484.
Title: Operation of a Continuously Frequency-Tunable Second-Harmonic CW 330-GHz Gyrotron for Dynamic Nuclear Polarization
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Abstract: The design and the operation of a frequency-tunable continuous-wave (CW) 330-GHz gyrotron oscillator operating at the second harmonic of the electron cyclotron frequency are reported. The gyrotron has generated 18 W of power from a 10.1-kV 190-mA electron beam working in a TE(-4,3) cylindrical mode, corresponding to an efficiency of 0.9%. The measured start oscillation current over a range of magnetic field values is in good agreement with theoretical start currents obtained from linear theory for successive high-order axial modes TE(-4,3,q), where q = 1-6. Moreover, the observed frequency range in the start current measurement is in reasonable agreement with the frequency range obtained from numerical simulations. The minimum start current was measured to be 33 mA. A continuous tuning range of 1.2 GHz was experimentally observed via a combination of magnetic, voltage, and thermal tuning. The gyrotron output power and frequency stabilities were assessed to be +/- 0.4% and +/- 3 ppm, respectively, during a 110-h uninterrupted CW run. Evaluation of the gyrotron output microwave beam pattern using a pyroelectric camera indicated a Gaussian-like mode content of 92% with an ellipticity of 28%. The gyrotron will be used for 500-MHz nuclear magnetic resonance experiments