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TIME-RESOLVED MEASUREMENT OF THE TEMPERATURE OF A PINCHED DENSE PLASMA BY THE RATIO OF THE SIGNALS OF TWO X-RAY DIODES WITH DIFFERENT SPECTRAL RESPONSE *

S.A. SOROKIN

Institute of High Current Electronics SB RAS, 2/3 Akademichesky Ave., Tomsk 634055, Russia, s.sorokin@rambler.ru, +7(3822)491617

One of the most effective ways to create a hot dense plasma is the implosion of cylindrical shells (liners) by the current of a high-current generator. The density of energy and particles of the pinched plasma are largely determined by the implosion time (initial radial size) of the liner, which should be longer than the rise time of current through the liner. Due to the preliminary injection of plasma into the region of the liner load, the rise time of the current through the liner can be reduced to several nanoseconds, and the initial radius of the liner can be reduced to 1 mm or less [1,2]. This approach makes it possible to obtain a plasma column with a particle density higher than the particle density in a solid, and a plasma energy density of more than 10^8 J cm^{-3} already at a generator current of 1-2 MA. The spectrum of thermal X-ray emission from such a plasma can be close to the Planck spectrum, which makes it possible to determine the plasma temperature from the ratio of the signals of radiation sensors with different spectral responses. In this work, under the assumption of the Planck radiation spectrum, the temperature dependence of the signal ratio of two photoemission X-ray diodes (XRDs) with an aluminum photocathodes and polypropylene filters 10 μm and 20 μm thick is calculated (Fig.1). It can be seen that in the temperature range from 100 eV to 350 eV there is a strong dependence of the signal ratio on temperature. The calculation results were used to determine the temperature of the pinched plasma column, which is formed after the 2-MA implosion of liners about 1 mm in diameter, made of 2.5-μm thick aluminum foil. The temperature measured in this way during the evolution of the plasma after its first stagnation satisfactorily corresponds to the temperature estimate from the Bennett relation.

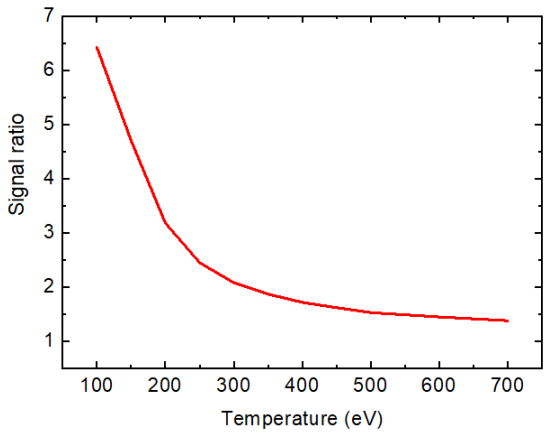

Fig. 1. Results of calculating (under the assumption of the Planck radiation spectrum) the temperature dependence of the signal ratio of two photoemission X-ray diodes (XRDs) with an aluminum photocathodes and polypropylene filters 10 μm and 20 μm thick.

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