filter spectrometer for measuring the electron component of plasma temperature in gobus-m2 tokamak [[1]](#footnote-1)\*)

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1,2Goryainov V.Yu., 1Voronin A.V., 1Zabrodsky V.V., 1Kurskiev G.S.

1Ioffe Institute of the Russian Academy of Sciences, Saint-Petersburg, Russia,  
 [vgoryainov@mail.ioffe.ru](mailto:vgoryainov@mail.ioffe.ru)  
2Peter the Great St. Petersburg Polytechnic University, Saint-Petersburg, Russia.

Temperature recording equipment is one of the most popular in the study of laboratory plasma behavior. In this work we present a technical solution for a filter spectrometer, which makes it possible to determine the temperature of the electron component of the plasma from its radiation in the X-ray region.

At the Globus-M2 spherical tokamak, two mutually complementary diagnostics were used to measure the electronic component of the plasma it is Thomson scattering of the laser beam during its interaction with the plasma and filter spectrometry of soft X-ray radiation. A laser was used to record the temperature discretely in time in 10 spatial regions of the plasma column from 5 to 20 times during the tokamak discharge. The high cost and limited time between failures of the laser did not allow the continuous use of this diagnostics. Filter spectrometry provided continuous temperature measurement throughout the entire current pulse and could be used as a monitor during the entire experimental campaign.

The spectrometer consisted of four photodetectors, beryllium filters, collimators, and a stabilized power supply. All elements of the device were mounted on a standard DU80 flange on the side facing the tokamak vacuum chamber. The photodetectors were made specially for this spectrometer using the SPD-8UVH technology and are equipped with integrated amplifiers [1]. The main feature of photodetectors was their high sensitivity and a time resolution of ~ 1 μs, which makes it possible to record fast processes in the tokamak plasma. Beryllium filters were manufactured at the Institute of Metals and Technology at the Peter the Great St. Petersburg Polytechnic University and had increased values of strength, plasticity, and uniformity [2, 3]. The thicknesses of the foils mounted on four photodetectors were 15, 27, 50, and 80 µm. The spectral characteristics of the filters were formed using the database [4]. An algorithm was developed for calculating the temperature dependence on time from measured X-ray signals. The results obtained were compared with the results of diagnostics of Thomson scattering, which installed on the tokamak. The measured temperatures are in agreement with the temperatures obtained by various methods.

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References

1. <http://technoexan.ru/en/products/sildet.php>
2. Mishin V.V., Shishov I.A., Minchena A. 2018 *Materials Physics and Mechanics*, 38 (1), pp. 40-47. [https://www.scopus.com/inward/record.uri?eid=2-s2.0](https://www.scopus.com/inward/record.uri?eid=2-s2.0%20)
3. Mishin V.V., Shishov I.A., Stolyarov O.N., Kasatkin I.A., Glukhov P.A. Enhanced mechanical properties of hot-rolled beryllium foils. 2020 *Materialia*, 11, 100726
4. [www./physics.nist.gov/PhysRefData/ASD/lines\_form.html](http://www./physics.nist.gov/PhysRefData/ASD/lines_form.html)

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