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## P4.060 Heavy ion beam probe design and operation on the T-10 tokamak

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Paper describes recent advances in Heavy Ion Beam Probing (HIBP), a unique diagnostics to measure the core plasma potential in the T-10 tokamak ( $R = 1.5$  m,  $a = 0.3$  m,  $B_{\text{tor}} = 1.5 - 2.5$  T). Fine focused ( $< 1$  cm) and intense ( $< 130$  mA)  $\text{Tl}^+$  beams with energy up to  $E = 330$  keV, equipped by advanced control and data acquisition system provides the measurements in the wide density interval  $n_e = (0.3 - 5) \times 10^{19} \text{ m}^{-3}$  and the wide range of plasma current  $100 < I_{\text{pl}} < 330$  kA in Ohmic and ECR-heated plasmas. The multichannel parallel plate electrostatic energy analyzer with a high temporal ( $\geq 1$  ms) and energy ( $\Delta E / E < 5 \times 10^{-5}$ ) resolution simultaneously provides data on the mean value of plasma potential  $\phi$  and its oscillations (by the beam extra energy), plasma density oscillations (by the beam current) and poloidal magnetic  $B_{\text{pol}}$  oscillations (by the beam toroidal shift) in each of 5 sample volumes (SVs). When SVs are poloidally shifted, we can determine the poloidal electric field  $E_{\text{pol}} = (\phi_1 - \phi_2) / x$ ,  $x \sim 1$  cm, and the electrostatic turbulent particle flux  $G_E \times B - n_e E_{\text{pol}} / B_{\text{tor}}$ . Cross-phase of density oscillations allows us to find the poloidal phase velocity of perturbations, or the plasma turbulence rotation, and the poloidal mode number  $m$ . Time evolution of local values of plasma parameters and/or fragments of radial profiles (as long as 2-6 cm) can be measured in a single shot at Low Field Side. The whole profile in the range ( $0.25 < \rho < 1$ ) is available shot by shot for  $B_{\text{tor}} \leq 2.2$  T. High gain (107 V/A) preamplifiers with 500 kHz bandwidth allows us to study broadband turbulence and various types of quasicohherent modes including tearing MHD modes and Geodesic Acoustic Modes.

**Presenter:** MELNIKOV, Alexander (Tokamak Division National Research Centre 'Kurchatov Institute')

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