SIMULATION OF THE SPECTRUM OF Z-PINCH FAST IONS IN THE VANISHING COLLISION EFFECT [[1]](#footnote-1)\*)

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When the Z-pinch is compressed, a neck is formed in which the ions are accelerated to energies of a few hundred keV (sometimes over 1 MeV). Two possible mechanisms, “thermal” and “accelerator”, are considered separately, as a rule. But, attempts to artificially divide ions into “thermal” and “fast” (“accelerated”) encounter difficulties in substantiation. Apparently, these mechanisms of generation of high-energy ions complement each other, resulting in the formation of the observed energy spectrum of ions leaving the waist. The modeling of ions of all energies can be combined based on the Fokker–Planck kinetic equation, taking into account the acceleration of ions due to a compressive magnetic field [1, 2]. Its numerical solution can satisfactorily explain the observed ion spectrum and neutron yield [3]. However, there is a problem of stability of the numerical scheme, which arises at the very final stage, corresponding to strong compression. Physically, this is due to the fact that the acceleration mechanism leads to an acceleration rate at the final stage of compression that is much higher than the Coulomb slow-down. In other words, there comes a moment when the influence of collisions on the kinetics of particles of certain energies becomes vanishingly small. Moreover, for ions of different energies, this occurs at different times. Such features of kinetics require a unified approach to the description of ions of all energies, but taking into account the features inherent in different energy ranges.

In this work, the energy distribution of ions in the waist and the spectrum of accelerated ions are modeled in the multi-group approximation, according to which the entire energy range is subdivided into a kind of “beams” in the phase velocity space. Next, the dynamics of each beam is considered, taking into account particle losses, their acceleration by a non-stationary compressive magnetic field, and slow-down. Losses of particles form the spectrum of outgoing ions.

The analysis showed that a correct explanation of the spectrum of accelerated ions requires the joint use of a kinetic description, macroscopic plasma dynamics and electromagnetic fields, but even in this case, a number of model parameters require clarification, information for which can be obtained on the basis of modeling the orbits of individual particles in a non-stationary electromagnetic field of the Z-pinch.

References

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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/It/ru/DH-Chircov.docx) [↑](#footnote-ref-1)