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Study of muon catalyzed 3Hed Fusion

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The thermonuclear reaction $d(^3He,\alpha)p$ 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 D_2 (HD) with energetic muons results in the formation of exotic muonic molecules such as $^3He\mu d$. It was theoretically shown [1] that ^3Hed fusion can occur in this 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 obtained.
The formation rates of the $d\mu d$ and $^3He\mu d$ molecules, the probability of the muon transfer from μd^* to μd, the upper limit for the "effective" $^3He\mu d$ fusion decay rate, yields of $^3He\mu d$ 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).

The speaker is a student or young scientist

Yes

Section

1. Experimental and theoretical studies of nuclear reactions

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