direct observation of the bound-state beta decay ($\beta_b$ decay) was done in 1992 by Jung et al [3] with the use of bare $^{163}Dy^{66+}$ ions stored in the heavy ion storage ring Experimental Storage Ring (ESR) at GSI. The measurement of the bound-state beta-decay rate of fully-ionized $^{205}$Tl ions is needed to determine the matrix element for the electron capture decay of the 2.3 keV excited state in $^{205}$Pb to the ground state of $^{205}$Tl. This matrix element is important for the determination of neutrino capture probability into the 2.3 keV state of $^{205}$Pb [4].

I will talk about the unique ion storage cooler ring facility offered at GSI. The production of bare $^{205}Tl^{81+}$ from $^{206}$Pb beam, it's separation from contaminants in FRagment Separator (FRS), transmission, storage and beam preparation in the ESR, as well as detection of decay events in the non-destructive Schottky detectors will also be discussed.

## References

[1] R. Daudel, M. Jean and M. Lecoin, J. Phys. Radium **8**, 238 (1947).
[2] J. N. Bahcall, Phys. Rev. **124**, 495 (1961).
[3] M. Jung et al., Phys. Rev. Lett. **69**, 15 (1992).
[4] M.K. Pevicevic et al., Nucl. Instr. and Meth. **A 621**, 282 (2010).