COLLISION OF COUNTER HIGH-ENERGY PLASMA FLOWS WITH A GAS JET IN A LONGITUDINAL MAGNETIC FIELD [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.191

1Toporkov D.A., 1Burmistrov D.A., 1Gavrilov V.V., 1Zhitlukhin A.M., 1Lidzhigoryaev S.D., 1Pushina A.V., 2Pikuz S.A., 2Ryazantsev S.N., 2Skobelev I.Yu.

1SSC RF TRINITI, [toporkov@triniti.ru](mailto:toporkov@triniti.ru)  
2Joint Institute for High Temperatures of the Russian Academy of Sciences

In this paper, motivated by the development of a compact source of high-power X-ray radiation [1-4], the results of an experimental study of the interaction of two counter high-energy plasma flows with a gas target are presented. A supersonic nitrogen/neon gas jet was formed using a flat Laval nozzle. The maximum particle density in the jet with a thickness of ≈ 4 cm and a width of ≈ 10 cm reached 4×1017cm-3. Plasma flows with velocities (4÷6) × 107 cm/s, ion density (2÷4) × 1015cm-3 and an energy content of up to 100 kJ were created by electrodynamic coaxial accelerators with pulsed gas injection – hydrogen, nitrogen and neon.

Varying the chemical composition of interacting objects allowed us to obtain a wide range of experimental data. The report focuses on determining the parameters of the plasma formed by the interaction of powerful plasma streams with a gas jet, as well as measuring the energy and spectral characteristics of X-ray radiation generated by this plasma.

The interaction dynamics of the plasma flows with a gas jet was recorded using a multi-frame X-ray MCP camera equipped with pinholes. The power and energy of radiation generated in the interaction zone of plasma flows with a gas target were measured by X-ray photodiodes. The time course of the electron temperature of the plasma formed during the plasma flows interaction with the jet was determined by the filter method. A transmission grating spectrograph and an MCP camera was used to register plasma radiation with a spatiotemporal resolution in the spectral range of 1-70 nm. The observed line intensities were compared with the results of numerical simulation of the spectra, which also made it possible to estimate the electron temperature of the plasma.

In conclusion, the experimental results obtained during the interaction of oncoming plasma flows of various chemical compositions with a gas target are compared. In particular, it is noted that in experiments with a gas jet and hydrogen plasma streams, the efficiency of converting the energy of the streams into soft X-ray energy turned out to be higher than when using nitrogen and neon plasma streams.

References

1. V.V. Gavrilov, A.G. Es’kov, A.M. Zhitlukhin, D.M. Kochnev, S.A. Pikuz, I.M. Poznyak, S.N. Ryazantsevb, I.Yu. Skobelev, D.A. Toporkov, and N.M. Umrikhin // Plasma Physics Reports, 2018, Vol. 44, No. 9, pp. 820–827
2. V.V. Gavrilov, A.G. Es’kov, A.M. Zhitlukhin, D.M. Kochnev, S.A. Pikuz, I.M. Poznyak, S.N. Ryazantsevb, I.Yu. Skobelev, D.A. Toporkov, and N.M. Umrikhin // Plasma Physics Reports, 2020, Vol. 46, No. 7, pp. 689–695
3. Toporkov D.A., Gavrilov V.V., Zhitlukhin A.M., Karlykhanov N.G., Kostyushin V.A., Matveenko Yu.I., Poznyak I.M. // XLVIII International (Zvenigorod) Conference on Plasma Physics and Controlled Fusion, 2021, T4-1
4. V.V. Gavrilov, A.G. Es’kov, A.M. Zhitlukhin, D.M. Kochnev, I.M. Poznyak, S.A. Pikuz, S.N. Ryazantsev, I.Yu. Skobelev, D.A. Toporkov, N.M. Umrikhin // 47th EPS Conference on Plasma Physics, 2021, EPS Europhysics Conference Abstracts, Vol. 45A, p. 545–548

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Pt/ru/GV-Toporkov.docx) [↑](#footnote-ref-1)