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POLARIZATION OF X-RAY LINES EMITTED FROM HOT REGIONS OF Z-PINCH DISCHARGES *)

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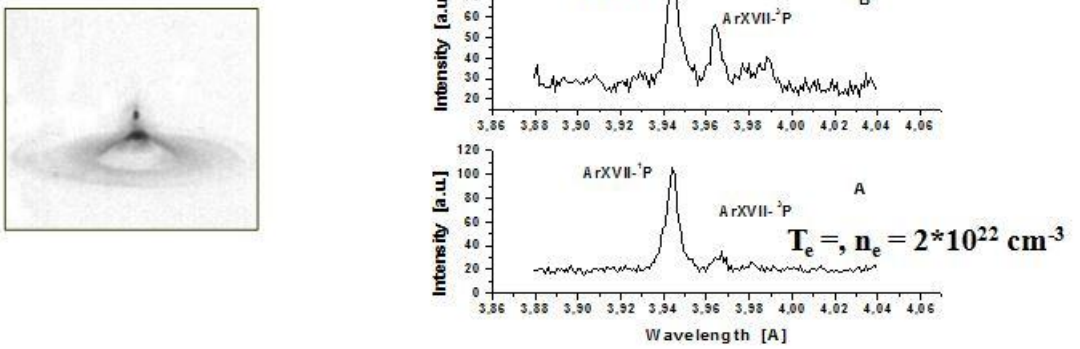
Hot regions of z-pinch discharges are studied as a possible source for nuclear fusion as well as for various practical applications. Traditional contactless approach for estimation of plasma parameters of pinch plasma is x-ray spectroscopy. Relative intensities of certain groups of x-ray lines provide plasma electron temperature and density. Analytical models describing relative intensities of diagnostic lines are generated in the assumption of maxvellian velocity distribution function of electrons.

It is however known that strong electromagnetic fields, electron beams with energy exceeding applied voltage are generated in plasma of high current discharges while its electron velocity distribution function is anisotropic. Given peculiarities might lead to polarization of x-ray spectra which causes a change in relative intensities of registered transitions. Polarization measurements are complicated enough and time taking. This paper describes possible optical schemes of such measurements, namely: application of x-ray crystals with mutually perpendicular dispersive elements, application of single crystal x-ray polarimeter, registration of x-ray spectra in various reflection orders.



In fig.1 A,B results of polarization measurements are given for the helium-like Ar (ArXII) spectra together with plasma image taken by pinhole camera. Both spectra are registered in one same discharge by usage of two identical Johann spectrometers with the dispersion planes oriented mutually perpendicular. Obviously, two spectra testify that relative intensities of intercombination (3P) and resonance (1P) lines used for determination of plasma electron density, are different. Such the peculiarity of given spectra is explained by polarization of detected lines. That is why estimation of electron density should be carried out taking into account this effect.

This paper likewise describes polarization experiments within registration of L-spectra of Cu, emitted by x-pinch discharges with the currents 150 кА and 260 кА. De Broglie spectrometers equipped by two mica crystals with perpendicular dispersive planes were used. In both the discharges L-spectra of Cu are polarized. Possible origin of polarization is discussed and corresponding recommendation is given to improve methods of plasma diagnostics.

*) abstracts of this report in Russian