Contribution ID: **94** Type: **Poster**

Repairing ^{205}Pb as an early Solar System chronometer by measuring the bound-state beta decay of ^{205}Tl

Monday 16 September 2024 20:15 (20 minutes)

Lead-205 looks like a promising cosmochronometer for the early Solar System due to its unique position among astrophysically short-lived radionuclides as an *s*-only isotope probing the termination of the *s* process [1]. Unfortunately, the 2.3 keV first excited state in ^{205}Pb reduces the half-life in stellar environments by around 6 orders of magnitude, which could severely inhibit ^{205}Pb production. However, Yokoi *et. al.* [2] pointed out that the bound-state β decay of ^{205}Tl could counter-balance this decay by producing ^{205}Pb. To clarify the complex production of ^{205}Pb, we measured the bound-state β decay of $^{205}Tl^{81+}$ at the Experimental Storage Ring in GSI, Darmstadt. From the measured half-life, we calculated new weak decay rates for a wide range of astrophysical conditions. AGB stellar nucleosynthesis models based on these new rates saw approximately a factor 2 increase in ^{205}Pb production (when legacy rates were controlled). With new production ratios, we predicted an updated steady-state interstellar medium (ISM) ^{205}Pb/^{204}Pb ratio. By comparing the ISM ratio to the ratio measured in the earliest meteorites, we derived, for the first time, a positive time interval for the isolation period of the solar material from enrichment.

[1] Lugaro (2018) PPNP 102:1–47.
[2] Yokoi (1985) A&A 145:339–346.

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Session Classification: Poster Session