INFLUENCE OF VACUUM TRACE ON COLLIMATION OF LABORATORY AND ASTROPHYSICAL JETS [[1]](#footnote-1)\*)

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It is known that an astrophysical jet does not propagate in a vacuum, but in a medium with a finite density. The environment has a significant influence on the parameters of the jet and its dynamics. The results of the previous numerical simulation [1] showed that in the case of the generation of several jets, the second and subsequent ones move in a medium with a low density, in the so-called vacuum trace of the first.

A PF-3 plasma focus (PF) facility at the Kurchatov Institute was used to carry out a series of experiments to study the influence of the vacuum trace effect on the generated jet within the framework of the program for laboratory modeling of astrophysical jets. Neon and helium were used as working gases. The jets were recorded with the K-008 streak camera. The main problem is that a single plasma jet is predominantly formed in the PF discharge, which is generated in the pinching stage. However, in some cases, as a result of repeated pinching, the formation of two or more jets is possible. The discharges in which several bunches were generated were selected and analyzed from an extensive base of sweeps. The experimental results showed that the parameters of the second jet differ significantly from the parameters of the first one. The velocity of the second jet is usually less than the velocity of the first one, which can be explained by different conditions for generating the jet as a result of re-compression of the current-carrying plasma sheath. Nevertheless, in this case, the formation of a shock wave does not occur, which indicates movement through a medium of lower density. The second jet is sufficiently well collimated and has a transverse size ~ 2 cm at a distance of 30 cm from anode and the aspect ratio of ≥2.

The performed numerical simulation of the propagation of the laboratory jet at the discharge in helium showed good agreement with the experimental results [2]. It is shown that after the flight of the first supersonic jet, a vacuum trace is formed behind it, the remaining plasma in which has a lower density, increased temperature and longitudinal velocity. The combination of these three factors leads to the fact that the jet following the first one, propagating already in the vacuum trace, experiences much less drag and less shock compression. This makes it more collimated.

It is shown that similar effects can take place and at the propagation of jets from young stellar objects.

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References

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2. I. Kalashnikov, et al. Astronomy Reports (2020), to be published
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/It/ru/DR-Il%27ichev.docx) [↑](#footnote-ref-1)