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FEATURES OF DATA PROCESSING OF AN EXPERIMENT ON STUDYING PROTON-PROTON CORRELATIONS IN THE d + ^{1}H ⟶ p + p + n REACTION

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A value of a neutron-neutron scattering length was obtained in different experiments. It can be observed that there is a difference in values of a neutron-neutron scattering length ann (in the range from −16 to −22 fm). In [1] it was suggested that such difference may be explained by influence of 3*N*-forces. It can be assumed that *pp* scattering length (or energy of $^1S_0$ virtual state) extracted in the $d + {}^1\mathrm{H} \longrightarrow n + p + p$ reaction will be influenced by 3*N*-forces and will differ from the value obtained in the experiment on the scattering of a proton on a hydrogen target. To test the assumption, INR RAS is currently carrying out work on the study of the $d + {}^1\mathrm{H} \longrightarrow n + p + p$ reaction.

Kinematic modeling was carried out according to technique developed at INR RAS. The possibility of extracting Epp and a_{pp} from an experimental energy spectrum of protons was shown. Parameters of the experimental setup for studying this reaction were determined. A scheme of the setup is presented in [2].

It should be noticed that there are two peaks in the modeling energy spectrum of protons. In our investigation protons are detected at an angle close to an angle of departure of the *NN*-system. In reactions with a formation and a breakup of a virtual *NN*-state a "breakup" particle can fly out in the center of mass system either forward (˜ 0°) or backward (˜ 180°). Only such particles from *NN*-state breakup can fly into the detector. The presence of two peaks in the energy spectrum of protons is explained by that fact. Difference between values of energies in the spectrum depends on energy of the virtual *NN*-state. With an increase of E_{pp} value distance between peaks in the energy spectrum of protons increases. Consequently, analysis of experimental energy spectrum of protons allows determining the value of the virtual singlet *pp*-state energy with some accuracy. Δ*E*-*E*-telescope is used for obtaining experimental energy spectrum. It can be noticed that there is complex dependence of energy losses of protons formed in the reaction $d + {}^1\mathrm{H} \longrightarrow p + p + n$ in the detecting Δ*E*–*E* system. Modeling showed that in spite of this fact two peaks are also present in the energy spectrum of proton losses in the *E*-detector.

The energy spectrum of protons corresponding to the $d + {}^1\mathrm{H} \longrightarrow p + p + n$ reaction can be obtained as a result of processing experimental data. It is possible to compare experimental and simulated energy spectra of protons with usage minimum χ^2 estimation method. This method permits to establish to which value of virtual singlet *pp*-state energy specific experimental spectrum corresponds. In the work modeling was carried out with various options for settings of detectors and an information collection system.

Determining neutron energy from the time of flight requires a fast start signal from the Δ*E*-*E*-telescope. Parameters of this telescope, in particular, depend on a value of the lower threshold of signal registration. It determines the possible ranges of energies of detected particles, requirements for background conditions and permissible loads of the information collection system. Choice of the threshold value for registration of proton energy by the *E*-detector was made from analysis of simulation results. It corresponds to possibility of determining time intervals that set optimal ratio of effect and background events.

1. E.S. Konobeevski et al., Physics of Atomic Nuclei. 81, 595603 (2018).
2. E.S. Konobeevski et al., Bulletin of the Russian Academy of Sciences: Physics. 84, 378381 (2020).

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