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Cyclotron resonance accelerator for electron beams

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Abstract: Electron Cyclotron Resonance Accelerator (eCRA) simulation results are presented for realistic TE111 cavity geometry and finite space-charge beams that confirm the single-particle idealized solutions. The simulations include cavity openings for RF inputs, beam injection, and pumping; RF input couplings that maximize efficiency; a thin window for exit of the accelerated beam; realistic magnetic field profiles; finite diameter multi-Ampere beams. One simulated example is for a copper cavity with Q0 of about 19,000, with RF input power at each port of 12.5 MW, an 8.0-A, 100 keV beam was found to be accelerated to 2.2 MeV, for a pulsed beam power of 17.6 MW at an efficiency of 67%. A wide variety of applications can be envisioned for MW-class eCRA beams with energies in the range 1-10 MeV. Our first proof-of-principle demonstration of eCRA is to provide beams to generate intense X-ray fluxes to enable the replacement of radioactive sources now widely used for sterilization of medical supplies and foodstuffs. This demonstration will be based on use of available S-band components, although the optimal operating frequency for eCRA could be about 1000 MHz. In any case, the possibility of MW-level average power eCRA beams—even with predicted efficiencies >80%–will depend upon the availability of the required RF sources to drive eCRA.

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Footnotes

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Yes

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