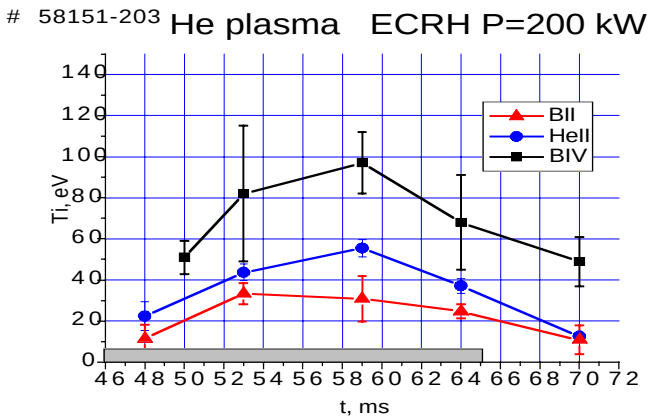
Results of Measurements of the Ion Temperature Profile of ECR Heated Plasmas in the L-2M Stellarator

G. S. Voronov, E. V. Voronova, S. E. Grebenshchikov, and L-2M Team

A.M. Prokhorov General Physics Institute, Russian Academy of Sciences, Moscow, Russia

After boronization of the vacuum chamber of the L-2M stellarator, the confinement characteristics and the electron temperature profile changed markedly[1]. In this connection, our immediate task was to carry out studies of the behavior of the ion temperature under these conditions.

Previous measurements of Ti were performed by analyzing the energy distribution of fast hydrogen ions produced by charge exchange[2]. In recent studies, the ion temperature was determined from Doppler broadening of spectral lines of impurity ions. With the help of a set of mirrors, the plasma radiation was focused on the entrance slit of a VMS-1 monochromator (D/F=1:6.5, F=600 mm, 1200 lines/mm,1.3 nm/mm, 200 – 800 nm). The detector was a CCD plate (1040_1140 pixels of size 16_16 μm) covered in part with an opaque screen. The plasma spectrum produced in the uncovered area was rapidly scanned and copied into the covered region. With this partial exposition method, the rate of recording was successfully increased up to 1000 frames per second[3]. The instrument function of the whole system was 0.04 nm, which corresponds to Ti ~1 eV for hydrogen and ~17 eV for boron ions. The plasma ion temperature is considerably higher, so the accuracy of measurements of Ti is limited primarily by a low intensity of signals from the plasma with a low impurity concentration.



The results of measurements of the evolution of HeII, BII, and BIV ions temperature during the ECR heating of a helium plasma are shown in he figure. The plasma density in these experiments was ~2×10^{19} m^{-3}, and the gyrotron pulse power was ~200 kW.

The results of measurements of Ti were compared with the time evolution of the ion temperature calculated by using the TRANSZ code[4]. The latter includes a complete set of neoclassical equations and involves additional anomalous fluxes corresponding to accepted empirical scalings. The calculated values of Ti are in fair agreement with the measured ones

1. A.I. Meshcheryakov, D.K. Akulina, G.M. Batanov, et al., Plasma Physics Reports, Vol. 31, No. 6, 2005, p. 452.
2. S.E. Grebenshchikov, L.M. Kovrizhnykh, I.S. Sbitnikova, et al., Soviet Journal of Plasma Physics , Vol. 9, p.696. (1983).
3. www.silar.spb.ru
4. S.E. Grebenshchikov, I.S. Danilkin, A.B. Mineev, Plasma Physics Reports, Vol. 22, No.7, 1996, p. 551.