

The PolFusion project: more insight on d–d spin dependent cross–sections

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Abstract

The chance to run and to optimize a fusion reactor with the use of nuclear-polarized fuel is discussed since many years. Furthermore the idea to construct a neutron-lean tokamak reactor still relies on our knowledge on the double-polarization cross-sections of the d–d reactions at the relevant very low energies, which have not yet been measured. Various theoretical predictions cover a wide range of values, especially for the Quintet Suppression Factor (*QSF*), whereas the only two parametrizations of d–d experimental data clearly predict no neutron suppression by polarizing the deuterons in the quintet state. In order to investigate the spin correlation cross-sections directly, a double-polarized d–d fusion experiment is under preparation at the PNPI in Gatchina (St Petersburg/Russia). The experimental program will consist of the measurement of the asymmetries in $\vec{d} + \vec{d} \rightarrow {}^3\text{He} + n$ and $\vec{d} + \vec{d} \rightarrow t + p$.

As a first goal the spin-correlation coefficients $C_{z,z}$ and $C_{zz,zz}$ will be measured to determine the Quintet Suppression Factors for both reactions. In the case of finding strong quintet-state suppression this could constitute a milestone for the design of future neutron-lean fusion reactors. The total cross-section modifications for polarized d–d fusion will also be investigated in analogy to the $d + {}^3\text{He}$ and $d + t$ reactions, where an increase of the cross-section by a factor of about 1.5 over the unpolarized case has been deduced. The experimental setup and the future upgrade plans will be described.