SIMULATIONS OF THE EFFECT OF THERMAL DEFORMATIONS ON THE IMAGE TRANSFER OF THE LIGHT COLLECTION SYSTEM OF DIAGNOSTICS “ACTIVE SPECTROSCOPY OF ITER”

Verdiyan A.S., Bondarenko A.V., Serov V.V., Tugarinov S.N.

Institution “Project center ITER”, Moscow, Russia

The method of active spectroscopy used on tokamaks is based on the injection of a beam of neutral atoms in the region of high-temperature plasma. As a result of the charge exchange on the neutrals, the completely ionized particles are converted into hydrogen-like ions emitting in the visible region of the spectrum. According to the profiles of the spectral lines measure the parameters of the plasma: temperature, speed, concentration of impurities. The method of active spectroscopy under the ITER tokamak conditions is described in [1]. A bunch of hydrogen atoms is injected into the plasma. Observation over the diagnostic beam area is carried out by two optical systems. Mirrors transmit radiation from the “active” region through a zigzag channel to the vacuum window. Next, the lens system builds on the receiving end of the fiber optic cable harness of the image of the study area. The fiber optic cable transmits a signal to the diagnostic room to a set of spectrometers. The attachment points of the mirrors of the optical system were exposed to photons and particles from the plasma. In operating mode, they experience cyclic thermal loads. The calculations carried out at St. Petersburg Polytechnic University showed that, in the operating mode, the greatest loads and displacements fall on the first mirror facing the plasma. The calculated linear and angular displacements of the other mirrors turned out to be one to two orders of magnitude smaller. In work [2] investigates the influence on the quality of the transmitted image of the angular and linear displacements of the first mirror. In this paper, the effect on the image quality of the calculated thermal displacements of all mirrors, separately and in total, is investigated using the Zemax software package. The image of a point source located in the center of the plasma cord is a spot of irregular shape. For the green wavelength, we calculate the root-mean-square and geometric radii and the position of the center of the image. These parameters characterize the spatial resolution of the diagnosis. The fraction of the rays reaching the image plane was also calculated, which characterizes the sensitivity of the system. The contribution of each mirror separately and the total contribution of all mirrors were evaluated. Findings. An optical scheme was built in the Zemax program that allows to evaluate the influence of environmental conditions on the diagnostic characteristics of ITER Active Spectroscopy. It is concluded that thermal deformations of mirrors in the operating mode of the installation do not limit the spatial resolution and diagnostic sensitivity.

References

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2. A.S. Verdiyan, A.V. Bondarenko, V.V. Serov, S.N. Tugarinov at the 61st All-Russian Scientific Conference of the Moscow Institute of Physics and Technology on the topic “Estimation of the maximum allowable deformations in the ITER light spectroscopy diagnostic system“ Active Spectroscopy ITER ”in the ZEMAX software package.”