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Plasma shielding effects on nuclear spectra: 18Ne application

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In this study, for the first time, in particular to astrophysics and fusion studies, how atomic nuclei embedded in the plasma environment are affected by plasma are systematically analysed. The related interactions in plasma environments considered as Debye and quantum plasma are depicted by more general exponential cosine screened Coulomb (MGECSC) potential. The plasma effects on the change of nuclear energy levels are probed through computations performed within the nuclear shell-model framework. For this purpose, the single-particle energy (spe) values to be used in the calculations are obtained by considering the modified Woods-Saxon (WS) potential due to shielding effect of plasma environment. As the modification in question is executed on Coulomb interaction term in WS potential, the computations are carried out for 18Ne nucleus which has two valence protons. Under the influence of the plasma, it is confirmed that the spe's change within certain limit value ranges. When considering the nuclear shell-model for the related computing, it is clear that this change leads to an obvious shifting in the energies of the nuclear states. It is observed that proton spe values are sensitive to Plasma shielding effect, and shielding effect has a significant potent on the ground-state and excited energy states of the nucleus. In particular, the ground-state binding energies are determined to be extremely sensitive to the plasma shielding parameters Plasma environments affect the proton spe and ground state energy (gse) in the same way.

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