AN EXPERIMENTAL STUDY OF THE NON-IDEAL EFFECTS OF THE RADIAL OHM'S LAW IN THE FLOWING MAGNETIZED PLASMA EXPERIMENT AND THE APPLICATION OF THE HEAVY ION BEAM PROBE TECHNIQUE ON A HELICON PLASMA

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ABSTRACT

There are two topics in this thesis. The first topic is an experimental study of the non-ideal effects of the radial Ohm's law in the Flowing Magnetized Plasma experiment. Two probes, a complex probe array and a nine-electrode probe, have been designed and built to study the non-ideal effects. By the probes, we identified there are two distinct plasma flow patterns. The experimental data shows the radial ideal Ohm's law is not fully satisfied and the non-ideal effects are very important. We identified the Hall effect is the most important non-ideal effect, the importance of the Hall effect is correlated to the ion skin depth and the characteristic length-scale of the Hall effect.

The second topic is the application of the Heavy Ion Beam Probe (HIBP) technique on a helicon plasma. The purpose is to explore the possibility of measuring the electric field fluctuations up to tens of MHz using the HIBP technique. A beamline system and a helicon device have been constructed. The ion beams are tuned and measured. The relevant calculations have been performed. It's proven that the plasma potential can not be measured accurately by using the traditional HIBP technique when the time for the ions fly through the plasma is comparable or longer than the periods of the fluctuations. However, our calculation shows with an energy analyzer capable of measuring two sample locations simultaneously, as long as the time for the primary ions fly from one location to the other is much smaller than the periods of the fluctuations, and the separation of the two trajectories of the secondary ions is much smaller than the wave length of the wave modes, it's still possible to measure these electric field fluctuation components along the direction determined by the two sample locations.