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## LIST OF SYMBOLS

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<i>Symbol</i>	<i>Details</i>
$\gamma$	Relativistic factor
$\alpha$	Pitch factor
$r_w$	Radius of cavity
$r_b$	Electron beam radius
$r_L$	Larmor radius
$v_{\perp}$	Perpendicular electron velocity
$v_{\parallel}$	Axialelectron velocity
$\omega_{cut}$	Cutoff frequency of the waveguide
$\omega_c$	Cyclotron frequency
$c$	Velocity of light in free space
$e$	Electron charge
$m_e$	Mass of electron
$B_0$	DC magnetic field
$v_p$	Phase velocity of RF wave
$v_g$	Group velocity of RF wave
$T_c$	Time taken by an electron beam to complete its one gyration
$\omega$	Angular frequency of the RF wave
$s$	Harmonic number
$m, n, q$	Azimuthal, radial, and axial mode indices
$k_{\perp}$	Transverse propagation constant
$J_m()$	$m^{\text{th}}$ order ordinary Bessel function of first kind
$C_{mn}$	Coupling coefficient
$v_{mn}$	The $n^{\text{th}}$ zero of $J$ (Bessel function)
$\theta, r, z$	Azimuthal, radial, and axial cylindrical coordinates
$k_0$	Free-space propagation constant
$\epsilon_0$	Free-space permittivity
$\mu_0$	Free-space permeability
$k_c$	Cutoff wave number
$I$	Normalized beam current
$I_b$	Beam current
$\beta_{\perp}$	Normalized transverse electron velocity
$\beta_{\parallel}$	Normalized axial electron velocity
$p$	Normalized momentum of the electrons
$p_{\perp}$	Transverse momentum of the electrons
$p_{\parallel}$	Axial momentum of the electrons

$\Delta$	Detuning parameter
$\varepsilon$	Electron energy
$u$	Normalized energy of the electron beam
$Z$	Axial dependence
$F$	Normalized field amplitude
$\theta$	Phase of electron
$P_{in}$	Driver power at the input cavity
$\eta_{\perp}$	Transverse efficiency
$\eta$	Electronic efficiency
$\zeta$	Normalized axial position
$V_b$	Beam voltage
$k_{\parallel}$	Axial wave number of waveguide mode
$\zeta$	The angle of the electron momentum vector about the gyro-center
$\psi$	Phase of the RF wave
$\mu$	Normalized length of cavity
$E_0$	Electric field amplitude in the input cavity
$Q$	Total quality factor of the cavity
$P_{out}$	RF output power
$\mu_d$	Normalized length of the drift tube
$q$	Bunching parameter of the electron beam
$r_d$	Drift tube radius
$L_d$	Drift tube length
$\rho_{ohm}$	Ohmic loss density on the cavity wall
$\sigma$	Electrical conductivity of the cavity wall
$\delta$	Detuning between operating frequency and the cold cavity frequency
$U_w$	Stored energy in the cavity
$L$	Length parameter of the individual cavity
$P$	Power in the cavity
$V_d$	Voltage depression
$I_L$	Limiting current
$\chi$	Susceptibility
$A$	Amplitude of the signal
$Q_{cpt}$	Coupling quality factor
$\Phi$	Normalized gain-bandwidth product
$G$	Gain
$\xi$	Stagger-tuning parameter

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## ABBREVIATIONS

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<i>Abbreviation</i>	<i>Details</i>
EW	Electronic warfare
EM	Electromagnetic
ECR	Electron cyclotron resonance
TWT	Traveling-wave tube
BWO	Backward-wave oscillator
CFA	Crossed-field amplifier
VIRCATOR	Virtual cathode oscillator
CW	Continuous wave
SWCA	Slow wave cyclotron amplifier
MIG	Magnetron injection gun
CRM	Cyclotron resonance maser
RF	Radio frequency
NRL	Naval research laboratory
PBG	Photonic band gap
<i>TE</i>	Transverse electric
<i>TM</i>	Transverse magnetic
PIC	Particle-in-cell
FDTD	Finite-difference time-domain
FFT	Fast Fourier transform