2D3V hybrid model of hall thruster plasmas with numerically reconstructed anomalous conductivity distribution [[1]](#footnote-1)\*)

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Numerical models of the discharge in a Hall thruster commonly based on fluid [1] or PIC [2] description of plasma dynamic. Fluid approach gives significant reduction of calculation time in comparison with kinetic one, but takes some assumption such as neglecting of nondiagonal terms of pressure tensor or demands solving of closing problem. The most popular solutions of the closing problem are the assumption that the moments upward the second equals zero and the second moment is constant (constant temperature assumption) and the assumption that the moments upward third equals zero and third moment could be expressed through the second one (Fourier assumption). PIC method automatically takes into account both nondiagonal terms of pressure tensor and all moments of distribution function. However, PIC method generates statistical noise and uncertainties caused by acceleration techniques. Also, PIC method takes a lot of time on calculation procedure. Besides the fluid and kinetic approaches there is hybrid one with fluid description of electrons dynamic and kinetic description of heavy species dynamic description [3-5].

In this paper a 2D3V hybrid model with fluid electrons and PIC ions and neutrals is developed. The difference from the previous model is in the magnetically aligned mesh in whole simulation region (including the region near the boundaries) and hydrodynamic approach with Fourier assumption for electrons. Anomalous electron transport across the magnetic field lines was modeled using reconstructed with the help of machine learning methods and 1D numerical model electron conductivity distribution. The first three moments of distribution function including nondiagonal terms of pressure tensor for neutrals and ions were calculated for KM-88 thruster discharge. The obtained results show that the fluid approach for the neutral is inappropriate on account of big influence of nondiagonal terms of pressure tensor which are omitted in fluid approach. Surprisingly for the authors, the modeling of ions dynamic in axial direction using fluid approach even in constant temperature assumption is quite feasible besides the fact that the temperature of the ions is significantly nonconstant function. However, the dynamics of the ions in a radial direction could be distorted when ions modeled as fluid.

References

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