Experimental study of spoke instability in reflex discharge with thermionic cathode using a high-speed camera

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This work presents the results of a study of the spoke instability [1] occurring in crossed ExB fields in a reflex discharge with thermionic cathode [2]. This instability, also known as the Simon-Hoh instability [3, 4], is a rotating sector with a changed plasma potential and broken plasma quasi-neutrality. During the experiment, argon under a pressure of 0.3 mTorr was pumped into a cylindrical chamber about 2 m long and 86 cm in diameter, the magnetic field was 1400 G, and the radial electric field was 10-15 V/cm. Measurements of luminescence intensity were performed using an Evercam 3000-16-M high-speed camera with maximum speed 56 900 frames per second. Using Fourier analysis, it was found that the electron beam emerging from the thermionic cathode rotates. The rotation radius is about 1 cm, the frequency is 10-15 kHz, which coincides with the spoke instability frequency previously measured by floating probes [2]. As a result of the study, the presence of the spoke instability in the main volume of the discharge was also optically confirmed.

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[2] Valinurov M, Gavrikov A, Liziakin G, Oiler A and Timirkhanov R 2023 *Plasma Physics Reports* **49** 649–655
[3] Simon A 1963 *The physics of fluids* **6** 382–388
[4] Hoh F 1963 *The physics of fluids* **6** 1184–1191