NON-SELF-SUSTAINED GLOW DISCHARGE AT CURRENTS UP TO SEVERAL HUNDRED AMPERES WITH ELECTRON INJECTION FROM TWO ELECTRON SOURCES

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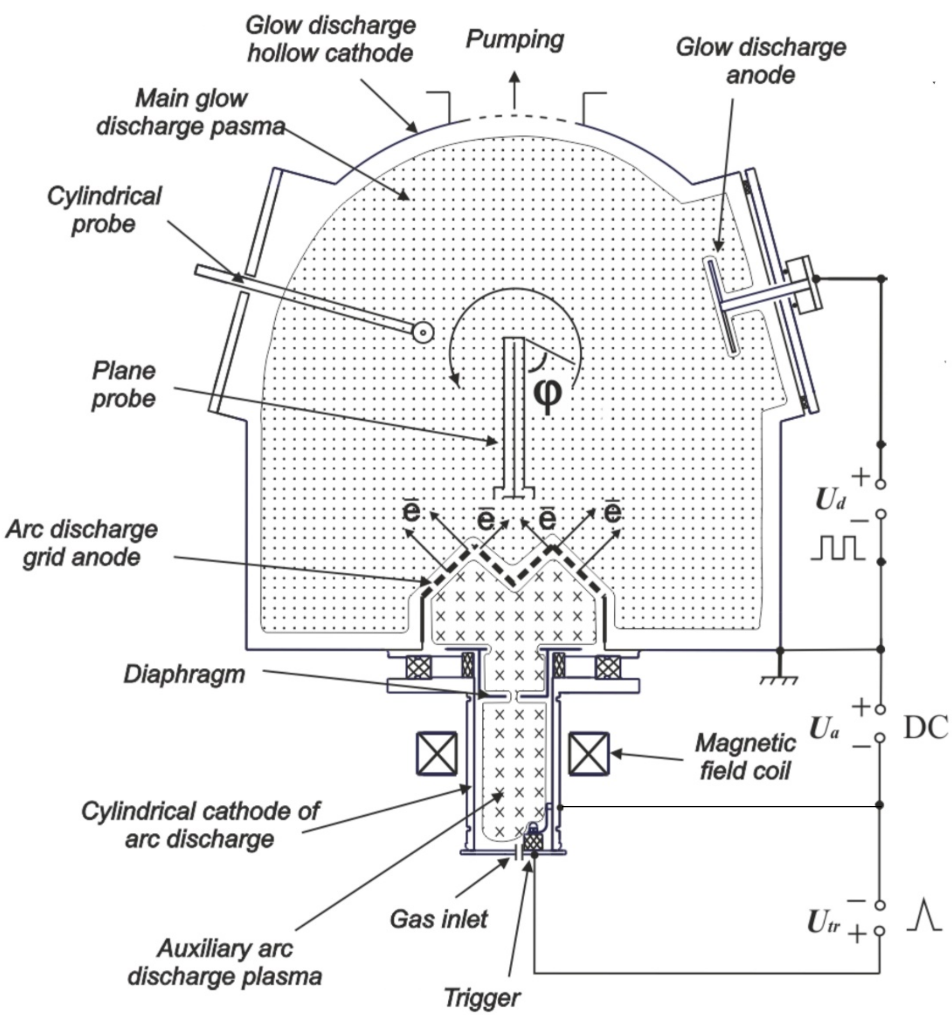
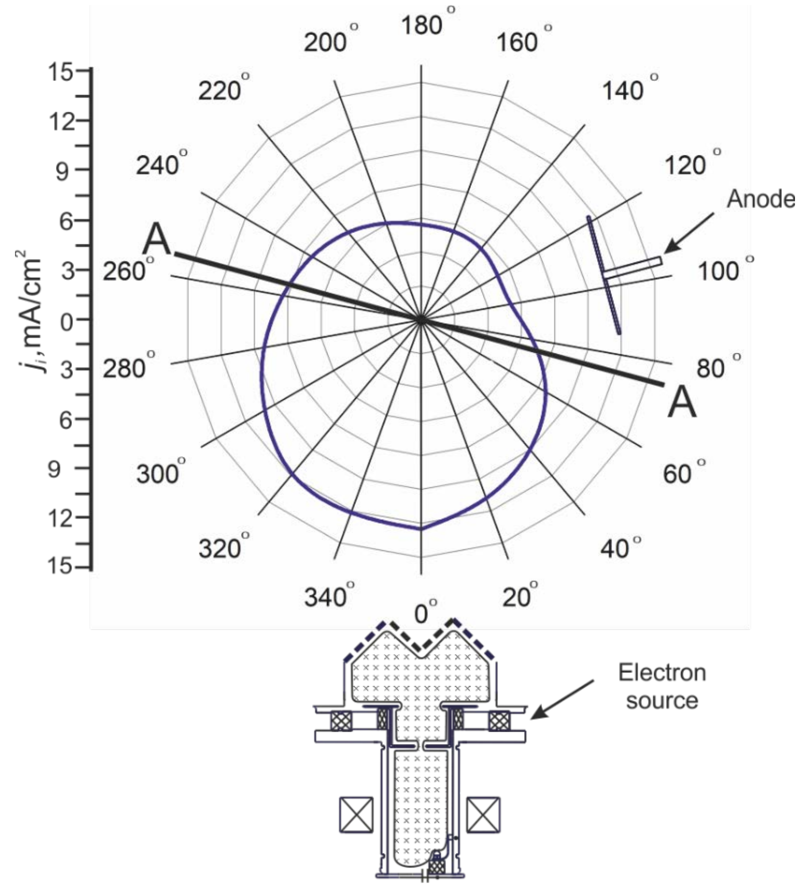
BRIEF RESULTS OF INVESTIGATION OF INHOMOGENEITY OF PLASMA DENSITY DISTRIBUTION



The characteristic azimuthal distribution of the ion current density from plasma to a flat probe (U_d = 180 V, I_d = 90 A, $p(N_2)$ = 0,65 Pa, (k_{inh} = 46%))



$$k_{inh} = \frac{\left| j_{i\_\max} - j_{i\_av} \right|}{j_{i\_av}} \cdot 100\%$$

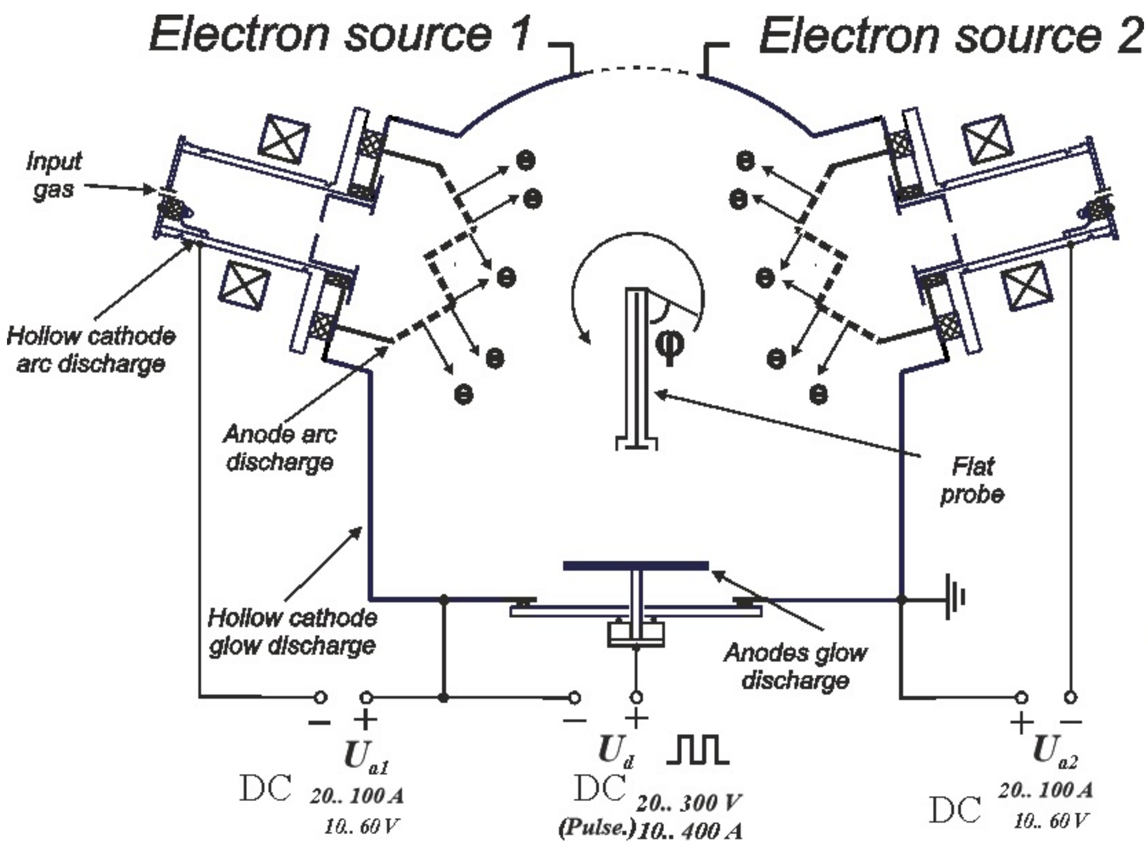
Denisov V.V., Ostroverkhov E.V. et al., *Phys. Plasmas*, V.26, 123510 (2019).

THE GOALS OF THE INVESTIGATION

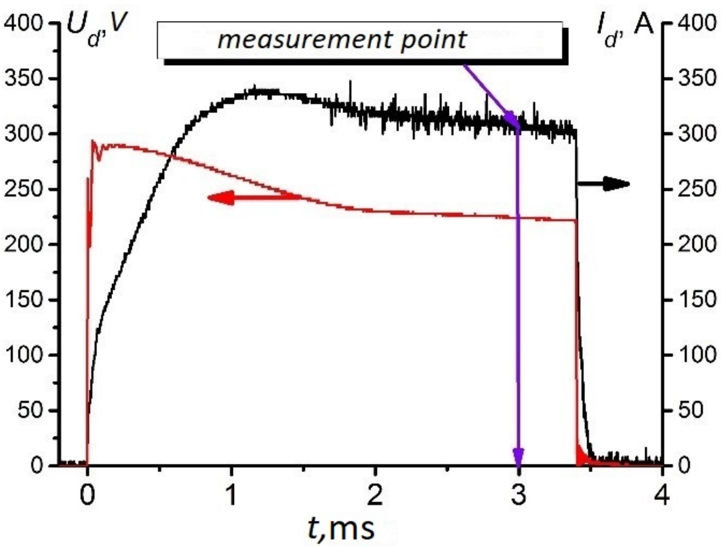
- To determine the effect of the combined operation of two electron sources on the plasma density distribution in the hollow cathode.
- Verify a compliance of the principle of superposition in the case of using of two electron sources.

The principle of superposition of plasma concentration distributions:
The distribution of plasma concentration in a hollow cathode of a non-self-sustained glow discharge under injection of electrons from 2 or more electron sources is the sum of plasma concentration distributions obtained for separate operation of electron sources.

EXPERIMENTAL ASSEMBLY #1

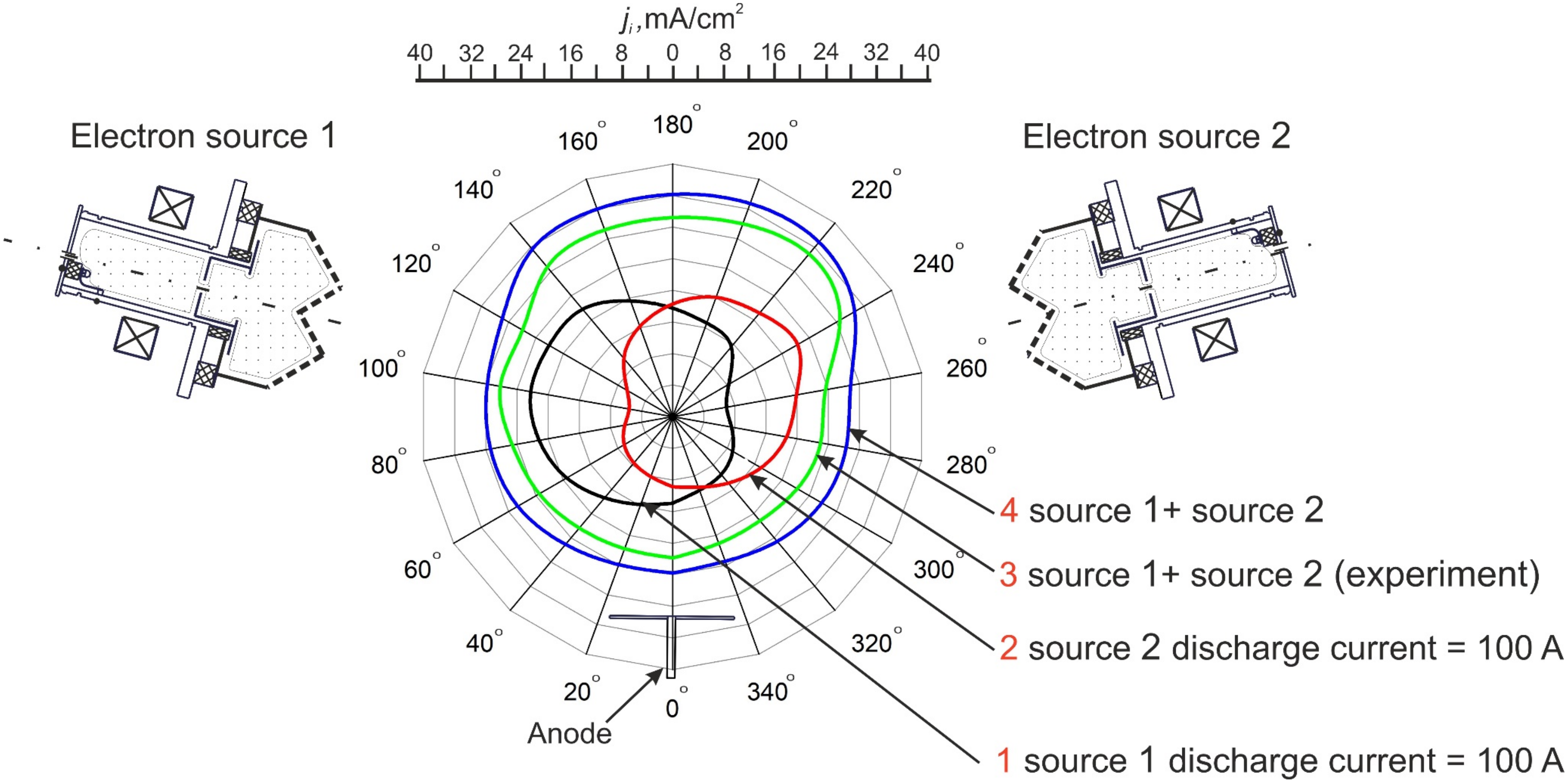


Time-phased waveforms of current and voltage pulses for non-self-sustained glow discharge



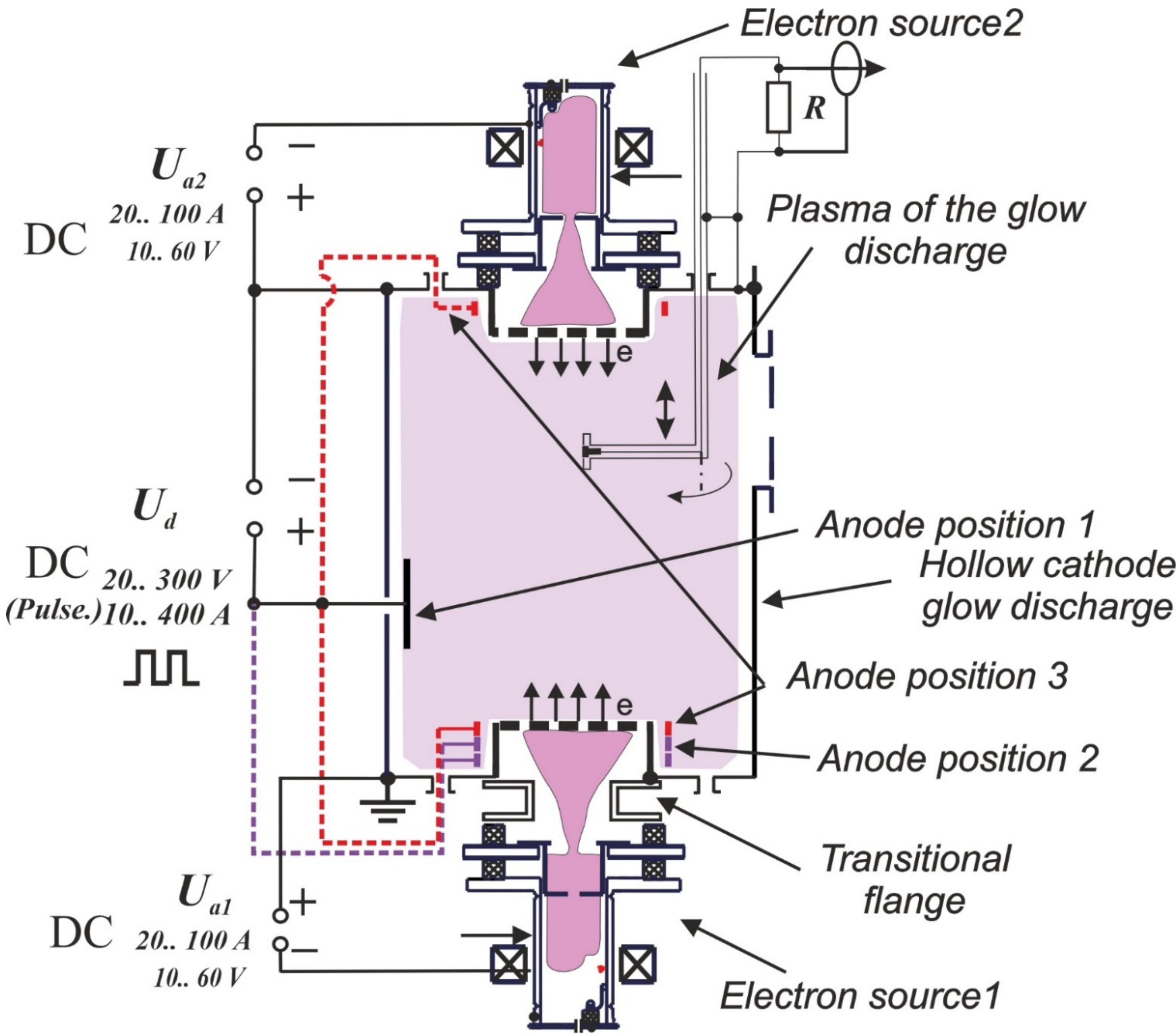
All data was obtained for U_d = 180 V, $p(N_2)$= 0,65 Pa, at the third millisecond of the discharge pulse.

AZIMUTHAL DISTRIBUTIONS OF ION CURRENT DENSITY FOR TWO ELECTRON SOURCES

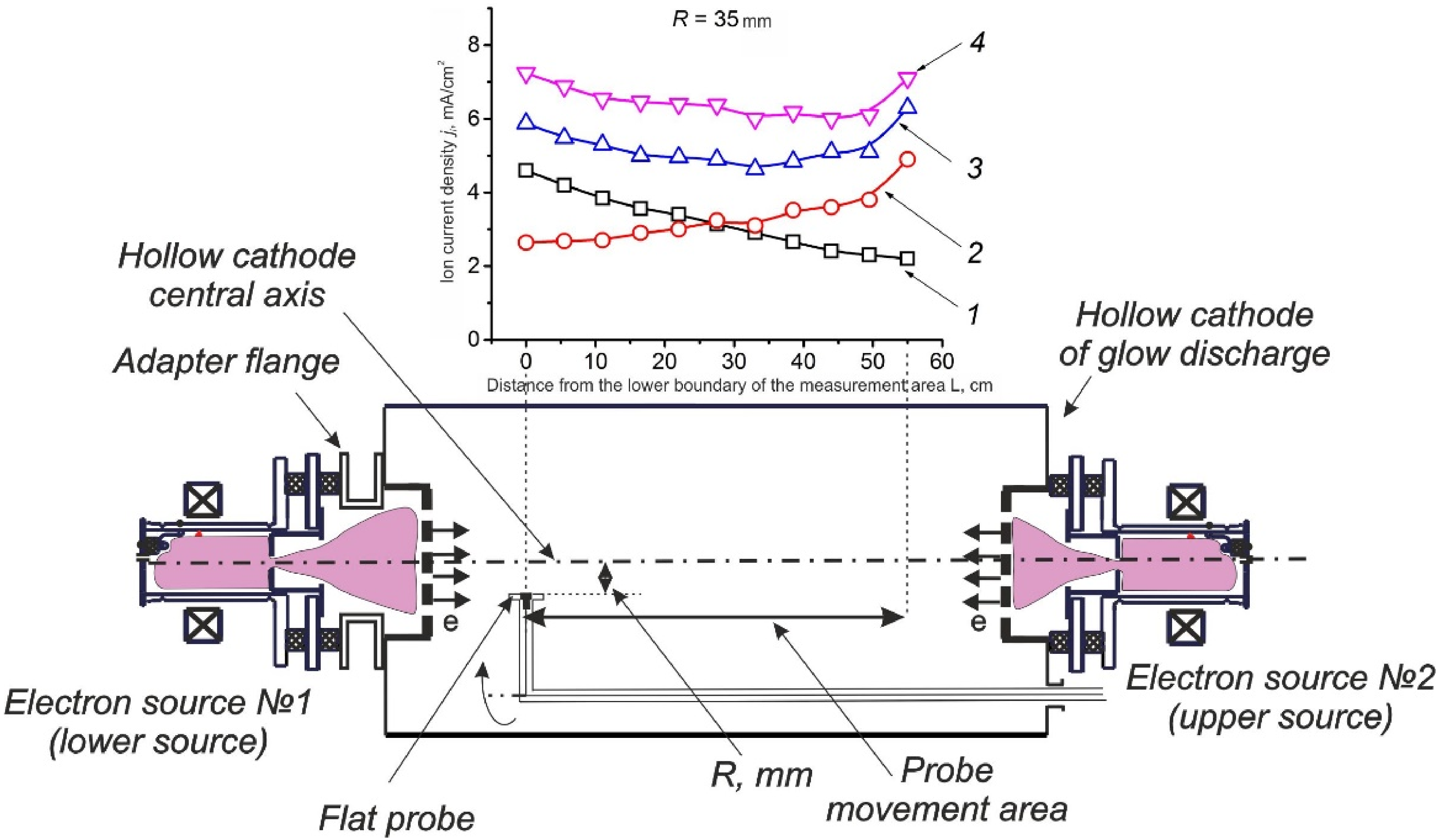


THE EXPERIMENTAL ASSEMBLY #2

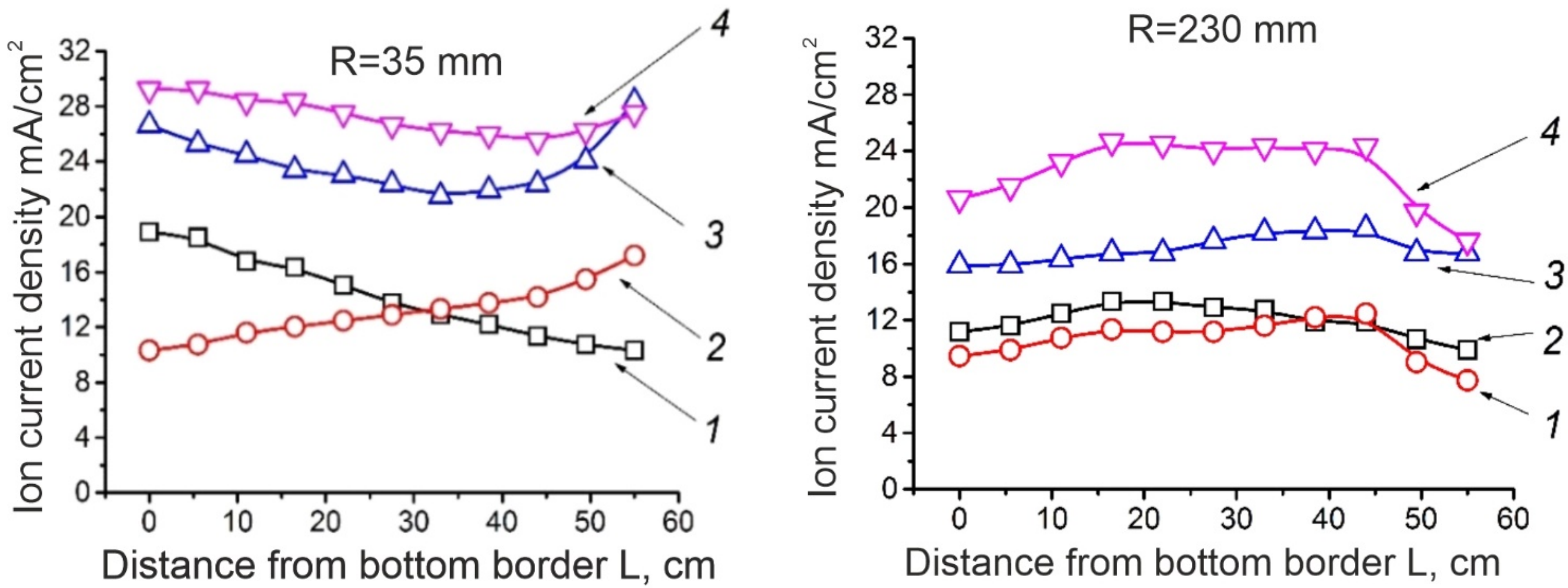
Chamber height: 1200mm
Chamber diameter: 600mm
Cathode diameter/height: 1:2
Volume: 3.4 m^3



THE EXPERIMENTAL ASSEMBLY #2

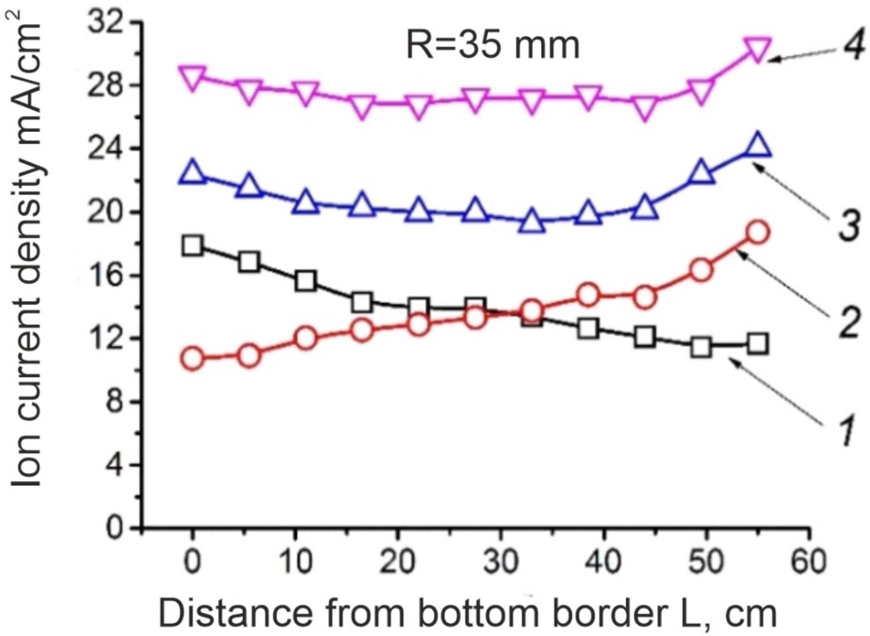


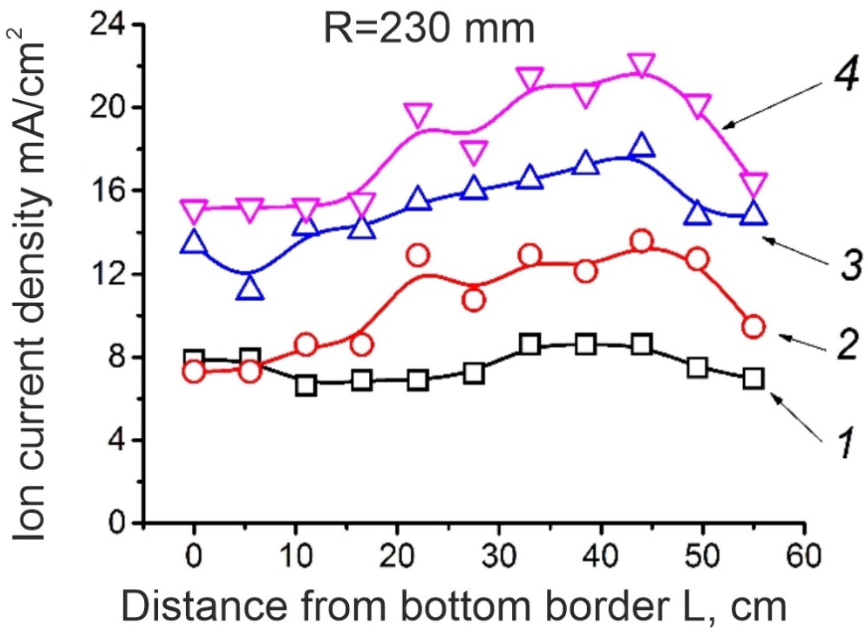
ANODE POSITION 1



Longitudinal distributions of the ion current density on a flat probe placed in the plasma of a glow discharge with a hollow cathode with separate (simultaneous) operation of electron sources at a radius of 35 and 230 mm from the chamber axis (anode position 1): 1 - during operation of the Electron source No. 1 (glow discharge current I_d = 100 A); 2 - during the operation of the Electron Source No. 2 (glow discharge current I_d = 100 A); 3 - with the simultaneous injection of electrons from the electron sources No. 1 and No. 2 (glow discharge current Id = 200 A

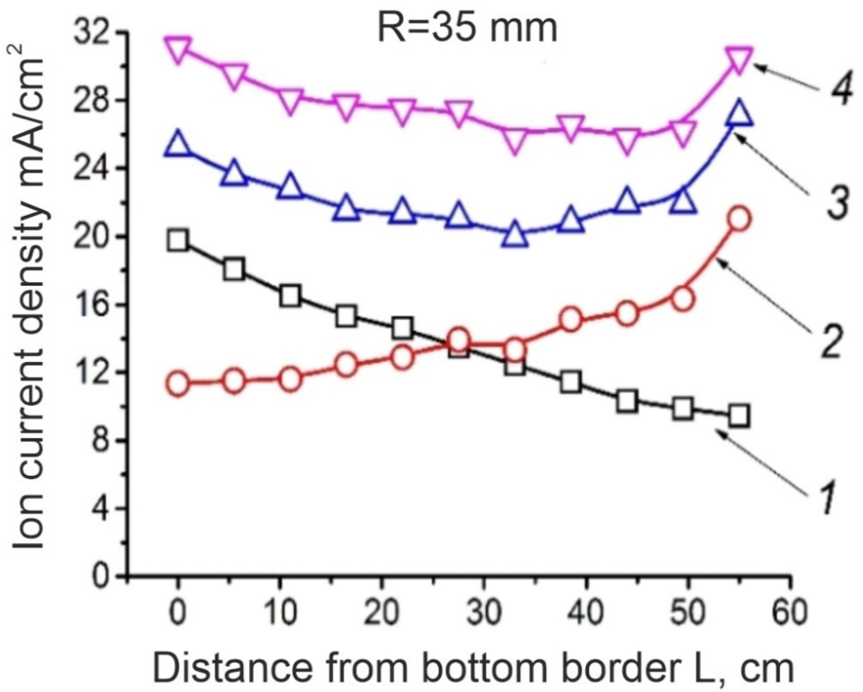
ANODE POSITION 2

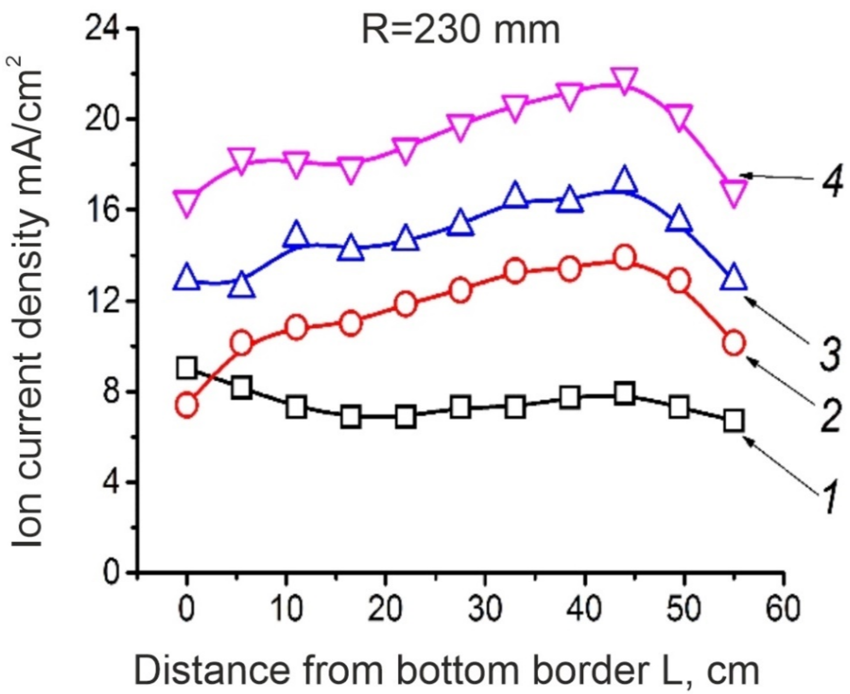




Longitudinal distributions of the ion current density on a flat probe placed in the plasma of a glow discharge with a hollow cathode with separate (simultaneous) operation of electron sources at a radius of 35 and 230 mm from the chamber axis (anode position 2): 1 - during operation of the Electron source No. 1 (glow discharge current I_d = 100 A); 2 - during the operation of the Electron Source No. 2 (glow discharge current I_d = 100 A); 3 - with simultaneous injection of electrons from the Electron Sources No. 1 and No. 2 (glow discharge current I_d = 200 A);
4 - algebraic sum of distributions 1 and 2 according to the principle of superposition

ANODE POSITION 3





Longitudinal distributions of the ion current density on a flat probe placed in the plasma of a glow discharge with a hollow cathode with separate (simultaneous) operation of electron sources at a radius of 35 and 230 mm from the chamber axis (anode position 3): 1 - during operation of the Electron source No. 1 (glow discharge current I_d = 100 A); 2 - during the operation of the Electron Source No. 2 (glow discharge current I_d = 100 A); 3 - with simultaneous injection of electrons from the Electron Sources No. 1 and No. 2 (glow discharge current Id = 200 A); 4 - algebraic sum of distributions 1 and 2 according to the principle of superposition

CONCLUSIONS

- Superposition principle is maintained, the calculated data check with those found by experiment.
- Usage the principle of superposition allows to scale the system on the base of non-self-sustained hollow cathode glow discharge.
- A ring-shaped anode placed in a geometric shadow region demonstrates the best distribution of the ion current density.

Thank you for attention!