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Simulation experiments for direct dineutron decay observation

In our previous studies, possible and statistically significant observations of a bound dineutron in nucler reactions with fast neutrons on 159Tb [1] and 197Au [2] nuclei was investigated, that coincides with the Migdal' s and Dyugaev's [3, 4] predictions about bound dineutron existence. To directly observe the decay of bound dineutrons, the estimation of half-life and the end-point energy for the dineutron decay was made [5, 6]. In addition, some suggestions for the future experiment for direct observation of bound dineutron decay were discussed in [7] along with the list of the nuclei as possible candidates, on which a bound dineutron could be observed in future experiments [8, 9].
In this work, we develop and test the simulation model for the future experiments proposed in [7] for the observation of bound dineutrons in neutron induced nuclear reactions on nuclei from the list defined in [8, 9]. The "irradiated"samples were placed between two thin plastic organic scintillators for detection of electrons due to dineuron decay and surrounded by two BGO detectors for detection of the emitted gamma-rays by nuclear reaction products. Detectors and corresponding circuits may operate both in coincidence and anticoincidence modes. The difference between the detected beta-spectrum with and without formation of dineutrons with thorough consideration of gamma-rays emitted from residual nuclei, can be the directly treated as the sign of the formation of a bound dineutron. The scheme of the decay of dineutron caused by the Gamov-Teller of Fermi transitions with the known decay schemes of residual nuclei are used for the simulation. The dineutron decay was emulated via 90Sr decay with a modified half-life. The predictions about the cross-sections of bound dineutrons formation were also taken into account. The list of the sample nuclei, on which the formation of bound dineutron is expected, was defined. Among them, 169Tm is considered as one of the most promising target nuclei. On the basis of the simulated experiment results, the future real experiment with a more precise estimate of reaction cross-sections will be defined and the corrections to the model of bound dineutron formation in nuclear reactions will be made.

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