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C. Couratin, G. Ban, A. Chapon, P. Delahaye, D. Dominique Durand, et al.. Measurement of the ${}^6\text{Li}$ charge state distributions following the ${}^6\text{He}^+$ beta decay. XXVII International Conference on Photonic, Electronic and Atomic Collisions (ICPEAC 2011), 2011, Belfast, Ireland. pp.152013, <10.1088/1742-6596/388/15/152013>. <in2p3-00753591>

HAL Id: in2p3-00753591

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Submitted on 27 May 2025

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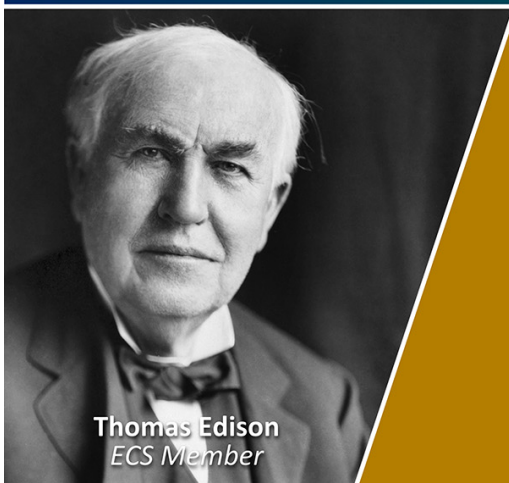
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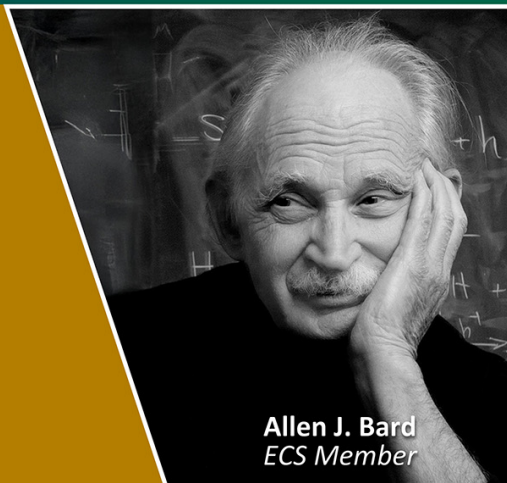
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Measurement of the ${}^6\text{Li}$ charge state distributions following the ${}^6\text{He}^+$ beta decay

C. Couratin*, G. Ban*, A. Chapon*, P. Delahaye[†], D. Durand*, X. Flécharde*, B. Guillon*, A. Leredde*, E. Liénard*, F. Mauger*, A. Méry[‡], O. Naviliat-Cuncic^{*,§}, E. Pierre*, G. Quemener*, D. Rodríguez[¶], J.C. Thomas[†], E. Traykov[†], S. Vaintraub^{||}, and Ph. Velten*

* LPC Caen, ENSICAEN, Université de Caen, CNRS/IN2P3-ENSI, Caen, France

[†] GANIL, CEA/DSM-CNRS/IN2P3, Caen, France

[‡] CIMAP, CEA/CNRS/ENSICAEN, Université de Caen, Caen, France

[§] Present address: NSCL, Michigan State University, East Lansing, Mi, USA

[¶] Departamento de Física Atómica, Molecular y Nuclear, Universidad de Granada, 18071, Granada, Spain

^{||} Weizmann Institute of Science, PO box 26, Rehovot 76100, Israel

[†] School of Physics, UCD Science Centre, Belfield, Dublin 4, Ireland

Synopsis We measure the probability of “shake-off” ionization of the daughter nucleus in the β decay of ${}^6\text{He}^+$ ions confined in a transparent Paul trap. This measurement, in good agreement with theoretical calculations, allows to reduce systematic error contributions in previous β - v correlation experiments dedicated to the search for physics beyond the Standard Model.

During β decay, the change of the nuclear charge can lead to the loss of some bound electrons of the recoiling daughter nucleus. This is the so-called “shake-off” ionization process. The LPCTrap device, which is coupled to the low-energy beam-line LIRAT of the SPIRAL facility at GANIL, has been recently modified to measure the charge state distributions of the recoil ions resulting from β decay.

In this set-up, the radioactive ions, ${}^6\text{He}^+$, are confined in a transparent Paul trap that enables the detection of the recoil ions Li^{2+} and Li^{3+} in coincidence with the β particles [1]. After leaving the Paul trap, the recoil ions are accelerated between two 90% transmission grids followed by a 50 cm field free region. The Time of flight measurement of the recoil ions allows then the charge state separation (figure 1). In addition, a focusing electrode has been installed in the flight tube to drive the ions towards the detector with maximal collection efficiency.

With this setup, the shake-off ionization probability has been measured for the first time in the decay of ${}^6\text{He}^+$ ions. This probability had been previously theoretically estimated to be $P=2.33\%$ [2]. The data analysis, which is still in progress, will enable to check the theoretical value.

Moreover, the number of coincidences recorded during the experiment is high enough to determine the β - v angular correlation parameter with a statistical uncertainty of $\sim 0.5\%$. For this measurement, the charge state distributions are part of the systematic effects to be considered. Their determination contributes to the limitation of the systematic error.

The LPCTrap set-up is presently unique in measuring recoil charge state distributions after the decay of radioactive ions. Perspectives in the framework of fundamental interaction physics experiments will be presented during the conference.

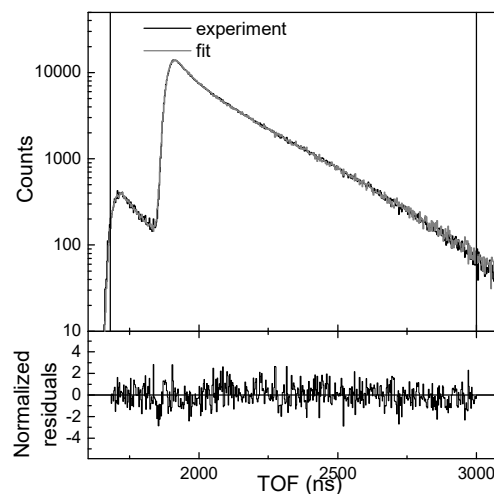


Figure 1. *Top:* Time of flight of the recoiling ${}^6\text{Li}^{2+}$ and ${}^6\text{Li}^{3+}$ ions resulting from the β decay of ${}^6\text{He}^+$. The experimental data are given by the black line, the gray line is a fit using MC simulations for ${}^6\text{Li}^{2+}$ and ${}^6\text{Li}^{3+}$ ions. *Bottom:* normalized residuals

References

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- [2] L. Wauters and N. Vaeck 1996 *Phys. Rev. C* **53** 497