Measurement of the Plasma Diamagnetic Current in the LBNL 6.4 GHz ECR Ion Source

Jonathan Noland1, Janilee Benitez2, M. Kireeff Covo1, Daniela Leitner1, Claude Lyneis1, Olli Tarvainen2, and John Verboncoeur3
1 Lawrence Berkeley National Laboratory, One Cyclotron Road, Berkeley, CA 94720
2 Department of Physics, University of Jyvaskyla, Jyvaskyla 40500, Finland
3 Department of Nuclear Engineering, University of California, Berkeley, CA 94709

Abstract
A method of measuring the diamagnetic current on the LBNL 6.4 GHz ECR ion source is described. The diamagnetic signal is proportional to the rate of plasma formation and decay. Furthermore, the integrated signal can be used to estimate the total plasma pressure, or energy density, and can thus be used to study the warm and hot electron populations in an ECR plasma.

Experimental Setup

Comparison of Faraday Cup Currents and Diamagnetic Loop Signal

Estimate of Plasma Energy Density

Schematic showing approximate location of the diamagnetic loop and aluminum support ring.

Effect of ECR First Stage on Plasma Ignition

1) Faraday cup currents start to increase as the plasma energy density is decreasing.
2) Higher charge state currents take longer to reach steady state.
3) The presence of a radial particle loss has been observed.

1) Plasma in the ECR forms at a faster rate than it decays at.
2) There is a delay of approximately 3 ms before the maximum rate of plasma formation occurs.
3) The maximum rate of decay occurs almost immediately as the RF power is turned off.
4) Plasma energy density increases logarithmically as microwave power is increased.

Electrons are present in the vacuum chamber on the order of seconds after RF power is turned off: Magnetic confinement of hot electrons.

Negligible change in ignition time.

Plasma ignition delayed by ~ 20 ms.

1) Electrons are present in the vacuum chamber on the order of seconds after RF power is turned off: Magnetic confinement of hot electrons.