NEW EXPERIMENTAL CONSTRAINTS ON THE ELECTRON SCREENING EFFECT IN ASTROPHYSICAL PLASMA

N.Targosz-Sleczka[1], K. Czerski[1,2,3], A.i. Kilic[1], D. Weißbach[1,2], A. Huke[2,3], G. Ruprecht[2], M. Kaczmarski[1], K. Maass[4], H. Winter[4]

[1] *Institute of Physics, University of Szczecin, Szczecin, Poland*
[2] *Institute for Solid-State Nuclear Physics, Berlin, Germany*
[3] *Institut für Optik und Atomare Physik, Technische Universität Berlin, Berlin, Germany*
[4] *Institut für Physik, Humboldt-Universität zu Berlin, Berlin, Germany*

Study of the d+d reactions at very low energies in metallic environments in the terrestrial laboratories, enables us to determine the strength of the screening effect in the strongly coupled astrophysical plasma in stars. So far, experimentally determined screening energies were extremely high in comparison to the theoretical predictions, and the reason for the observed discrepancies remained unrecognized.
Results of new measurements of the $^{2}H(d,p)^{3}H$ and $^{2}H(d,n)^{3}H$ reactions at energies from 6 to 25 keV were performed in Zirconium under ultra-high vacuum conditions. The target surface contamination and the deuteron density have been continuously monitored. Precisely determined energy dependence of the screening enhancement factor deviates significantly from the single-parametric curve fitted only with the screening energy.
To explain the experimental data it was necessary to include an additional contribution resulting from a hypothetical 0+ threshold resonance in 4He of a single-particle structure. The resonance component could be calculated as a coherent superposition with transition matrix elements for the dd reactions, reducing the value of experimentally obtained screening energy. However, its absolute value still overestimates the theoretical limit and can additionally be influenced by a number of crystal lattice defects of the metallic target.