Numerical modeling of the generation of Alfvén waves by laser plasma in a magnetized background plasma at Alfvén-Mach numbers less than one

Berezutsky A.G., Tishchenko V.N., Miroshnichenko I.B., Chibranov A.A., Shaikhislamov I.F.

In this work we investigate the results of a numerical simulation of the generation of extended Alfvén waves by laser plasma bunches under conditions when the initial speed of expansion of the plasma bunches is less than the Alfvén velocity.

Using a 4-fluid MHD model, the “resonance” conditions [1] were studied, under which a train of laser plasma bunches generated a single wave packet, the length of which and the efficiency of converting the energy of the bunches into a wave are maximum. In [1], it was shown that the maximum length and efficiency of ~ 40% Alfvén wave generation are achieved using a train of ~ 15 laser plasma bunches with a Mach number MA ~ 0.2 ÷ 0.3. The azimuthal magnetic field in the Alfven wave reaches ~0.15 ÷ 0.2 from the background magnetic field. Wave localized in a magnetic field flux tube with radius is 0.5Rd. The repetition rate of bunches and the wavelength are ~ 2 ÷ 3 times greater than for MA~1. In this work, we study the remaining resonance conditions: ion-plasma length Lpi=c/ωpi, thermal β, and optimal values of the Larmor radius at fixed values of the MA ~0.2 and the number of plasma bunches.

1. Tishchenko V.N., Berezutsky A.G., Dmitrieva L.R., et al. // Solar-terrestrial physics. – 2022. – Vol. 8. – No. 2. – pp. 101-107.
2. Berezutsky A. G. et al. Generation of torsional Alfvén and slow magnetosonic waves by periodic bunches of laser plasma in a magnetised background //Quantum Electronics. – 2019. – Vol. 49. – №. 2. – p. 178.

The work was carried out within the framework of the Russian Science Foundation Project No. 24-22-00106.