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Thermonuclear reaction rates in rp process of sd shell nuclei

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Using the newly constructed isospin non-conserving (INC) shell-model Hamiltonians, we have derived a new set of resonant and non-resonant (direct capture) contributions to radiative proton-capture reaction rates on sd shell nuclei important for astrophysical rp process, namely, 23Al(p,γ)24Si, 25Al(p,γ)26Si, 28P(p,γ)29S, 29P(p,γ)30S, 35Ar(p,γ)36K, 31Cl(p,γ)32Ar and 32Cl(p,γ)33Ar. The INC Hamiltonian is a combination of an isospin-conserving Hamiltonian, Coulomb interaction and effective isospin-symmetry breaking forces of nuclear origin. The advantage is that Coulomb effects are taken into account with great care, thus the approach allows us to predict unknown nuclear level schemes and to describe decay modes more accurate than the traditional shell model. We confirm that proton capture on excited states of some target nuclei may noticeably contribute to the total rp process rates, e.g. 32Cl(p,γ)33Ar and 31Cl(p,γ)32Ar. We compare our results with previous shell-model calculations and with estimations provided by currently available statistical model.

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