DOUBLE POLARIZED DD-FUSION

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A double-polarized dd-fusion experiment is under preparation at PNPI, Gatchina. The experimental program includes the measurements of the asymmetry in the differential cross section of the reactions $d + d \rightarrow {}^3He + n$ and $d + d \rightarrow t + p$. The total cross section modification for polarized dd-fusion will also be investigated. Increase by a factor of 1.5 was already deduced for the $d + {}^3He$ and the $d + t$ reactions. The spin-correlation coefficients $C_{z,z}$ and $C_{zz,zz}$ will be measured to determine the quintet-state suppression factor for both reactions, which has quite different theoretical predictions and is very important for the building of neutron-lean fusion reactor.

The experimental setup consists of two polarized sources, a detector system and polarimeters for the polarization measurements. The polarized atomic beam source (ABS) from the former SAPIS experiment at IKP of the University of Cologne was sent to PNPI to be used as a polarized deuterium jet target. It is also equipped with the essential parts of the Cologne Lamb-shift polarimeter (LSP). All the equipment has to be refurbished and updated for the deuterium beam. The polarized deuteron beam will be produced by the polarized ion source POLIS from KVI, Groningen, which was sent to PNPI in the summer of 2010 along with the LSP. The expected target density of $2 \cdot 10^{11}$ at/cm^2 and an ion beam of ~ 20μA will provide a luminosity of $3 \cdot 10^{25}$ cm^{-1}s^{-1}. This will result in 2 months of beam time for the quintet-state suppression factor at 30 keV. The polarization of the ion beam and the jet target will be measured with the LSPs. A nuclear-reaction polarimeter will also be used for the ion beam. A 4π-detector system is designed using the Hamamatsu silicon PIN-photodiodes.

In addition, more spin-correlation coefficients can be measured at different energies with this experimental setup, to get more information about the dd-fusion process. The screening effect due to atomic electrons which shows up in the astrophysical S-factor may also be investigated in this experiment for different spin combinations of the electron and nucleus.