probe development for electric propulsion diagnostics [[1]](#footnote-1)\*)

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This report focuses on the new type of Retarding Potential Analyzer (RPA) [1], which is used to measure the energy spectrum of ions in plasma. Probe diagnostics of plasma is very important in areas, connected with energy producing and satellite development. Ion energy detection is particularly important when it comes to ion or hall engines which are installed on spacecraft.

In a typical configuration, a probe uses three or four grids with holes, radius of which is equal to several Debye length of plasma. The first grid limits influence of internal grids on external plasma and is maintained under floating potential. The second and fourth grids are supplied with a small negative potential for electron reflection. The fourth is not necessary. The third grid is kept under the positive potential and slows down and filters ions. This grid transmits ions only with sufficient energy, which then reach the collector, forming a small negative current on it. As a result, the dependence of the collector current on the voltage on the third grid allows you to get the function of distribution of ions on the energies.

For particular plasma it is necessary to use a probe with a specific geometry and when the plasma parameters change (temperature, density, etc.) it is necessary to change the probe. This problem is very important when examining electric rocket engines, where density of the plasma on a big angle to engine axis is much lower, than the density on the axis On the periphery a probe with high transparency is required for accurate measurements and on the axis the probe transparency needs to be reduced to reduce the probability of negative effects such as secondary electron emission and erosion of probe elements.

This paper proposes a new design of the probe, which significantly improves the accuracy of measurements and expands the range of application of RPA-probes. The main idea of the new probe is to combine the collector and the third grid [2]. It is proposed to use electrodes with coaxial holes instead of grids. During the development of the probe, a review of existing structures was carried out, the Child-Langmuir law was used and numerical modeling of ion trajectories in IOS-3D [3] was applied.

The report presents a new probe with the description of the most important elements, such as the characteristics of the electrodes, material requirements, and insulation methods. Comparison of the main characteristics of the new probe with the most common designs was made and results of modeling of the proposed geometry were presented. Also, the analysis of the influence of the deviation from the coaxial arrangement of electrodes on the results was carried out in the report.

References

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3. Shagayda A. Simulation of charged particles in the ion-optical systems of ion engines (IOS-3D). Software Package, 2014, No. 2014610277

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