Nuclear Theory

Alpha-Cluster Model, Charge Symmetry of Nuclear Force and Single Particle Bound State Potential in Symmetrical Nuclei

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A phenomenological alpha-cluster model based on the charge symmetry of nuclear force allows one to estimate the last proton position radius (LPPR) in a symmetrical nucleus. The values of LPPR obtained for the symmetrical nuclei with 5<=Z<=45 are used in a long standing problem of determination of the Woods-Saxon single particle bound state potential parameters. With respect to the charge symmetry of nuclear force a requirement of equality of the nuclear potentials for the last neutron and the last proton in a symmetrical nucleus is added to the standard well-depth procedure in solving the Shr\"{o} dinger equation for the nucleon bound states, which makes the Coulomb radius the crucial parameter to determine the others and the value of the last proton rms radius. The Coulomb radii have been obtained with using LPPR. Analysis of the last proton rms radii, the Coulomb radii, the nuclear potential radii obtained at the calculations in comparison with LPPRs, the Coulomb radii from the alpha-cluster model together with the experimental radii shows that for the nuclei with Z>=15 it is inappropriate to represent a single particle bound state by the Woods-Saxon potential. For the nuclei with 5<=Z<=14 the error of the spectroscopic factor obtained with standard parameters in DWBA analysis of pure peripheral one nucleon transfer reactions is estimated. It is shown that for some nuclei using the standard parameters brings an error more than 20%.

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