Plasma heating and neutron production in the TUMAN-3M

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Intense energetic neutral beams injection (NBI) is used for auxiliary plasma heating in experiments on TUMAN-3M compact tokamak [1]. Recently, it was found that efficiency of plasma heating and neutron production in the TUMAN-3M are hampered when NBI energy exceeds some critical value ~14keV [2]. Among possible reasons for this degradation in plasma heating and neutron production is plasma pollution by impurity influx, or neutral beam attenuation in beam transmitting port [3]. This loss of beam power may results from the process in which a fraction of the neutral beam is re-ionized and the tokamak magnetic field deflects it to the port's wall.

A series of experiments on TUMAN-3M was conducted with the injection of high-energy atoms, aimed at clarifying the mechanism of saturation of neutron rate and ion temperature with beam energy. A new transmission port was installed between the injector and the tokamak, which, thanks to a larger cross-section, reduced beam-wall interaction, and a risk of the beam attenuation. The efficiency of NBI was estimated through ion temperature, fast particle spectra and neutron rate measurements. Observation of impurity lines from tokamak plasma and $D_{\square}$ emission in the transmitting port was used to identify a possible reason of plasma heating saturation at higher energy and power of the beam, and to clarify a possible role of beam-wall interaction in the transmitting port. Numerical simulation of neutron rate as function of beam power was carried out using the NUBEAM code.

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References:

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