2Y6 Efficiency Enhancement by Using Depressed Collector Techniques in Devices Employing Gyrating Electron Beams,*

AMARJIT SINGH,[a] E. P. CHOJNACKI, W. W. DESTLER, D. GOUTOS, V. L. GRANATSTEIN, W. LAWSON, and C. D. STRIFFLER, University of Maryland, College Park, MD 20742--This presentation deals with energy recovery from the spent beam in a large orbit gyrotron. Energy recovery is of special interest where intrinsic efficiency is relatively low, as for harmonic operation. The approach involves conversion of the rotational velocity of the beam after rf interaction, into axial velocity, and then collecting the beam particles on electrodes at depressed potentials.

In a large-orbit gyrotron system, the axis-encircling beam can be generated by passing an axially streaming beam through a magnetic cusp.[1] A second cusp with reverse radial magnetic field would fulfill the objective of 'unwinding' the beam, so that it could deliver energy to the retarding electrostatic field generated by the depressed collectors.

A beam parameter of importance for both energy recovery and rf generation is the ratio of perpendicular velocity to axial velocity commonly denoted by α. We have studied this parameter under different conditions by computer simulation of the particle trajectories. A rise in α results from crossing the first cusp and a fall to a low value results from crossing the second cusp. The effects of finite cusp width and width of the emission surface are included in the simulation. The value of the residual α depends upon these parameters, the accelerating voltage, and the value of the magnetic field, viz-a-viz that value which would cause a reflection of the electrons from the cusp for a given value of accelerating voltage and radius at which the annular beam is injected. In a typical situation, α falls by more than a factor of ten after the second cusp.

Data obtained from simulations and techniques for reducing the variations of α in a beam of finite radial width are discussed. The design parameters for the experiment in progress are presented.

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[1]M. J. Rhee and W. W. Destler, Phys. Fluids 17, 1574 (1974).