GENERATION OF ELECTROMAGNETIC RADIATION FROM A ROTATING 
ELECTRON RING IN A RIPPLED MAGNETIC FIELD 

Y.Z. Yin* and G. Bekefi 
Department of Physics and Research Laboratory of Electronics 
Massachusetts Institute of Technology 
Cambridge, Massachusetts 02139 

ABSTRACT 
Calculations show that modes resembling the free electron laser (FEL) instability are excited when electrons move in quasi-circular orbits under the combined action of a uniform axial magnetic field and an azimuthally periodic wiggler magnetic field. In the model, a thin annular ring of rotating electrons is confined in a hollow cylindrical waveguide, or between concentric cylinders comprising a coaxial waveguide, and the dispersion equations for the transverse magnetic (TM_{\epsilon,m}) modes are derived and analyzed. Coherent radiation occurs near frequencies \( \omega \) corresponding to the crossing points of the electromagnetic modes \( \omega = \omega_C(\epsilon, m) \) and the beam modes \( \omega = (z+\Omega_n) \), where \( \omega_C \) and \( \Omega_n \) are the waveguide cutoff frequency and the electron cyclotron frequency, respectively, and \( n \) is the number of wiggler periods. The computed instability growth rates are found to be somewhat larger than those calculated for the conventional, linear FEL.

*Permanent address: Institute of Electronics, Academia Sinica, Beijing, Peoples's Republic of China.