Possible Experiments to Search for Singlet Deuteron and the Problem of the Existence of Neutral Nuclei

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The existence of the dineutron has been predicted 75 years ago, but the question of its existence has not yet been finally resolved. Currently, a number of experimental studies indicate the existence of the dineutron, as well as other lightest neutral nuclei (for example, tetraneutron). If a dineutron exists, then, according to the principle of isotopic invariance, a ${}^1S_0-$ state of two nucleons must also exist. The possibility of describing the neutron-proton interaction in the ${}^1S_0-$ state at low energies as the excitation of a quasi-stationary level lying below the deuteron decay threshold (singlet deuteron) is discussed. The position, neutron and radiative widths of the level are determined by the scattering length, effective radius and cross section for radiative capture of neutrons by protons. Contemporary status and new possible experiments to search for this level in the radiative capture of neutrons by protons and in the resonant scattering of gamma quanta by deuterons are discussed. The discovery of a singlet deuteron would be confirmation of the existence of the dineutron.