effect OF inherent MAGNETIC FIELDS OF FAST ELECTRON BEAM GENERATED IN HIGH-CURRENT Z PINCHES ON THE INTENSITY OF breamsstrahlung AND CHARACTERISTIC RADIATION OF PINCH PLASMA

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Among the schemes of indirect compression of spherical targets using soft x-rays of high-current Z pinches the most promising are the scheme of dynamic "holraum “proposed in [1] and the scheme of static” holraum" with two separate sources proposed in [2]. Along with the generation of powerful soft x–ray fluxes, Z-pinch is a source of accelerated electrons. Preheating the target with fast electrons can result in a lower fuel compression density in the target.

Measurements of the characteristics of accelerated electron beams under compression of multi-wire tungsten assemblies with current up to 4 MA were carried out on the powerful pulse generator "Angara-5-1". As shown by the measurements of the slit camera obscura, fast electrons are formed in the central region of the pinch near the axis, where there is practically no magnetic field from the pinch current and the electrons are not magnetized. This area corresponds to the highest density of the substance, which increases the efficiency of the generation of braking and characteristic X rays. The effective transverse size of the radiation source in the characteristic radiation of Lα tungsten is ~1.3 mm, which corresponds to the transverse size of the soft x-ray source and confirms the generation of the characteristic radiation from the densest central region of the pinch.

The current of fast electrons, measured by the Rogovsky coil in experiments on compression of multi-wire tungsten assemblies, was from 10 to 50 kA. This current is limited by its own magnetic field and is in order equal to the current of Alfven (IA). When the beam radius is of the order of 0.5 mm and beam current is of the order of the Alfven current own azimuthal magnetic field on the boundary of the beam will be 5–10 T.

Since the current of accelerated electrons is of the order of the Alfven current, the effective path of electrons in the plasma is of the order of the pinch length. The result is consistent with estimates of the measured intensity of the characteristic radiation of the tungsten Lα under current of fast electrons, on the assumption that the effective range of the fast electrons in the pinch is of the order of the length of the pinch. The results obtained can be used to estimate the current of accelerated electrons in pinch in experiments on high-power pulse generators.

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References

1. Smirnov V.P., 1991, Plasma Phys. Control Fusion, v. 33, p. 1697.
2. R.E. Olson, G.A. Chandler, M.S. Derzon, D.E. Hebron, J.S. Lash, R.J. Leeper, T.J. Nash, G.E. Rochau, T.W.L. Sanford, N.B. Alexander, and C.R. Gibson// Fusion Technol. 1999. V. 35. N. 2. P. 260