Few and Multiply Charged Helium-like Neutron Rich Ions: Correlation and Deformation Effects

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The energies of the ground state, mass corrections and mass polarization for few and multiply charged Helium-like ions for 9000 nuclei with charge from $Z = 2$ to $Z = 118$ and neutron number from $N = 2$ to $N = 250$ are calculated with very high accuracy. Recently obtained experimental data for 3500 nucleus assembled with 9000 masses of neutron-rich nucleus, calculated by the method of Hartry-Fock-Bogolubov, have been used as input data for the mass of the nuclei. Mass polarization correction is included in the developed minimization procedure as the perturbation of second order. The obtained values for electron energy characteristics improved by an order of magnitude *(in atomic units)* with its inclusion.

The staggering effects between the mass excess of the nuclei and the electron energy characteristics are studied when organizing deformation multiplets for these 9000 nuclei. New correlations between the energy of the ground state and nuclear proton and neutron magic numbers are established. The obtained results make it possible to verify and possibly establish new neutron magic nuclear numbers in nuclei with large number of neutrons, and to study the effects induced by the deformation of the nucleus on the electron structure. The high accuracy of the results allows their utilization in precision approaches for analysis of low-density high-temperature astrophysical *(in the solar corona)* and laboratory *(controlled fusion, tokamak)* plasma, as well as approaches for the analysis of highly correlated plasma in the crust of neutron stars.