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The influence of electronic and nuclear correlation on weak decays

Monday, 20 June 2022 14:30 (25 minutes)

We discuss our novel theoretical and computational method for calculating beta-decay rates of radioisotopes in astrophysical scenarios, which takes into account both nuclear end electronic degrees of freedom at the same level of theory. Within this framework, we analyze the 134Cs —-> 134Ba and 135Cs ——> 135Ba beta decays, which are crucial production channels for Ba isotopes in Asymptotic Giant Branch (AGB) stars. We find a significant increase (by more than a factor 3 for 134Cs) of the half-lives with respect to previous recommendations by Takahashi & Yokoi (TY). The major impact on half-lives comes from nuclear excited state decays, while including electronic temperatures yields a ~20% increase, at energies typical of low- and intermediate-mass AGB stars. Our predictions strongly modify branching ratios along the s-process path, and allow nucleosynthesis models to account well for the isotopic admixtures of Ba in presolar SiC grains.
We also present novel results concerning the weak decay of several other nuclei, such as 63Ni in presolar grains, and 129I to determine the Xe isotopic ratios. We compare them with TY87, finding large discrepancies. Finally, we also discuss the speculative application of our approach to the cosmic lithium problem.

Session

Theoretical Nuclear Astrophysics

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