



Contribution ID: 250

Type: not specified

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

Wednesday 28 September 2016 09:00 (25 minutes)

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 $\rightarrow d + \rightarrow d \rightarrow 3\text{He} + n$ and $\rightarrow d + \rightarrow d \rightarrow t + p$. 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 + 3He 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.

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Session Classification: Nuclear

Track Classification: A. Nuclear