Contribution ID: **53** Type: **Contributed Oral**

Bound-state beta-decay of Thallium-205 to constrain s-process predictions for the early Solar System

Saturday, 18 February 2023 16:15 (15 minutes)

Bound-state β-decay (β_b^--decay) is a radically transformative decay mode that can change the stability of a nucleus and generate temperature- and density-dependent decay rates. In this decay mode the β-electron is created directly in a bound atomic orbital of the daughter nucleus instead of being emitted into the continuum, so the decay channel is only significant in almost fully stripped ions during extreme astrophysical conditions. The β_b^--decay of $^{205}Tl^{81+}$ could influence our understanding of the production of ^{205}Pb, a short-lived radioactive (SLR) nucleus that is fully produced by the s-process in stars. In the context of the early Solar system, SLRs are defined by half-lives of 0.1-100 My and their abundance in meteorites can be used to constrain the formation of the Solar System [1]. Historically, it has been noted that thermal population of the 2.3 keV state of ^{205}Pb in stellar conditions could dramatically reduce the abundance of s-process ^{205}Pb by speeding up the EC-decay to ^{205}Tl. This destruction of ^{205}Pb is potentially balanced by the β_b^--decay of $^{205}Tl^{81+}$ [2]. Currently, a theoretical prediction for the half-life of fully stripped ^{205}Tl is used in stellar models, but given the importance of the $^{205}Pb/^{205}Pb$ chronometer, a measurement of the β_b^--decay for $^{205}Tl^{81+}$ was conducted at the GSI Heavy Ion Facility in March 2020. A $^{205}Tl^{81+}$ beam was stored in the Experimental Storage Ring, and the growth of $^{205}Pb^{81+}$ daughters with storage time was directly attributable to the β_b^--decay channel. The authors will report a preliminary measured half-life and detail how this half-life can be used to more accurately predict the ^{205}Pb abundance in the early Solar System.

[1] M. Lugaro, et al. Progress in Particle and Nuclear Physics, 102:1–47, 2018.
[2] K. Yokoi, et al. Astronomy and Astrophysics, 145:339–346, 1985.

Supervisor

Iris Dillmann

Funding Agency

NSERC

Supervisor Email

dillmann@triumf.ca

Your Email

gleckenby@triumf.ca

Primary authors: LECKENBY, Guy (TRIUMF); Dr CHEN, Rui Jiu (GSI Helmholtzzentrum für Schwerionenforschung GmbH); SIDHU, Ragandeep Singh (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI)); Dr MANCINO, Riccardo (GSI Helmholtzzentrum für Schwerionenforschung GmbH); Prof. LITVINOV, Yuri (GSI Helmholtzzentrum für Schwerionenforschung GmbH); Prof. TAKAHASHI, Kohji (GSI Helmholtzzentrum für Schwerionenforschung GmbH); GLORIUS, Jan (GSI Helmholtz Center Darmstadt); Prof. MARTINEZ PINEDO, Gabriel (GSI Helmholtzzentrum für Schwerionenforschung GmbH); Dr WEICK, Helmut (GSI Helmholtzzentrum für Schwerionenforschung GmbH); DILLMANN, Iris (TRIUMF); GRIFFIN, Chris (TRIUMF); Dr PIGNATARI, Marco (Konkoly Observatory); Dr LUGARO, Maria (Konkoly Observatory); Dr BATTINO, Umberto (University of Hull); Ms KAUR, Tejpreet (Panjab University Chandigarh); Dr CRISTALLO, Sergio (National Institute of Astrophysics INAF, Abruzzo Observatory); Dr VESCOVI, Diego (Goethe University Frankfurt); Dr FAESTERMANN, Thomas (Technische Universitat Munchen); Dr GERNHAUSER, Roman (Technische Universitat Munchen)

Presenter: LECKENBY, Guy (TRIUMF)

Session Classification: February 18 Afternoon Session

Track Classification: Nuclear Physics