The Role of Tensor Force in Heavy-Ion Fusion Reactions

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The tensor interaction is of current interests in nuclear physics. It could play a major role in structure, in particular away from stability, as well as in reaction. The full tensor force has been incorporated in the symmetry-unrestricted three-dimensional time-dependent Hartree-Fock (TDHF) theory. The impact of tensor force on the fusion cross-section and Coulomb barrier has been systematically investigated in the heavy-ion fusion reactions ^{16}O+^{16}O, ^{40}Ca+^{40}Ca, ^{40}Ca+^{48}Ca, ^{48}Ca+^{48}Ca, and ^{16}O+^{208}Pb. We found that the height of dynamical Coulomb barrier is systematically increased by the inclusion of tensor force for the spin-unsaturated systems, while the position of the barrier keeps the same. The calculated Coulomb barrier with the tensor force has better agreement with the experiments than the results without the tensor force included. The tensor correlation has minor effect for the spin-saturated reaction systems in the dynamical time evolution. A notable effect is observed in the reaction system ^{48}Ca+^{48}Ca, where around 136% to 10% better agreement with experimental fusion cross-section around Coulomb barrier is improved by the inclusion of tensor force.