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Weak rates determining the production of the ^{205}Pb cosmochronometer in AGB stars

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^{205}Pb has been proposed as a cosmochronometer for the early solar system as it is only produced in the s-process and has a half-life of 17 My. This half-life can change dramatically in the stellar environment depending on the ionization stage of ^{205}Pb and ^{205}Tl and the thermal population of excited nuclear states. ^{205}Pb has an excited $1/2^-$ state at 2.3 keV that shortens its half-life by six orders of magnitude. On the other hand ^{205}Pb can be produced by bound-state beta decay of highly ionized ^{205}Tl. To reliably model the synthesis of ^{205}Pb in AGB stars therefore requires a consistent treatment of both electron capture rates in ^{205}Pb and bound-state beta decay rates in ^{205}Tl for a wide range of temperatures and densities. Compared to previous work by Takahashi and Yokoi we could improve the rates by using an experimentally determined value for the bound-state beta decay of ^{205}Tl that has been measured recently by the E121 collaboration at GSI. We also improved the description of the interaction between ions and plasma and used Dirac-Hartee-Fock calculations for the spectra and wave functions of the ^{205}Pb and ^{205}Tl ions.

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