**Study of muon catalyzed 3He*d* Fusion**

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The thermonuclear reaction d(3He,α)p is a very rich playground to study various phenomena in different fields of science. Astrophysicists use data of the cross section to build and tune a theory of primordial nucleosynthesis. Most nuclear reactions data doesn’t contain energy dependencies below several keV, the most interesting region for astrophysics.

From a practical point of view, the reaction is extremely efficient in energy generation. While producing 18.3 MeV worth of energy, one of the highest energy outputs among nuclear reactions, it doesn’t contain nor produce radioactive elements. It makes possible the construction of the safest and efficient thermonuclear reactor.

The use of muons expands studies even more. It makes possible to investigate the reaction at extremely low energy (several eV) that has never been done before. Bombarding a gas mixture of 3He and D2 (HD) with energetic muons results in the formation of exotic muonic molecules such as 3He*μd*. It was theoretically shown [1] that 3He*d* fusion can occur in the formation.

The experiment aimed to investigate muon catalyzed 3Hed fusion is being carried out at PSI (Switzerland) by the PNPI group (Gatchina, Russia). It enables the study of processes involving mesomolecules.

The experimental setup adopted from the previous experiment MuSun [2] includes the cryogenic TPC, muon beam detectors, kicker and detection system of electrons coming from muon decays. The kicker allows muons to enter the fiducial volume only one by one. The data collected enables to determine a muon stop position, detect tracks of electrons created via the muon decay as well as tracks of fusion products. Information about the energy of each particle is also stored.

The formation rates of the *dμd* and 3He*μd* molecules, the probability of the muon transfer from *μd*\* to *μd*, the upper limit for “effective” 3He*μd* fusion decay rate, yields of 3He*μd* molecules have been obtained and presented.

1. M.P. Faifman and L.I. Men'shikov, Hyperfine Interact. 119, 127 (1999).

2. V.A. Ganzha et al., PNPI Main Scientific Activities HEPD 2007–2012, 106 (2013).