

## Lawrence Physics Workshop

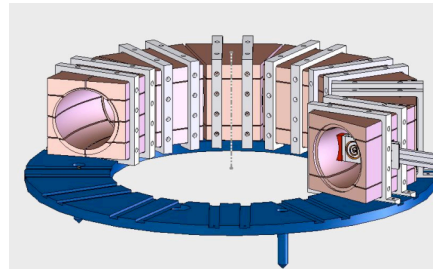
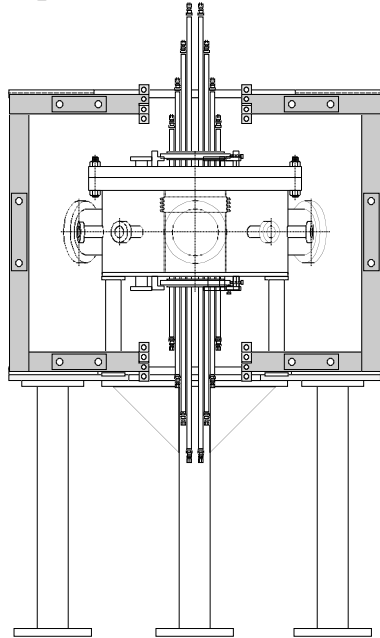
### Laboratory Notebook: *Plasma Oscillations Experiment*

Names:

Date:

**Objective:** To observe the lowest frequency oscillation of a (toroidal) electron plasma, measure its period as a function of magnetic field strength, and determine the number of trapped electrons.

**Apparatus:** The Lawrence Nonneutral Torus II is a (partially) toroidal trap for electron plasmas.



Cutaway view of  
internal electrodes

**Background:** Electron motion in this experiment has at least three time scales: 1) Electrons gyrate about the magnetic field very rapidly. 2) The center of an electron's "cyclotron" orbit drifts when an electric field is present in addition to the magnetic field. In this experiment the self-electric field of the plasma causes the electron column to rotate around its own axis. 3) In this experiment the  $m=1$  "diocotron instability" causes the plasma to move off-center in the vacuum chamber. The plasma therefore "sees" an electric field due to the induced ("image") charge in the vacuum chamber wall. This induced electric field causes the center of the plasma column to drift around the center of the vacuum chamber with a period given by,

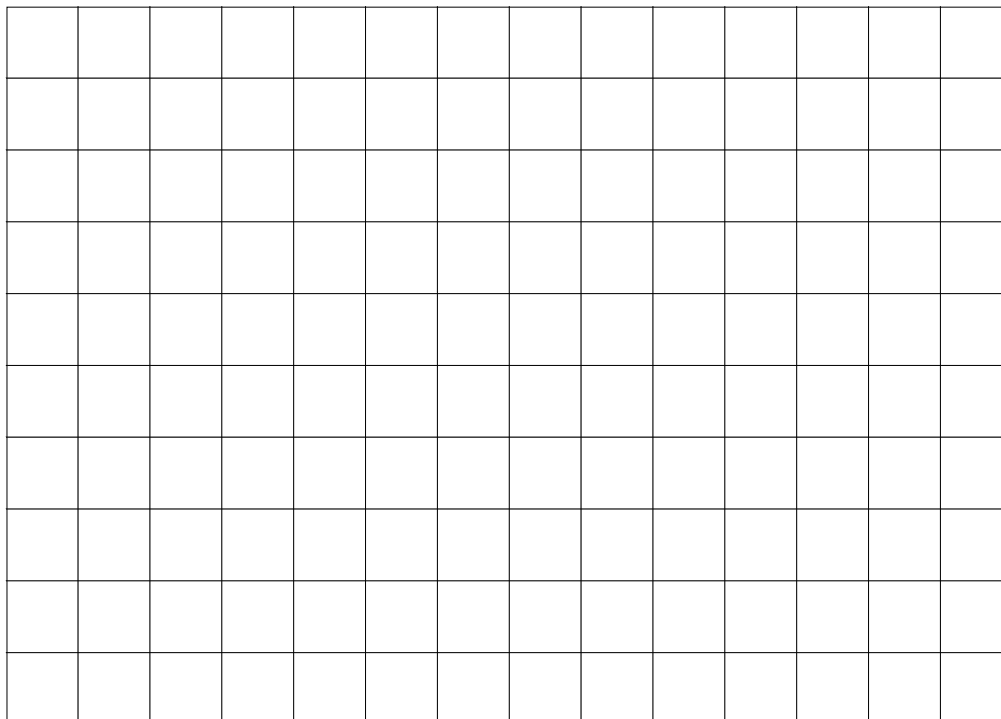
$$T_D = 2.18 \times 10^5 \frac{b(\text{cm})^2 L(\text{cm}) B(\text{G})}{N} \text{ microseconds}$$

where  $b$  (3.81 cm) is the radius of the internal electrodes,  $L$  is the length of the plasma,  $B$  is the magnetic field strength, and  $N$  is the number of electrons in the plasma. In this experiment we measure the period of the diocotron oscillation and the magnetic field strength in order to determine the number of electrons in the plasma.

**Data:**

Magnetic Field (Gauss)	Period (microseconds)

**Graph:**



**Conclusions:**