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Improved global α optical model potentials at low energies

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Many nuclear astrophysics applications involve radiative α -particle captures, α decays and α -particle transfer reactions. Theoretical estimates of the corresponding reaction rates within the framework of the statistical model of Hauser-Feshbach remain highly uncertain due to the poor knowledge of the α -nucleus optical model potential, especially at low energies far below the Coulomb barrier. In the present paper we propose new global α -optical potentials that take into account the strong energy dependence and nuclear structure effects that characterize the alpha-nucleus interaction. The real part of the potential is calculated using a double-folding procedure over the M3KY effective nucleon-nucleon interaction. A Woods-Saxon potential is used for the imaginary potential where now a new parametrization is introduced to describe its energy dependence. Three potentials are developed, one with purely volume absorption, one with volume plus surface absorption, and finally, one where in addition to volume and surface absorption, the dispersive contributions obtained from the dispersive relation are included. The three potentials considered are able to reproduce the bulk of experimental data on (α, γ) , (α, n) , (α, p) and (n, α) reactions as well as the existing elastic scattering data at energies of relevance to astrophysical applications. However, when considering reaction rates for nuclei in the experimentally unexplored mass region, deviations within a factor of 10 are found. These uncertainties are mainly due to the difficulty in constraining the diffuseness of the imaginary potential from analyses of existing experimental data.