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Spectra of Neutrons from a Beam-Driven Fusion Source

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A tokamak-based source of nuclear fusion neutrons, such as considered in some recent papers and program talks, employs injection of fast atom beams into plasma. Energy spectrum is one of the key characteristics of a neutron source. Distributions of electrically charged fusion products are also important to know since they contribute to plasma heating, if they are confined, and they influence the first wall, if they are lost from the plasma. Compared to thermonuclear fusion product spectra, the treatment of distributions of fusion products from a beam-heated plasma is much less complete in existing bibliography. The bibliography is not abundant for the case of non-Maxwellian velocity distributions of fuel nuclei. The results in early works show different shapes of neutron spectra for DT reaction. Spectra in more recent works differ from earlier ones. In addition to beam particle slowing down, suprathermal tails due to nuclear elastic scattering of fast ions are taken into consideration in some recent studies. The details of calculation of fuel nuclei distribution functions and particular numerical techniques to obtain the fusion product spectra are not discussed in those works. The purpose of this contribution is to describe a fast, easily reproducible semianalytical approach to calculate the distributions of fusion products in case of the presence of substantial suprathermal tails in fuel nuclei velocity distributions. Results for a variety of distributions of suprathermal fuel nuclei will be presented. Numerical techniques and a number of methods of verification of calculated fusion product spectra will be discussed.

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