neutron yield from Z-pincHes with power ion energy distribution

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This paper presents the method and results of calculations of Z-pinch dynamics including generated neutron yield in case of non-thermal energy distribution of ions. In spite of neutron yield from Z-pinch systems is essentially larger compared to tokamaks, the former ones are not suitable for stationary thermonuclear fusion reactor. The advantage of neutron sources, based on Z-pinch systems, is their low metal consumption and the absence of additional ion heating sources. Instead ions are heated (kinetic energy is increased) by MHD instability, generated in Z-pinch plasma [1]. Kinetic energy of the ions becomes large enough to provide intensive nuclear fusion reaction in Z-pinch plasma.

The process of continuous transformation of Maxwellian energy distribution of ions into the power energy distribution due to regrowth of tail is described. It is shown that ion heating is fast enough so that time of ion-ion collisions is not enough to create Maxwellian plasma. On contrary Z pinch plasma contains enhanced number of the fast ions at the moment of maximal plasma compression. Nuclear collisions of high energy ions with bulk plasma ions is the reason of enhanced neutron yield in Z-pinch systems.

The differences are found for the characteristics of neutron emission, generated by plasma with power ion energy distribution compared to the ones, generated by plasma with Maxwellian [2] and monochromatic ion energy distributions. The main differences are:

Appearance of double hump distribution in ion energy spectra (for the plasma with averaged ion energy less than 3 keV);

Enhanced neutron yield compared to the plasma with Maxwellian and mono energetic distributions (for the plasma with averaged ion energy less than 3 keV);

Present study emphasizes the importance of investigation of the systems with non-maxwellian ion energy distributions for the production of pulsed neutrons.

References

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