

# MuSun EXPERIMENT: THE CONTROL OF IMPURITIES IN ULTRACLEAN DEUTERIUM GAS

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The MuSun experiment is aiming to measure the rate of muon capture by the simplest nucleus, the deuteron. This is the simplest weak interaction process on a nucleus that can both be calculated and measured to a high degree of precision. The capture rate has to be evaluated to better than 1.5% precision by measurement of the difference between the lifetimes of positive and negative muons in deuterium-filled TPC. This method requires reliable registration of muon stops in deuterium gas in TPC. The experiment requires the highest level of deuterium gas purity, considering all admixtures with  $Z > 1$  on the level of 1 ppb [1], maintained during running periods of several months. This critical and challenging task is achieved by continuous gas purification with the system CHUPS, and the purity must be verified. In the main runs, the TPC will be operated at  $T=31$  K and  $P=5$  bar, corresponding to 0.064 density of  $\text{LH}_2$ . At such conditions, only nitrogen admixture can remain in deuterium gas at unsuitable level of  $\sim 20$  ppb. We use two independent methods of measurement of nitrogen concentration in deuterium: 1) chromatographic analysis of deuterium gas; 2) registration of recoiled carbon nuclei after muon capture by nitrogen nuclei in the TPC volume.

This talk reports the recent progress in the second method of evaluation of nitrogen concentration in deuterium gas at the level of 1 ppb and lower. The energy spectra of second pulses observed in the TPC is shown on the upper figure (The 1st pulse is the muon stop signal). The upper curve is the spectrum of 2nd pulses when the signal of decay electron is absent. The lower curve is the same with the muon decay electron present. The difference between them is the spectrum of all the products of muon capture by nitrogen (on the lower figure). The peak of recoiled carbon nuclei is seen at 120 keV energy.

This method makes possible the evaluation of the muon lifetime correction even without precise knowledge of nitrogen concentration.

1. <http://muon.npl.washington.edu/exp/MuSun/documents/prop07.pdf>.

