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Linear comparisons of the GTC, GT3D, and FULL codes including trapped electrons in R/L_{Ti} and $k_{\perp}\rho_i$ scans*

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Introduction: GTC, GT3D, and FULL codes

- GTC code: global, nonlinear, PIC code, now including trapped electron effects; local Maxwellian equilibrium distribution functions
- GT3D code: global, nonlinear, PIC code, now including trapped electron effects; local (for linear runs) or canonical (for nonlinear runs) Maxwellian equilibrium distribution functions
- FULL code: radially-local (ballooning representation, flux-tube) linear eigenvalue code, including complete electron effects; has been compared to GS2 several times before, with good agreement

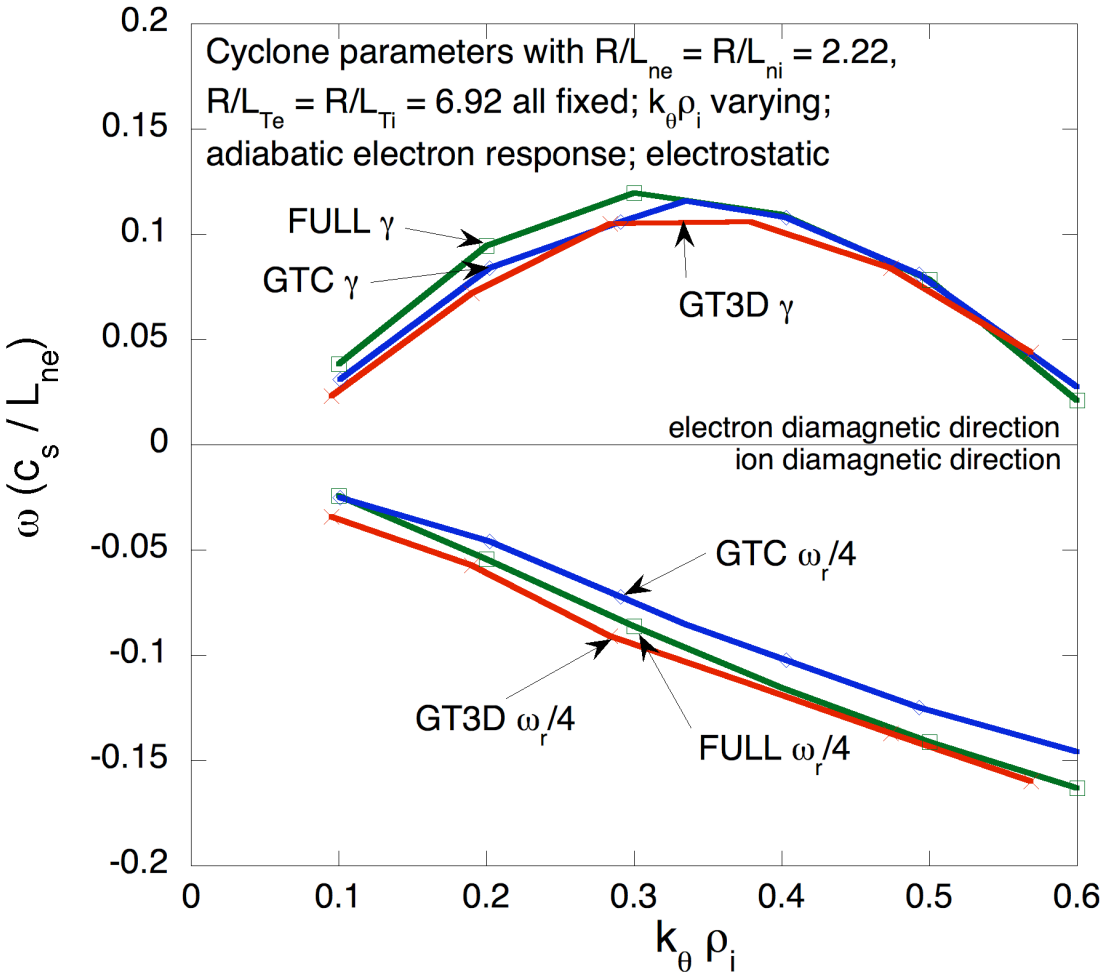
Parameters

- Use standard Cyclone parameters [Dimits, et al, Phys. Plasmas **7**, 969 (2000)] on reference surface ($r_0/a = 0.5$)
- Circular, concentric surfaces; electrostatic; collisionless
- Vary $k_\theta \rho_i$ at fixed $R/L_{Ti} = R/L_{Te} = 6.92$, $R/L_n = 2.22$ (on reference surface) with adiabatic electrons, and with trapped electrons
- Vary R/L_{Ti} (and ρ_i) at fixed $R/L_{Te} = 6.92$, $R/L_n = 2.22$, and $k_\theta \rho_i = 0.335$ (on reference surface) with trapped electrons
- Compare linear growth rates and real frequencies of TEM and ITG roots

Profiles

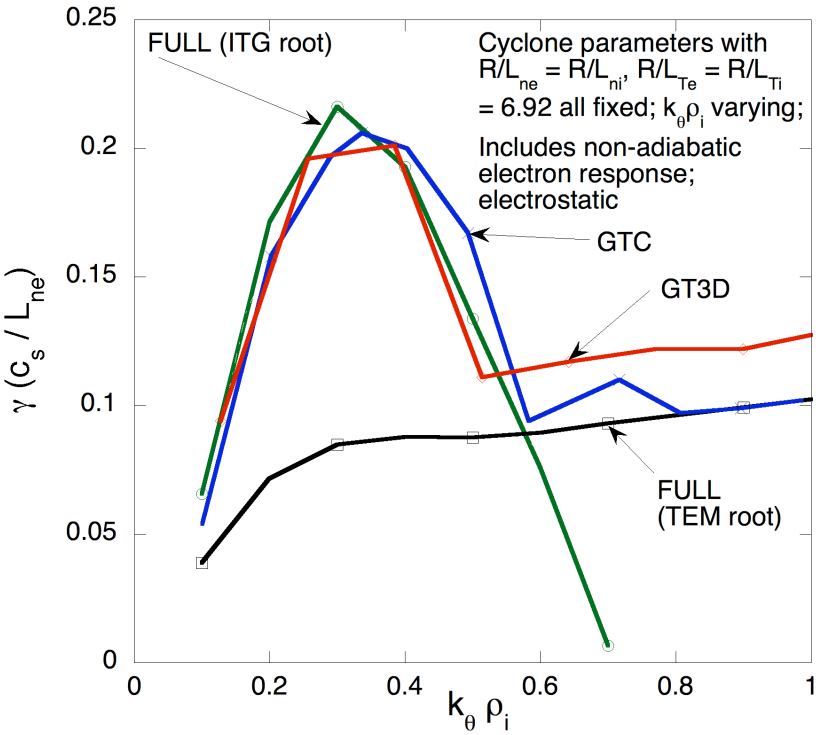
- FULL: radially-local: only knows about density and temperature values and gradients on reference surface $r_0/a = 0.5$
- GT3D: global: uses $T_j = T_{0j} \exp\{-(\Delta_r/L_{Tj}) \tanh [(r-r_0)/\Delta_r]\}$; $n = n_0 \exp\{-(\Delta_r/L_n) \tanh [(r-r_0)/\Delta_r]\}$; with n & T_j gradients obtained from these expressions
- GTC: global: uses $\eta_{Tj} = -(R\, d \ln T_j /dr)$ $= \eta_{Tj0} \exp\{-[(r-r_0)/\Delta_r]^6\}$, (likewise for η_n), with n & T_j constant in r (*i.e.*, constant gyroradius)

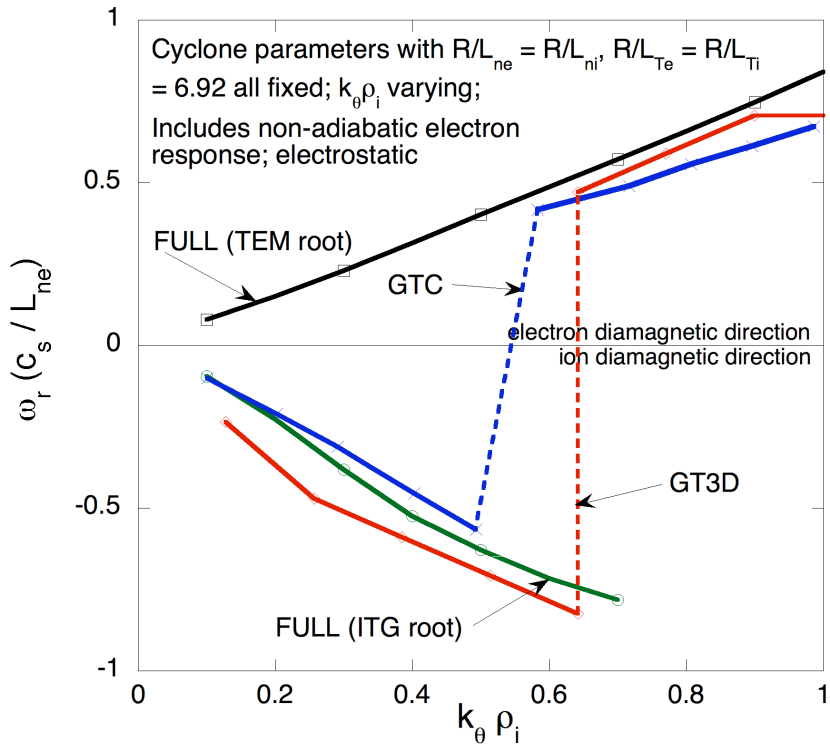
$k_\theta \rho_i$ Scan - Adiabatic Electrons



- Vary $k_\theta \rho_i$ at fixed $R/L_{Ti} = R/L_{Te} = 6.92$, $R/L_n = 2.22$ (on reference surface) with adiabatic electrons

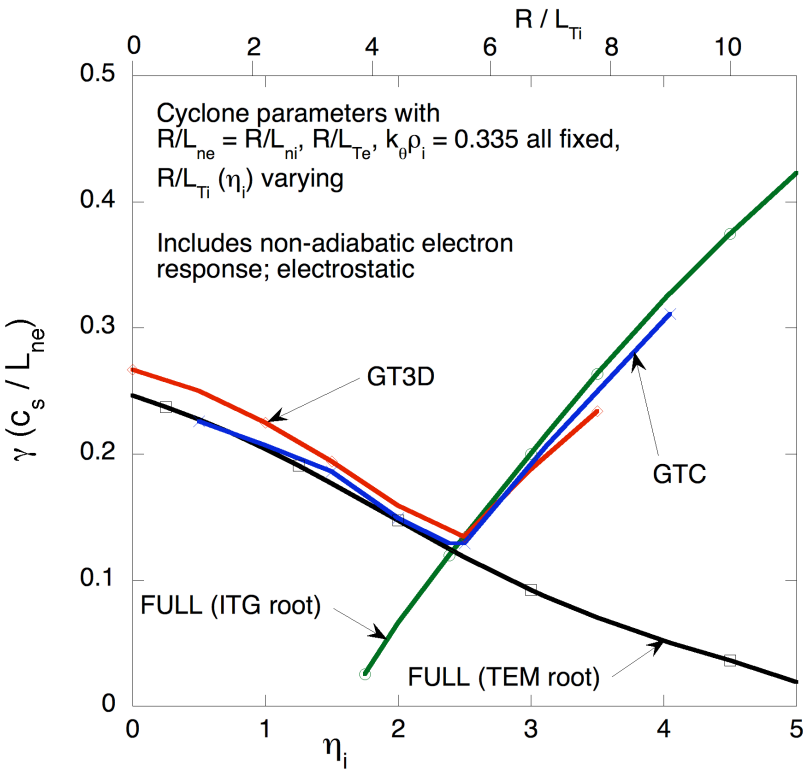
$k_\theta \rho_i$ Scan - Trapped Electrons

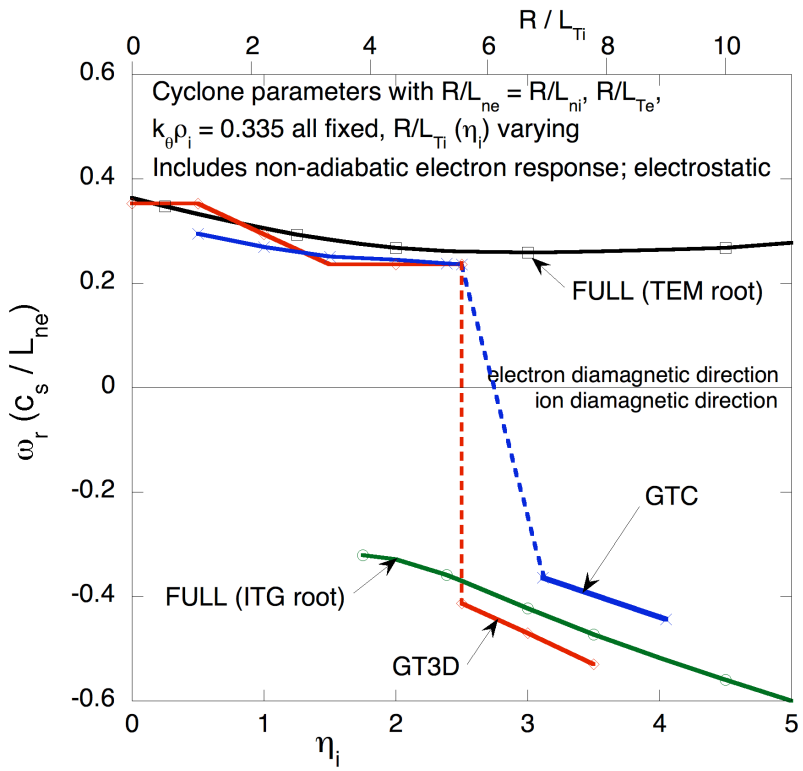




- Vary $k_\theta \rho_i$ at fixed $R/L_{Ti} = R/L_{Te} = 6.92$, $R/L_n = 2.22$ (on reference surface) with trapped electrons

R / L_{Ti} (η_i) Scan - Trapped Electrons





- Vary R/L_{Ti} (and η_i) at fixed $R/L_{Te} = 6.92$, $R/L_n = 2.22$, and $k_\theta \rho_i = 0.335$ (on reference surface) with trapped electrons

Conclusions

- The GTC and GT3D codes now include trapped-electron effects.
- Scans over R/L_{Ti} (η_i) and $k_\parallel \rho_i$ show reasonably good agreement on the linear growth rates and real frequencies for both the TEM root and the ITG root among the GTC, GT3D, and FULL codes. It is planned to add the LORB5 code (A. Bottino, CRPP-EPFL) to this comparison.
- Some of the differences are due to the differing radial variation, away from the reference surface, of n and T_j values and gradients between the codes. Work has started on generalizing the n and T_j profiles in GTC.