CRYOGENIC TIME–PROJECTION CHAMBER FOR MEASUREMENT OF MUON CAPTURE RATE ON THE DEUTERON

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The motivation of the MuSun experiment is to measure the rate Λ_d for muon capture on the deuteron to better than 1.5 % precision 0. This process is the simplest weak interaction process on a nucleus that can both be calculated and measured to a high degree of precision. MuSun is the evolution of preceding study of muon capture on the proton, the MuCap experiment 0. The MuSun experiment is carried out at the world's most intense muon source of Paul Sherrer Institute (Switzerland). The central detector of the experiment is the Cryogenic Time Projection Chamber (CryoTPC). CryoTPC is the active target which detects the muon stop event in deuterium and positions its spatial coordinates. CryoTPC is filled with deuterium at the pressure of 5 bar and the temperature of 31 K. These conditions are defined by the demands of the reaction kinematics and provide required gas density. The applied high voltage of 10 kV/cm gives a possibility to identify confidently the muon stops, captures on deuteron or heavy admixtures and fusion events.

The experimental setup includes: *a*) the cooling system on the base of the cryorefrigerator and the neon heat pipe. This system supports the temperature stability of ± 0.05 K in the range of 23-300 K; *b*) the cryogenic purification system 0. The system produces the continuous circulation of deuterium by the cryogenic adsorption compressor with the purification in the cryogenic adsorber. System supports the flux up to 5 standard liters per minute and stabilizes the pressure with the accuracy of 1 mbar at 3-12 bar level. The system supports purity of the working gas at the level of 1 ppb of residual air admixtutes; *c*) the cryogenic distillation system 0 for isotopic purification of deuterium. This system produces deuterium with the protium concentration less than 100 ppb.

Auxilary systems: automatic liquid nitrogen refilling system, high voltage system, readout system with cooled preamplifiers, vacuum system. All parameters of the CryoTPC system are controlled by slow control system and included into the common dataflow of the experiment.

1. MuSun collaboration. http://muon.npl.washington.edu/exp/MuSun/Collaboration.htm.
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