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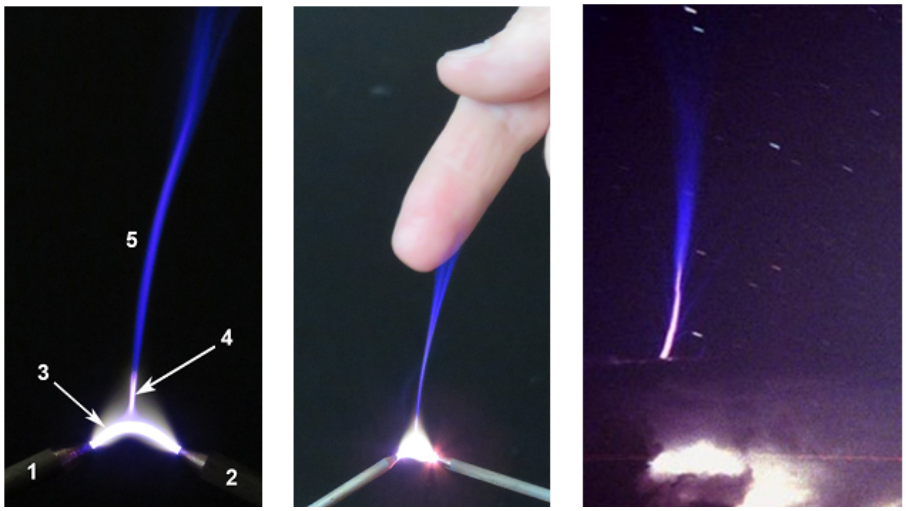
THE APOKAMP: NEW FORM OF ATMOSPHERIC PLASMA JET
FROM EXPERIMENTAL REVEALING TO THE THEORETICAL EXPLANATION

Here we present a new phenomenon in gas discharge physics: an extended plasma jet developing perpendicular to the bending point of the arc discharge channel between two electrodes. The group of experimentalists led by Eduard Sosnin (Institute of High Current Electronics, Tomsk, Russia) first discovered this phenomenon in 2016. It occurs if the pulsed-periodic (1.5-2.5 us pulse width at 16-50 kHz) electric discharge between two electrodes is initiated under the specific conditions. One of the electrodes have to have a high-voltage pulse-periodic potential, while the other one is under the floating potential (i.e. connected via the 3-10 pF capacitor to the "ground"). The discoverers have entitled it an "apokamp" (from Greek *από* - "off" and *καμπη* - "bend"). Apokamp represents a plasma jet propagating with supersonic velocities (about 100-220 km/s) perpendicularly to the bending point of the main discharge channel between electrodes. It is clearly seen that apokamp at low-pressures represents an exact "tiny" analogue of large-scale stratospheric transient luminous events, e.g. "blue jets" or "blue starters".



The apokamp phenomenon appearance (left and center image) and the color photo of a "blue jet" over a large thunderstorm taken north of Reunion Island in the Indian Ocean (right).

The attached video is the result of a deterministic theoretical modeling of apokamp in pure oxygen using "two-moment" model of a non-equilibrium discharge plasma implemented in COMSOL Multiphysics 5.2a. The overall structure of the phenomenon from the simulation standpoint completely fits the experimental observations (video corresponds to the duration of 1.6 us). Simulation shows that apokamp is not associated with neutral gas convection of any kind. The apokamp jet grows within a single voltage pulse (2.5 us) having the nature of a positive streamer developing from the bending point of the main discharge.

REFERENCES

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