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Spin-correlation experiment for investigating dd reactions in PNPI

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After Leemann et al. [1] experimentally demonstrated that the thermonuclear reaction cross section of $^3He(d,p)^4He$ could be increased by a factor of 1.5 by using polarized reactants, theorists [2] showed that the same effect could be achieved with other reactions, in particular, in $^2H(d,p)^3H$ and $^2H(d,n)^3He$. The usage of polarized particles could lead to improvements of future thermonuclear reactors. However, there are no experiments performed with both polarized deuterons at energy below 100 keV due to its complexity and high cost. Low cross-sections and cosmic background are the biggest issues of the experiment.
PNPI Gatchina (Russia) in collaboration with Forschungszentrum Juelich (Germany) and INFN University of Ferrara (Italy) have been carring out the first low-energy spin-correlation experiment POLFUSION [3] with both reactants polarized. Two polarized beam sources have been brought to Gatchina from KVI (Groningen, Netherlands) and University of Ferrara with necessary improvements [4]. The 4π detector system to measure the angular distributions of the fusion products has been developed by PNPI. It consists of 576 silicon PIN photodiodes arranged in a cubic structure.
POLFUSION sets the goal to measure vector and tensor analyzing powers, spin correlation coefficients, quintet state suppression factor of dd reactions with various combinations of polarization directions. The results will allow to solve the discrepancy
between different theoretical predictions.
The experimental setup is described. Results of the test-run in 2020 are presented. Details of future plans are discussed.

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