surface-wave-sustained low-pressure microwave discharge in an open cavity [[1]](#footnote-1)\*)

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In this work, we study the propagation process of the low-pressure microwave discharge sustained by the surface electromagnetic waves (SEW) [1] in an open microwave cavity formed by a pair of plane-parallel metallic mirrors. The discharge was initiated in the 2-m-long quartz tube with diameter of 27 mm filled with air. The SEW was excited by the waveguide applicator [2], connected to the magnetron 3 with a power of 800 W, generating rectangular pulses at a frequency of 2.45 GHz.

Surface wave sustained discharge propagates outwards from the microwave radiation source [1] and forms the plasma column between the launcher and the first mirror of the microwave cavity that supported by the SEW. The open cavity consists of two plane copper mirrors with diameter of 12 cm. The discharge tube passes through the holes in the mirrors centers. The cavity is pumped by microwave energy through the coupling hole in the first mirror. The plasma column penetrates in the cavity is acting as a plasma antenna and excites the field in the cavity volume. The propagation of the discharge in the cavity suspends in the minimum of the field created by itself due to violation of the SEW existence condition [1]: surface wave can propagate only in plasma with the density $n\_{e}$ more than the threshold density $n\_{min}=\left(1+ε\_{d}\right)n\_{c}$, where $ε\_{d}$ is the dielectric constant of quartz, and $n\_{c}$ is the critical plasma density. The structure of the discharge end has diffusion like density profile with characteristic lengths about 2 cm [3]. Plasma with such a density distribution at the end of the discharge enters the region of the volume field of the cavity increasing towards the antinode, which leads to a fast ionization. When the threshold density $n\_{min}$ is reached, the surface wave continues the propagation. This development of the discharge continues until the next node of the field, where it stops and the whole process is repeated. Thus, the discharge propagates in the form of successive ${\~λ\_{0}}/{2}$ (where $λ\_{0}≈6.1 cm$ – is a free space wavelength) until the energy reserves are exhausted or until they reach the second mirror. At the final stage of propagation, the discharge turns into a surface-wave-sustained plasma column with some modulation of the plasma density. It was shown that the discharge length between the mirrors can be controlled by tuning the cavity.

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References

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