Contribution ID: **216** Type: **Oral talk (15 min + 5 min questions)**

Muon Capture on the Deuteron. The MuSun Experiment

Friday, 15 July 2022 17:29 (20 minutes)

This article present the result of the MuSun experiment, precise measurement of muon capture rate by deuteron (Ld). The rate of the reaction μd(F=1/2)⟶νμ+n+ n is measured with precision 1%. That accuracy makes it possible to fix the low-energy constant (LEC) in an effective EFT field theory in a model-independent way. After that this makes it possible to reliably calculate the cross sections of weak reactions in two–nucleon processes, for example, such as pp synthesis going to the sun p+p⟶d+e+νe or neutrino scattering on deuteron νe+d⟶p+p+e-.
The experiment performed on a muon beam of the Swiss Meson Factory (Paule Scherrer Institute, PSI). The experimental technique is based on measuring the rate of muon loss in deuterium by registration Michel electrons. The basis of the setup was a time-projection chamber (TPC), an active target filled with deuterium. Decay electrons were detected with a geometric efficiency of 70% by two external cylindrical proportional chambers and scintillation counters. The measurements were carried out at a deuterium temperature of 31 K and a pressure of 5 bar. For additional isotopic purification of deuterium, a cryogenic separation was used, which allows to reduce the concentration by protium to the level of 10-4. In this case, the correction of Ld associated with the pd synthesis is less than 1 Hz. To reduce the amount of heavy elements in deuterium, a cryogenic circulating purification system was developed. This allow to reduce the presence of impurities in deuterium to 0.5•10-9. Measurement of such a low concentration of impurities was carried out by chromatographic method with cryogenic concentration. In order to reliably determine the Ld correction associated with muon capture on impurities, which is 99% nitrogen, an additional experiment was carried out on a muon beam with the addition of 2•10-6 nitrogen. As a result, the muon transfer rate to nitrogen LdN= 2.2(1)•1011 Hz was measured and corresponding correction to Ld was determined as 1.5 Hz.
At the end of MuSun experiment 1.2•1010 useful events were collected, events with the muon stopping in the sensitive area of the TPC with registration of the decay electron. The statistical error of the measurement is 4 Hz. The main systematic correction to the μd capture rate connects with muon losses in the dd fusion reaction μdd⟶3Heμ+n. It is reliably calculated as 8.0(1)Hz.

The speaker is a student or young scientist

No

Section

1. Experimental and theoretical studies of nuclear reactions

Primary authors: Dr VOROPAEV, N.I. (Petersburg Nuclear Physics Institute named by B.P.Konstantinov of NRC «Kurchatov Institute»); VASILYEV, Alexander (Petersburg Nuclear Physics Institute named by B.P.Konstantinov of NRC «Kurchatov Institute»); Mr GANZHA, V.A. (Petersburg Nuclear Physics Institute named by B.P.Konstantinov of NRC «Kurchatov Institute»); Dr IVSHIN, K.A. (Petersburg Nuclear Physics Institute named by B.P.Konstantinov of NRC «Kurchatov Institute»); Dr KRAVCHENKO, P.V. (Petersburg Nuclear Physics Institute named by B.P.Konstantinov of NRC «Kurchatov Institute»); Dr KRAVTSOV, P.A. (Petersburg Nuclear Physics Institute named by B.P.Konstantinov of NRC «Kurchatov Institute»); Mr NADTOCHIY, A.V. (Petersburg Nuclear Physics Institute named by B.P.Konstantinov of NRC «Kurchatov Institute»); Dr TROFIMOV, V.A. (Petersburg Nuclear Physics Institute named by B.P.Konstantinov of NRC «Kurchatov Institute»); Prof. VOROBYEV, A.A. (Petersburg Nuclear Physics Institute named by B.P.Konstantinov of NRC «Kurchatov Institute»); Dr VZNUZDAEV, M.E. (Petersburg Nuclear Physics Institute named by B.P.Konstantinov of NRC «Kurchatov Institute»)

Presenter: Dr VOROPAEV, N.I. (Petersburg Nuclear Physics Institute named by B.P.Konstantinov of NRC «Kurchatov Institute»)

Session Classification: Experimental and theoretical studies of nuclear reactions