Method of reconstruction of anomalous conductivity on basis of integral parameters of hall thruster [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2022.49.1.120

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One of the key problems on the way of a Hall thruster modeling is the model of anomalous electron transport. As it was measured with the LIF diagnostics [1], [2], commonly used Bohm type conductivity is inappropriate for Hall thruster modeling. Nowadays, the state-of-the-art models use experimentally measured anomalous conductivity profile [3]. Unfortunately, such approach does not allow calculating plasma in discharge chamber a priori and demands expensive LIF diagnostics equipment, which is not available for many researchers. There were some attempts [5-8] to create a priori turbulent models of anomalous electron transport. However, these models use some plasma parameters such as plasma oscillations magnitude, wave number or the oscillation mode, which leads to the anomalous transport. . Another approach was applied in Ref. [9, 10], where the machine learning techniques were used to interpolate the LIF data obtained for thrusters of different power.

In this paper the inverse problem was solved in terms of 1D3V hybrid model [11,12] using as input parameters discharge current, thrust, discharge divergence and beam energy homogeneity. The search of the anomalous conductivity was carried out using Byes optimization (machine learning technique). It was shown that chosen integral parameters gives unique solution for anomalous conductivity distribution and obtained solution gives qualitative agreement for calculated and experimentally measured local plasma parameters.

References

1. J.A. Linnell, and A.D. Gallimore, in 31st International Electric Propulsion Conference, Ann Arbor, 105 (2009).
2. C.J. Durot, B.A. Jorns, E.T. Dale, and A.D. Gallimore, in 35th International Electric Propulsion Conference, Atlanta, 29 (2017).
3. I.G. Mikillides, and I. Katz, Physical Review E, vol. 86, 046703 (2012).
4. M.A. Capelli, C.V. Young, E. Cha, and E. Fernandez, Phys. Plasmas, vol. 22, no. 11, 2015.
5. T. Lafleurm S.D. Baalrud, and P. Chabert, Phys. Plasmas, vol. 053503, no. 2016, 2017.
6. M.K. Sharfe, C.A. Thomas, D.B. Sharfe, N. Gaskon, A. Cappelli, and E. Fernandez, IEE Trans. Plasma Sci., vol. 36, p. 1, 2007.
7. M. Reza, F.Faraji, T. Andreussi, and M. Andrenucci, in 35th International Electric Propulsion Conference, Atlanta, IEPC-2017-367, (2017).
8. B. Jorns, Plasma Sources Science and Technology, vol. 27, p. 104007, 2018.
9. B. Jorns, T. A. Marks and E. T. Dale, in AIAA Propulsion and Energy Forum, AIAA 2020-3622, August, 2020.
10. A. Shashkov, A. Lovtsov, and D. Tomilin, Physics of Plasmas, vol. 24, 043501 (2017).
11. A. Shashkov, A. Lovtsov, and D. Tomilin, Eur. Phys. J. D, vol. 73, 173 (2019).
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLIX/Lt/ru/FF-Shashkov.docx) [↑](#footnote-ref-1)