Analysis of Globus-M2 tokamak plasma heating experiments using diamagnetic measurements [[1]](#footnote-1)\*)

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The work presents an analysis of the estimate of the thermal energy stored in plasma (WP). Discharges with the toroidal magnetic field up to 0.9 T and the plasma current up to 0.4 MA were studied in regimes with auxiliary heating using neutral beam injection (NBI). Two injectors were used, with the particle energies keV and keV and the total output power in atomic beams. Taking into account the ohmic heating power the total heating power density achieved the value of .

The evolution of WP was estimated using the free boundary equilibrium code PET [1]. The code solves the Grad–Shafranov equation and also calculates the diamagnetic flux. Irrespectively the last closed magnetic surface was reconstructed by the movable filaments method [2]. This method modeled the plasma current by a set of 19 current-carrying rings. The input data are the magnetic fluxes measured by 21 loops placed on the vacuum vessel wall near the plasma boundary, the plasma current and the currents in poloidal field coils and central solenoid. The signals from the magnetic loops were also used to determine the distribution of the currents over the vessel wall. In PET simulation the shapes of plasma pressure and current density profiles, as well as plasma beta (β) were varied in such a way that the calculated with PET the last closed magnetic surface and the diamagnetic flux coincided with the experimental values. Such approach made it possible to determine the plasma thermal energy as well as the normalized internal inductance (li).

Measuring the diamagnetic flux from the plasma made it possible to calculate the 𝛽dia [3] and thermal stored energy Wapprox by the approximate equation. The difference between WP and Wapprox in the range from 6 to 16 kJ was less than 10%

The li was determined from the expression for the vertical magnetic field using the 𝛽dia as the poloidal beta. This li were in a satisfactory agreement (less than 10% difference) with li obtained by PET in the range of inductance from 0.8 to 1.2.

The calculated by PET values of plasma energy was compared with WP values obtained from kinetic measurements of the plasma temperature and density profiles by Thomson scattering diagnostic, charge exchange recombination spectroscopy and neutral particle analyzer. The values of effective plasma charge Zeff were obtained from the intensity of bremsstrahlung.

References

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