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PECULIARITIES OF INTERACTION OF ONCOMING SUPERSONIC FLOWS OF FULLY IONIZED PLASMA IN A LABORATORY MAGNETIC ARCH *)

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The majority of electromagnetic radiation sources from stellar coronae are located in configurations with closed magnetic lines, which are difficult to study with spacecraft due to the limitations of spatial resolution. The possibility of laboratory modeling of these structural elements will make it possible to verify theoretical predictions of the processes occurring, such as example, magnetic reconnection occurring during the counter propagation of fluxes in a magnetic arch.

The objective of the study is to carry out laboratory simulations of the interaction of two flows in coronal loop and to investigate result dynamics. The magnetic field was generated by coils whose axes were perpendicular to one another. Plasma injection was achieved through the vaporization of the cathode material occurring during an arc discharge. This ensures that the flow rate remains constant regardless of the discharge current. The type of material determines the flow velocity and its density.

The plasma density distribution was investigated through the utilization of a high-speed camera[1]: the relative density was determined by the brightness of luminescence of plasma regions at the camera's focal point. To study the electromagnetic radiation of the plasma in the frequency range of 1-20 GHz, a Vivaldi-type antenna located outside the vacuum volume was used, the signal from which was recorded by a broadband oscilloscope.

In the experiment, the cathode materials (Al, Cu, etc.), plasma flux densities, and the current in the magnetic coils were varied. It was experimentally shown that the collision of plasma streams leads to a rupture of the force lines of the magnetic field of the arch, accompanied by the generation of non-thermal electromagnetic radiation at frequencies of 2-10 GHz. The features of the spectrum of this radiation are investigated, its frequency-time characteristics are determined, and a possible mechanism of its occurrence is discussed.

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References

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