Observation of a new decay channel of the DD threshold resonance

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Deuteron fusion reactions at room temperature can occur with large cross sections due to the significant electron screening energies found in metallic deuterides [1]. Including the deuteron-deuteron (DD) threshold resonance could increase the reaction probability by several orders of magnitude, as demonstrated in accelerator experiments. This 0^+ resonance is essential in explaining the enhanced reaction probability observed in both metallic and gaseous target experiments as deuteron energies decrease. The most likely decay channel of this resonance is internal pair creation, resulting in a continuous spectrum of electrons and positrons with energies up to 22.84 MeV [2].

Currently, an experimental attempt is underway to observe a new reaction channel at the eLBRUS Ultra High Vacuum Accelerator Facility of the Szczecin University, Poland [3]. To reduce the natural background and systematical uncertainties, Si detectors of different thicknesses and various Al absorption foils placed in front of the detector were applied to confirm e-/e+ emission. To distinguish the effects of direct fusion events from non-fusion events arising from elastically scattered particles (e.g., protons, e-) within the target and protection foils, Monte Carlo Geant 4 simulations and calibrated experimental set-ups with radioactive sources ^{204}Tl, ^{60}Co, and ^{241}Am were used. In order to demonstrate the validity of the simulated results, a comparison between the simulated electrons and proton particle energy spectrum and the experimentally measured one will also be presented [4]. We also found that the electron-proton branching ratio increased significantly at lower deuteron energies, down to 6 keV, which supports the threshold resonance mechanism.

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