DISPERSION INTERFEROMETER FOR THE GLOBUS-M2 TOKAMAK [[1]](#footnote-1)\*)

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To register the behavior of the plasma density during the discharge and implement the possibility of plasma density control on the Globus-M2 tokamak (St. Petersburg, Russia) the dispersion interferometer (DI) based on a CO2 laser with artificial phase modulation of the probing radiation was developed at the Budker Institute of Nuclear Physics (Novosibirsk, Russia). The interferometer circuits, previously created by a team of authors for the GDL (Novosibirsk, Russia) [1] and TEXTOR (Julich, Germany) [2] installations, were used as a prototype in the development of this DI. The measurement module described in [3] was developed to record DI signals and calculate the plasma density.

During the experimental campaigns of 2021-2022, the DI with the measuring module was tested on the Globus-M2 tokamak. The measurements were made in discharges with a plasma current IP = 0.2–0.4 MA and a toroidal magnetic field BT = 0.6–0.9 T in divertor and limiter magnetic configurations. Before testing, the DI was calibrated using a movable wedge installed in the region of the forward and backward beams crossing the plasma. The calibration showed that the measurements results and calculations are matched within the uncertainty of the expected phase shift. The measurement error of the phase shift absolute value was less than 2.5%.

Nowadays, DI is a full-fledged part of the Globus-M2 tokamak diagnostic complex and makes it possible to obtain real-time reliable data on the absolute value of the plasma electron density in all operating modes of the facility. The range of the noise component during linear density measurements does not exceed <nl>min ≈ 6×1012 cm-2 with a time resolution of 20 µs. In the upgraded version of the measuring module, it is possible to control the valve for gas injection into the tokamak vacuum chamber during the operating pulse with the aim of building a feedback system to control the plasma density using a DI as a detector, which is planned in the future.

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References

1. Соломахин А.Л., Багрянский П.А., Воскобойников Р.В., Зубарев П.В., Квашнин А.Н., Лизунов А.А., Максимов В.В., Хильченко А.Д. Дисперсионный интерферометр на основе CO2 лазера. – Приборы и техника эксперимента, 2005, N5, с. 96-106.
2. Dreier H., Bagryansky P., Baumgarten N., Biel W., Lambertz H. T., Lehnen M., Lizunov A., Solomakhin A. First results from the modular multi-channel dispersion interferometer at the TEXTOR tokamak. – Review of Scientific Instruments, 2011, 82, 063509
3. Иваненко С.В., Гринемайер К.А., Пурыга Е.А., Квашнин А.Н., Багрянский П.А. Измерительный модуль дисперсионного интерферометра на основе СО2 лазера для управления плотностью плазмы. – ВАНТ. Сер. Термоядерный синтез, 2022, т. 45, вып. 1, с.67 - 78

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