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THE USE OF A CODED APERTURE FOR DIAGNOSTICS OF PLASMA RADIATION SPATIAL DISTRIBUTION OF EXPLODING WIRES *)

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To obtain an image of a plasma source in the X-ray range, a pinhole camera is usually used, which is a small-diameter hole in a screen opaque to X-rays. The most important advantage of the pinhole camera is the ease of manufacture and application. However, due to the low aperture of the pinhole camera, the radiation energy that comes to detector is often insufficient to obtain a high-quality image. One of the alternative means of such diagnostics is the use of a coded aperture (CA), which is a structure of intersecting mutually perpendicular transparent and opaque stripes [1]. Such the CA was used in experiments to study of exploding wires plasma images of hybrid X-pinches in the X-ray range at the KING facility. The 1x1 mm CA overlapped by a Be filter was used, which in structure and correlation properties is close to a PnP type CA [2], with image recording on a fluorescent imaging plate without a protective coating. At the same time, for auxiliary visualization, plasma images were recorded on two pinhole cameras, both open and covered by Be filter to cut off soft X-rays, which made it possible to accurately determine the location of bright emitting points on the pinch.

The radiation transmitted through a CA gives a complicated picture of the encoded image, therefore the use of a mathematical procedure for the real plasma image reconstructing is required. This procedure was developed [1] and it is an iterative method for solving an incorrectly posed problem – the Fredholm integral equation of the 1st kind. It has been shown that the use of a coded aperture not only greatly increases the efficiency of the recording system, but also allows to reach a spatial resolution even better than in the case of a pinhole camera. In particular, the fine structure of the spatial distribution of bright dots along the pinch, which could not be resolved when recording with a pinhole camera, was discovered by this method.

References

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