Investigation of t+t collisions using ACCULINNA beam line and a liquid tritium target

A.S. Fomichev, D.D. Bogdanov, M.S. Golovkov, A.M.Rodin, S.I. Sidorchuk, S.V. Stepantsov, G.M. Ter-Akopian, R. Wolski, V.A. Gorshkov, M.L. Chelnokov, Yu.Ts. Oganessian.

Flerov Lab. of Nuclear Reactions, JINR, Dubna, 141980 Russia, e-mail: fomichev@nrsun.jinr.ru

The use of a tritium target in experiments with radioactive beams seems to be promising for the study of light neutron-drip nuclei. In this respect, favorable are transfer reactions between tritium nuclei and neutron-excess projectiles studied in a projectile energy range of 15–30 MeV/n. Relevant examples could be 2n-transfer reactions ^{3}H+^{3}H$\rightarrow^5$H+p, ^{8}He+^{3}H$\rightarrow^{10}$He+p, etc., or 1p-transfers ^{8}He+^{3}H$\rightarrow^7$H+α, ^{11}Li+^{3}H$\rightarrow^{10}$He+α, etc. Angular distributions obtained for reaction products in these reactions can give useful information about clustering structures in both the exotic projectiles and drip-line reaction products [1,2]. However, the use of a tritium target is even more promising for the study of resonance states of nuclei lying beyond the neutron drip line. Recently, an environmentally safe liquid-tritium target was installed at the radioactive beam line of separator ACCULINNA [3] working with primary beams of U-400M cyclotron. The target cell has a material thickness of 0.4 mm for tritium, beam opening of a diameter of 10 mm and the entrance and exit windows closed with two pairs of 12-μ stainless steel foils. On both sides, these foils are vacuum-tight welded to the cell body providing two small vacuum volumes equipped with a tritium absorber, which prevents the penetration of tritium leaks in the reaction chamber.

Separator ACCULINNA was upgraded to meet conditions imposed by the tritium target and improve precision for the transfer reaction study. The beam line was extended in order to deliver the beam beyond the cyclotron hall to a low-background room where a reaction chamber housing the target and position sensitive ΔE$\times$E Si-telescopes is installed. Neutron wall based on 41 DEMON detectors was placed at a distance of 2.5 m from a target.

A primary beam of 58 MeV tritons was obtained from the U-400M cyclotron and delivered to the tritium target. The separator ion optics was used to select the beam having widths of >0.5 % and >0.5° in the energy and angular distributions. Being delivered to the tritium target the triton beam with an intensity of 1×10^8 s^{-1} was focused in a 4-mm spot. All together, the beam quality, target parameters and performance of detector telescopes, allow one to have a resolution of >300 keV for the widths of ^{5}H resonance states, which could result from the t+t reaction. One resonance state around 1.9 MeV was recently obtained for this nucleus in reaction ^{6}He+p$\rightarrow^5$H+2p [4]. Results of an experiment aimed at the study of transfer reactions occurring in t+t collisions will be presented.

References:

[1] G.M. Ter-Akopian et al., Phys.Lett. B 426 (1998) 251.

[2] R. Wolski et al, Phys. Lett. B 467 (1999) 8.

[3] A.M. Rodin et al., Nucl. Inst. Meth. **B 126**, 236 (1997).

[4] G.M. Ter-Akopian, et al., Proc. Symposium on Fundamental Issues in Elementary Matter, September 2000, Bad Honnef, Germany. will be published in journal Heavy Ion Physics.