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Measurement and Studied on Some Plasma Parameters in the Edge of IR-T1 Tokamak

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Abstract— **The Plasma resistivity has been measured in the edge plasma of IR-T1 tokamak. The fundamental plasma parameters of electron temperature (*Te*) and electron density (ne) are measured simultaneously for calculating the radial profile of vertical and parallel resistivity using IV characteristics of a moveable single Langmuir probe. Since the effective charge (*Z*eff) and *Te* together define the plasma resistivity, *Z*eff considered for resistivity measurement in Spitzer model. The results have shown that electron density increased from edge to core of plasma column, as the parallel electrical resistivity of the plasma decreases with increasing temperature. As temperature of plasma raised, resistivity drops rapidly so Reduction of resistivity with increasing temperature could leads to prolonging of the duration of the plasma discharge.**

Keywords-: *Tokamaks; resistive MHD; electron collisions; Impurities in plasmas; ohmic heating; electric discharges.*

I. Introduction

Any realistic plasma will have a density gradient, and the plasma will tend to diffuse toward regions of low density. We assume that the plasma is weakly ionized, so that charge particles collide primarily with neutral atoms rather than with one another. As the plasma spreads out as a result of pressure gradient and electric field forces, the individual particles undergo a random walk, colliding frequently with the neutral atoms. When plasma consists of just electrons and ions, all collisions are coulomb collisions among charge particle [1-3]. If a uniform steady electric field is imposed on plasma this electric field will accelerate the ions and electrons in opposite directions. The accelerated particles will collide with other particles and this fractional drag will oppose the acceleration. Resistivity is determined by the collisional drag on electrons moving against the background of ions. Suppose that an electric field E exists in a plasma and that the current that it drives is all carried by the electrons, which are much more mobile than the ions. Then in steady state the electron equation of motion changes, so that $E=\eta J$ is ohm's low, and η is the resistivity. The transverse or cross field resistivity was calculated by Spitzer as the rate of momentum transfer from electrons to ions through collisions in a resistive magnetohydrodynamics [4],

$$\eta_{\perp} \equiv 1.03\times10^{-4} T_e^{-3/2} Z \ln\Lambda \ \ (ohm.m) \qquad (1)$$

where the electron temperature T_e is in electron volts, Z is the ion atomic mass and $ln\ \Lambda$ is the coulomb logarithm. Also parallel resistivity defined by [5],

$$\eta_{Spitzer} = \eta_{||} = 5.24\times10^{-5} \frac{Z \ln\Lambda}{T_e^{3/2}} \ \ (ohm.m) \qquad (2)$$

ln Λ is coulomb logarithm which is a term that accounts for the multiple small angle collisions in the plasma and Debye shielding.

$$\Lambda = 1.5492\times10^{13} \frac{T_e^{\frac{3}{2}}}{Z^2\sqrt{n_e}} \qquad (3)$$