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FY11-12 T & T XP ideas

(1) Collisionality scaling of turbulence at high beta
(2) Polarimetry measurements of microtearing turbulence

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and the NSTX Research Team

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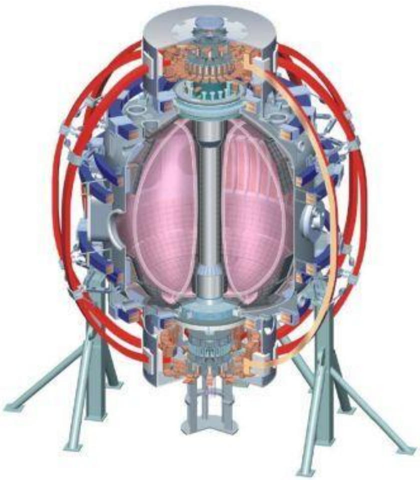

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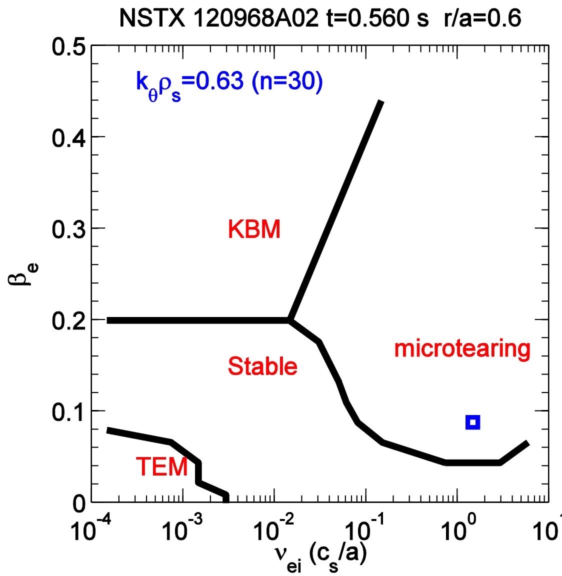
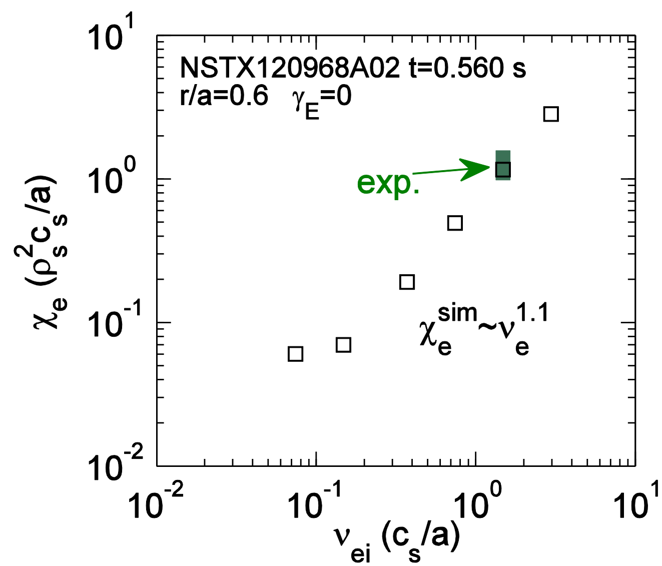
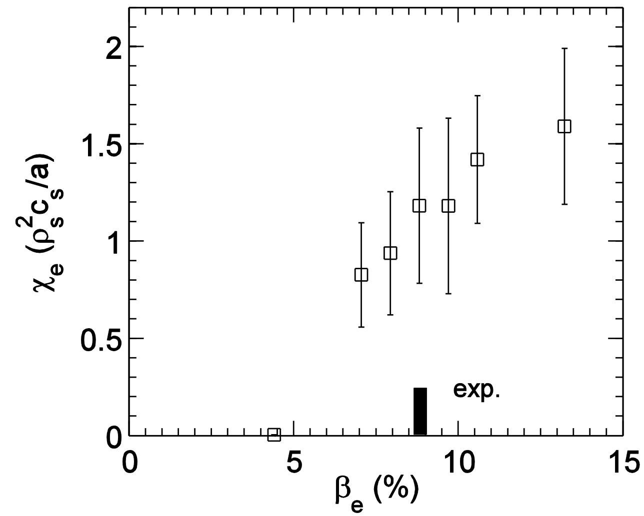
XP motivation from gyrokinetics* – microtearing modes favored at high β_e, ν_e (Z_{eff})

ν_e-β_e linear regime diagram



Non-linear GYRO simulations





- Microtearing driven by a/L_{Te}, β_e, ν_e

$$\nu_e = \nu_{ei} \cdot \frac{Z_{eff} + H(v/v_{th})}{(v/v_{th})^3}$$

- Keep in mind that Z_{eff} is stabilizing to ETG

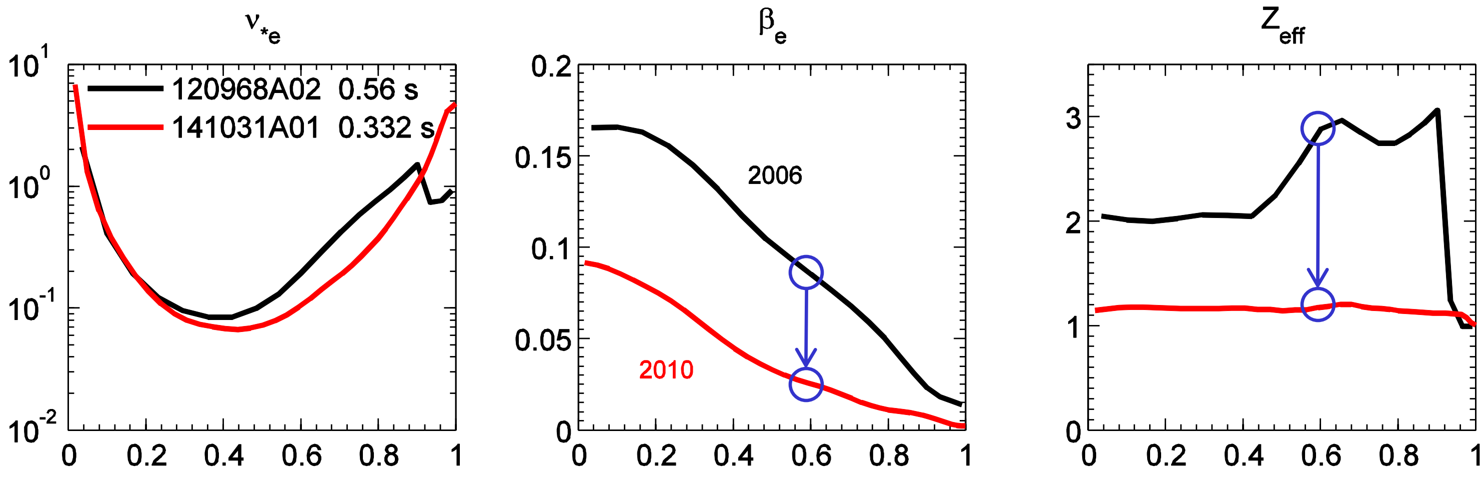
$$\left(\frac{R}{L_{Te}}\right)_{crit}^{ETG} \sim \left(1 + Z_{eff}\frac{T_e}{T_i}\right)(\cdots)$$

*Applegate et al. (2007)
Wong et al. (2007,2008)
Guttenfelder et al. (TTF,APS 2010)

(1) ν_* scaling of turbulence at high beta

- Strong, favorable confinement scaling in STs ($\Omega_i\tau_E \sim \nu_*^{-0.95}$) (XP532, Kaye) → microtearing (MT) modes one possible explanation (Guttenfelder et al., APS 2010; PRL, submitted)
- XP1037 (Ren) found high-k intensity increased with decreasing ν_*, opposite to naïve expectation from previous τ_E scaling and MT modes

- Recent simulations find microtearing favored at high β_e, ν_e (& Z_{eff})
- XP1037 operated at lower n_e, P_{NBI} ($\rightarrow\beta_e$) and Z_{eff} – ETG predicted to be unstable



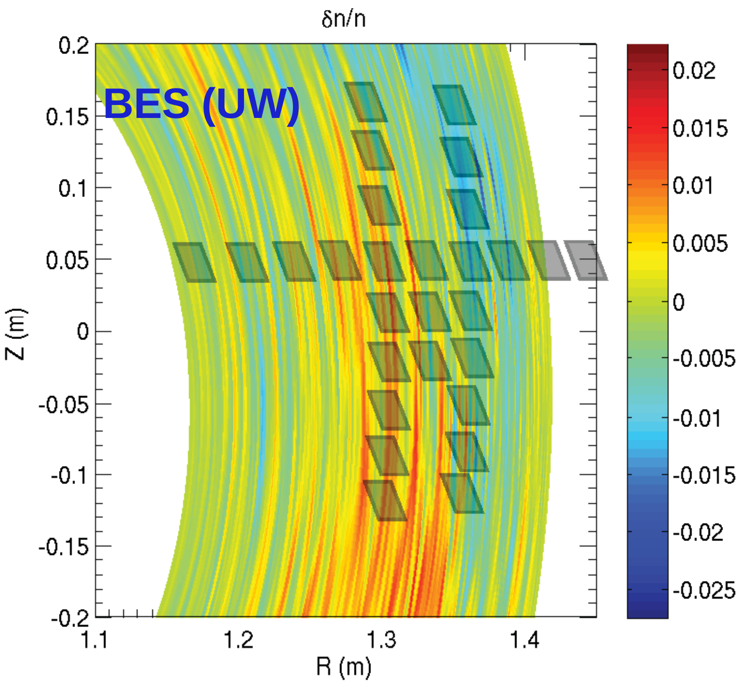
⇒ Repeat ν_* scan at highest feasible β_e (and Z_{eff}) with high-k, BES, and polarimetry (if available) in an attempt to "identify" microtearing $\delta n/n$ (δB) trend

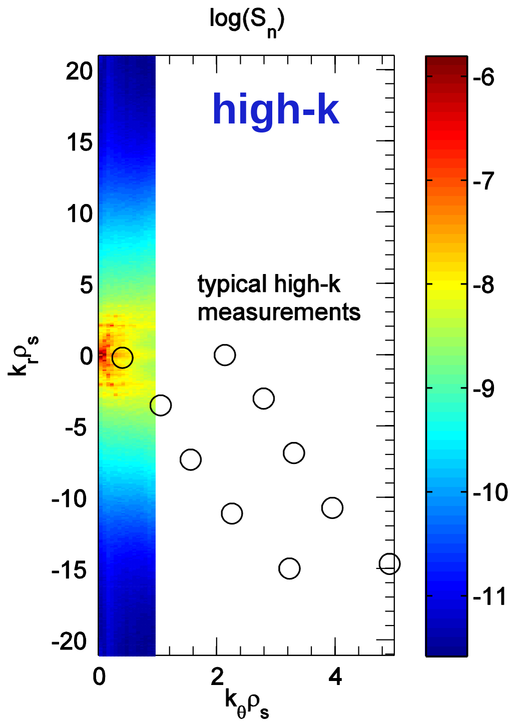
- 2 days (1 day minimum), addresses R11-1

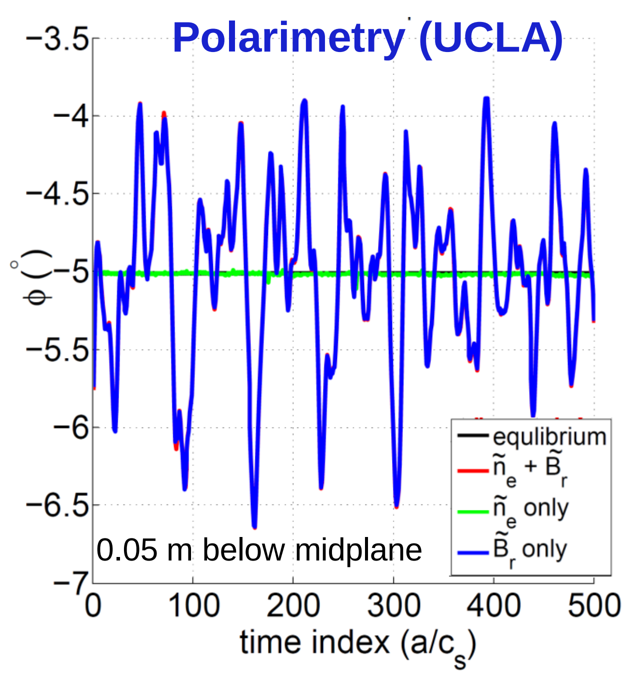
(1) ν_* scaling of turbulence at high beta

1) Scan 2-3 values of ν_*, [0.7/0.35, 0.9/0.45, 1.1/0.55] (MA/T) maximizing beta (i.e. high density, ~4MW NBI)
2) One additional case at low β_e, ν_e (i.e. lower density and P_{NBI}) where microtearing absent
3) Additional discharges for perturbative impurity measurements with ME-SXR (JRT2012)
4) Repeat for two high-k & BES locations
   - ETG can become more unstable further out in plasma, may expect different scaling trends

- Best discharge(s) will be used for extensive non-linear gyrokinetic simulations for validation







(2) Polarimetry measurements of microtearing turbulence

- Microtearing favored at high β_e, ν_e (& Z_{eff})
- Focus on a discharge with high β_e, ν_e, Z_{eff} (w/ Li), a/L_{Te} (outer half radius) with high-k scattering, BES
- Essential to wait for polarimetry availability (UCLA, Zhang et al)

1) Start with I_p/B_T = 0.7 MA / 0.35 T, ~4 MW
2) Add Li to maximize Z_{eff}
3) Increase power to 6 MW
4) For comparison, additional discharges at lower β_e, ν_e, Z_{eff} (low ne, ~2 MW, no/little Li, ELMy) where microtearing should be absent

- Looking for 1 or 2 optimal discharges to focus extensive non-linear gyrokinetic *microtearing* simulations for validation exercise
- 1 day (0.5 day minimum), polarimetry mandatory