Investigation of an extremely fast formation of anode spots in a nanosecond atmospheric discharge [[1]](#footnote-1)\*)

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By employing multi-frame laser interferometry, shadow, and schlieren imaging, we trace the formation of a nanosecond spark discharge in millimeter-sized air gaps formed by a point cathode and flat anode or vice-versa. We discover that the electrical breakdown of the discharge gap is associated with extremely fast (<<1 ns) explosive formation of micron-sized (~10–50 μm) cathode and anode spots. We find that the characteristic delay between the instants of the anode and cathode spot initiation can be much shorter than 1 ns. The spots appear as rapidly evolving near-electrode plasmas with an electron density *n*e~1019–1020 cm-3. The spots then give rise to highly ionized spark channels with a pronounced filamentary structure. Our findings indicate that the extremely fast formation of anode spots is associated with an ultrafast gap breakdown promoted by an ultrafast ionization wave governed by the rapidly evolving cathode spot. The role of the ultrafast ionization is discussed as a fundamental mechanism of the breakdown.

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