# Laboratory Observations of Wave-Induced Radial Transport within an "Artifcial Radiation Belt"

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Energetic electrons trapped within a strong dipole magnetic field have been produced by applying microwave electron cyclotron resonance heating to a low-pressure hydrogen discharge. The microwaves are absorbed at the fundemental cyclotron resonance, and the energetic electrons (1 keV $< E_h <$ 50 keV) are localized to a small region where the cyclotron absorption layer intersects the dipole's equator. We refer to these energetic particles as an "artificial radiation belt.". In the experiment, the collision time, $\tau_{col}$, of the energetic electrons is long, and thousands of gradient-$|B|$ drift orbits are possible between collisions, $\omega_{dh}\tau_{col} \geq 10^3$. As the intensity of the radiation belt increases, large-amplitude drift-resonant instabilities, $\omega \simeq \omega_{dh}$, are excited. The frequency spectrum of these instabilities are time-varying and complex, and chaotic radial transport is induced whenever the frequency spectrum is both intense and compact. Since the energetic electrons are strongly magnetized, the first and second adiabatic invariants, $\mu$ and $J$, are preserved during the nonlinear drift-resonant, wave-particle interactions. The energetic electrons act as a one-dimensional Vlasov fluid, and this allows a relatively simple self-consistent model of the growth and saturation of the drift-resonant instability. The model agrees with the temporal characteristics of the measured radial transport and the observed frequency sweeping of the instability.

**References**:

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