Dynamics of the current shell of a self-contracting plasma discharge with external injection of gas jets [[1]](#footnote-1)\*)

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The movement of the current shell in the plasma focus is accompanied by a separation of the current from the insulator, the accumulation of magnetic energy and addition of gas in the interelectrode gap with the collapse of the current shell at the end of the anode. In general, the whole process is optimized to obtain the final result - the maximum radiation yield. This is achieved by choosing the geometry, the initial gas pressure, and the magnitude of the discharge current, which ensures the completion of plasma compression in a few microseconds. Earlier, separate attempts were made by gas injection to vary the density profile of the initial gas distribution in the chamber, adding another parameter for better coordination of the stages of this complex process [1,2,3]. Systematic studies in this direction have not been previously conducted. For such experiments, a PF-MOL installation was constructed, with electrodes of an intermediate type between Meiser and quasipherical. The energy source is a capacitor bank with an energy reserve of ~ 100 kJ. In one of the options, an interelectrode insulator made of caprolon was used, in another, it was made of ceramic. The chamber was filled with working gas using a high-speed electrodynamic valve. Gas spreading was recorded at the moment of ignition of a glow discharge between specially introduced electrodes. The setup in the first version worked stably with a neutron yield of up to 109/shot. In this mode, the initiating breakdown did not touch the caprolon insulator. With an increase in gas supply, breakdown occurred on the insulator surface, and discharge was without neutron generation. A series of calculations on pulsed injection of a working gas has been performed. Taking into account the results, the neutron yield was increased by a factor of 2–3. In the variant with a ceramic insulator, work was carried out both during preliminary filling of the chamber and during pulse injection of the working gas. Accordingly, a combination of these methods was used. The neutron yield thus increased to 1.2 \* 1010 /shot. at a current of 750 kA. Magnetic probe measurements were carried out. The course of development of the current shell and the dynamics of its movement along the electrodes are restored. A significant amount of information has been obtained, including determining the concentration of the discharge current in the region of the pinch collapse. Images of the focus zone and plasma shell with microsecond exposure were obtained. The effect of the injected gas on the generation of radiation is discussed. An increase in discharge current in excess of 1.5-2.0 MA necessitates the use of a relatively heavy plasma shell. Therefore, we can consider the question of the formation of a shell of heavy gases, which compresses the injected deuterium jet. At low currents in the operating range of this installation (600 kA), a trial experiment was conducted with compression by the helium shell of the deuterium injected along the axis. Neutron generation was obtained with an output of 1.5\*10 9 /shot.

References

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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/It/ru/CG-Lototskiy.docx) [↑](#footnote-ref-1)