

## Shell-model half-lives for r-process waiting point nuclei including first-forbidden contributions

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We have performed large-scale shell-model calculations of the half-lives and neutron-branching probabilities of the r-process waiting point nuclei at the magic neutron numbers  $N=50$ ,  $82$ , and  $126$ . The calculations include contributions from allowed Gamow-Teller and, for the first time, also from first-forbidden transitions. We find good agreement with the measured half-lives for the  $N=50$  nuclei with charge numbers  $Z=28-32$  and for the  $N=82$  nuclei  $^{129}\text{Ag}$  and  $^{130}\text{Cd}$ . The contribution of forbidden transitions reduce the half-lives of the  $N=126$  waiting point nuclei significantly, while they have only a small effect on the half-lives of the  $N=50$  and  $82$  r-process nuclei. We also discuss the kexi approximation used in FF transitions and found that it is not a very good approximation when FF should be considered in the half lives.

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