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STUDY OF CROSS-FIELD PARTICLE TRANSPORT IN DISCHARGES WITH NON-LOCAL HEAT TRANSPORT IN THE LHD HELIOTRON *)

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When macroparticles are injected at the plasma periphery in magnetic confinement devices, positive electron density perturbations arise due to material evaporation, and negative electron temperature perturbations occur due to the influx of cold evaporated particles and their radiation. The concept of "non-local" heat transport is applied to the experimentally observed heating of the central plasma regions while the periphery cools. Two approaches are considered for describing this phenomenon: (1) modeling the evolution of the plasma thermal conductivity coefficient, assuming the plasma remains stationary [1]; (2) modeling plasma movement with a constant thermal conductivity coefficient [2]. The goal of this study is to analyze the evolution of electron density during the observation of non-local heat transport (NLT) following polystyrene macroparticle injection into the plasma of the LHD heliotron [1-2].

The evolution of electron density, assuming no electron sources within the plasma column, is described by the equations

$$\frac{dn}{dt} = -\mathrm{div}(\Gamma);\ \Gamma = -D\frac{dn}{dr} + Vn(r), \qquad (1)$$

where Γ is the electron flux, D is the diffusion coefficient, and V is the convective velocity. To reconstruct the profiles of D and V, a code was developed that utilizes the evolution of electron density $n_e(r,t)$ and the algorithm proposed in [3]. The inverse problem of determining the time-independent transport coefficients V and D from the known evolution of $n_e(r,t)$ is solved in the algorithm by calculating the evolution of the flux on the magnetic surface with a radius ρ

$$\Gamma(r,t) = -\frac{d}{dt}\int_0^r \rho n(\rho,t)d\rho \qquad (2)$$

and for each radius of the magnetic surface, an overdetermined system of equations (3) was solved

$$\Gamma_j(r,t) = -D\left.\frac{dn(r,t)}{dr}\right|_j + V(r)n_j(r,t),\ j = 1 \dots k \qquad (3)$$

where k is the number of time layers.

The report presents an analysis of electron density perturbations in three discharges of the LHD heliotron following the injection of a polystyrene macroparticle. It is shown that the evolution of density perturbations has a diffusion-like character, even with "non-local" electron temperature transport.

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