NSTX

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FY11-12 T & T XP ideas

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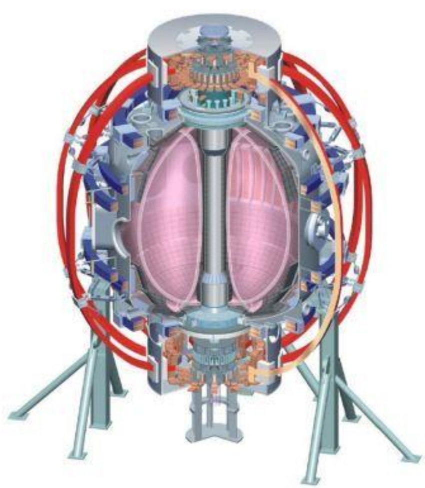
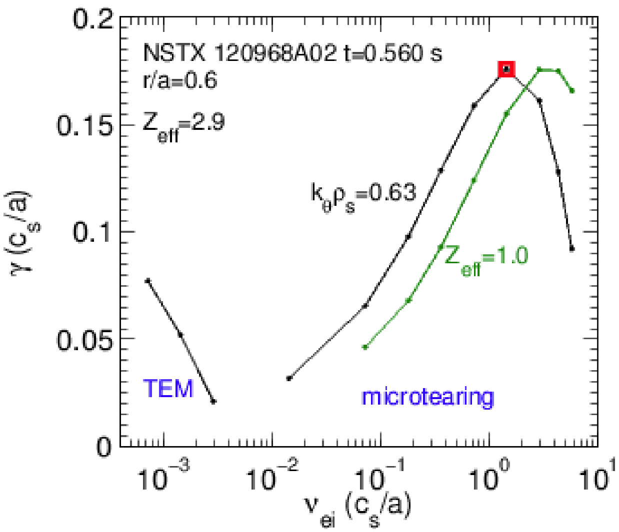
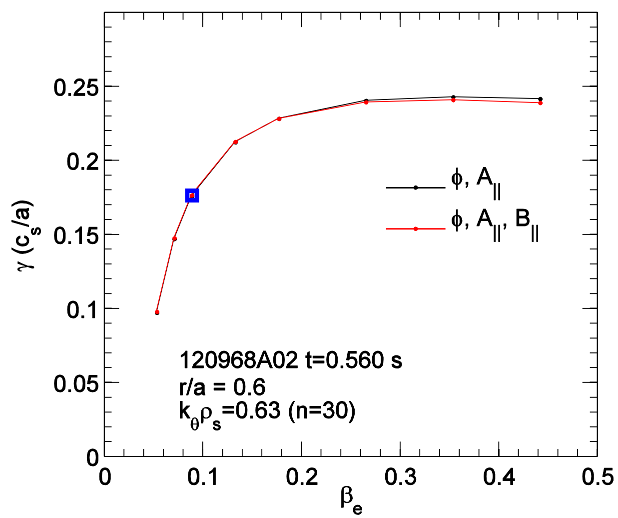


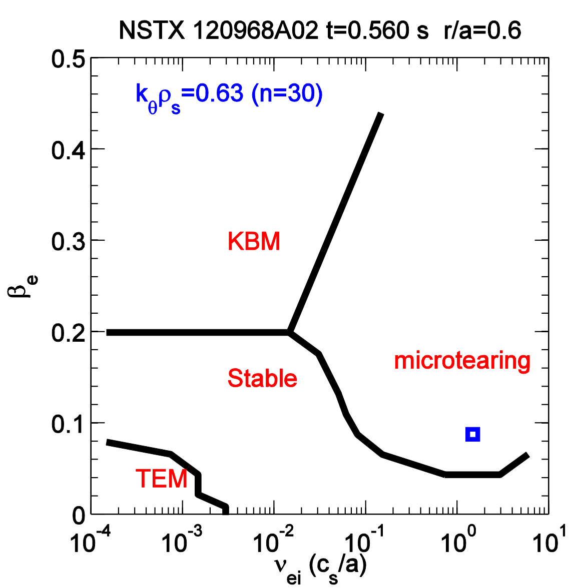
Motivation from gyrokinetics* – microtearing modes favored at high β_e, ν_e (Z_{eff})

Linear growth rates

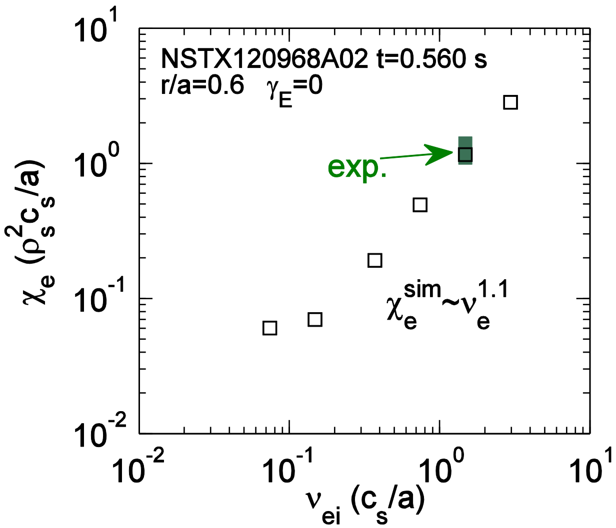


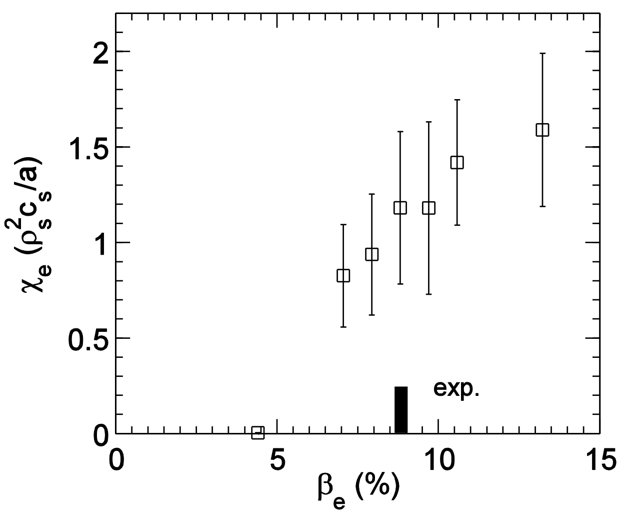


ν_e-β_e linear regime diagram



Non-linear GYRO simulations





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

Motivation from gyrokinetics

- Microtearing modes are favored at high β_e, ν_e (Z_{eff})
- ITG/TEM favored at lower ν_e
- ETG will be favored at lower Z_{eff} $(a/L_{Te})_{threshold} \sim (1+Z_{eff}T_e/T_i)$

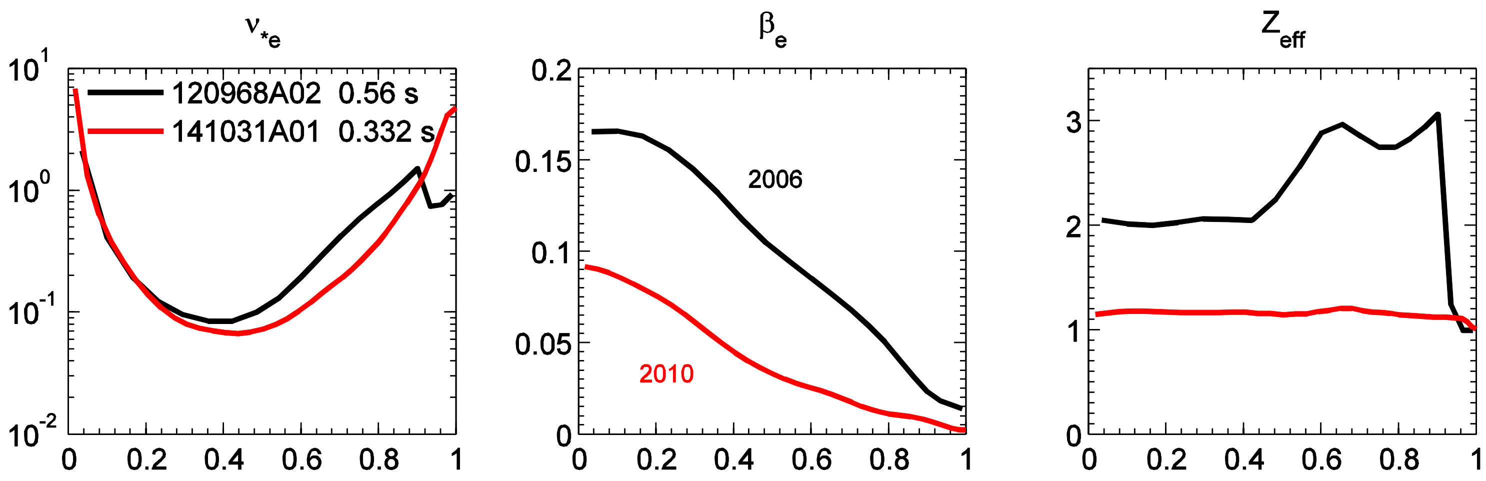
- Microtearing (high β) not expected to contribute much to particle or momentum transport

- Utilize: (1) ν_* scan at high β
  (2) β scan (or disparate β)
  (3) Li scan (Z_{eff})

- To investigate:
  (1) turbulence features consistent with microtearing mode, or transition in characteristics (e.g. MT $\rightarrow$ TEM/ETG), and relation to χ_e (R11-1)
  (2) differences in multi-channel transport trends (D_{imp}/χ_e, χ_φ/χ_e) as regime varies (e.g. MT $\rightarrow$ TEM/ETG) (JRT12)

(1) ν_* scaling of turbulence at high beta – (R11-1)

- Strong, favorable confinement scaling in STs ($\Omega_i\tau_E \sim \nu_*^{-0.95}$) (XP532, Kaye) – microtearing (MT) modes one possible explanation
- XP1037 (Ren) found high-k intensity increased with decreasing ν_*, *opposite* to previous τ_E scaling and MT expectation
- XP1037 operated at lower n_e, P_{NBI} ($\rightarrow\beta_e$) and Z_{eff} – ETG predicted to be unstable



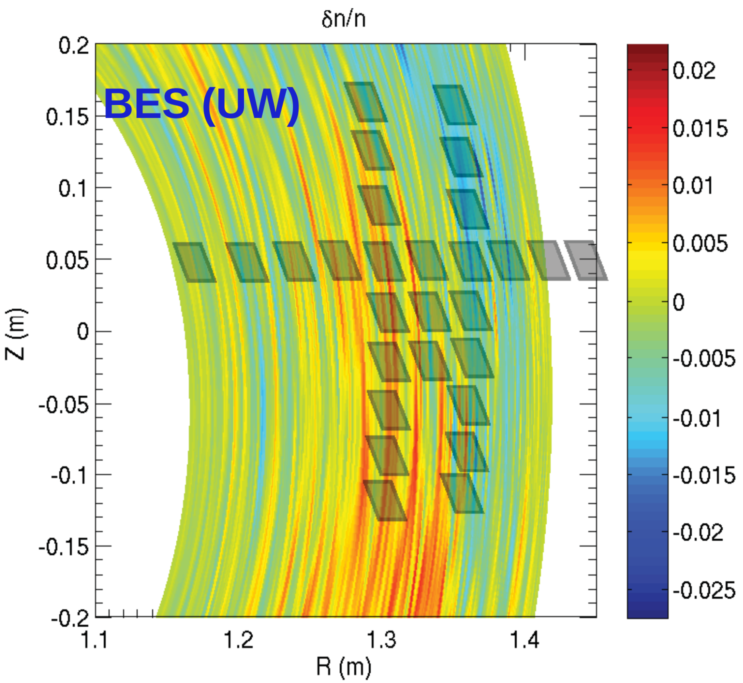
- Recent simulations (Guttenfelder et al., APS 2010) find microtearing favored at high β_e, ν_e (& Z_{eff})

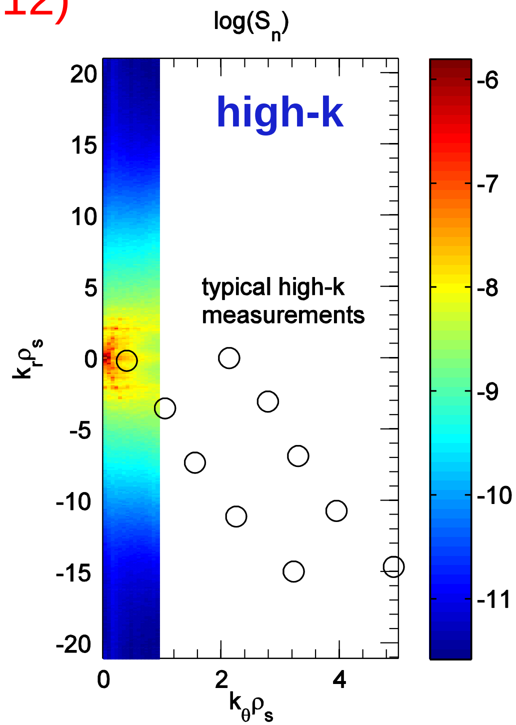
$\Rightarrow$ Repeat ν_* scan at highest feasible β_e (and Z_{eff}) with high-k, BES, FIReTIP, polarimetry (if available), reflectometers (depending on n_e profile) in an attempt to "identify" microtearing $\delta n/n$ (δB) trend

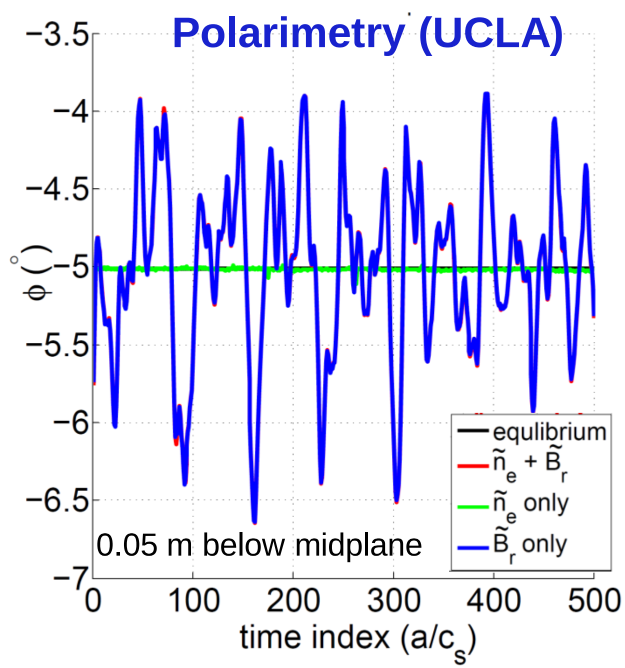
(1) ν_* scaling of turbulence at high beta – (R11-1)

- For 2-3 values of ν_*, run a few conditions:
  - Baseline discharge
  - Gas puff + ME-SXR for perturbative impurity transport (JRT12)
  - n=3 NRMP modulation for perturbative momentum transport
- Repeat for two high-k locations (e.g. R=125 & 137 cm)
  - ETG can become more unstable further out in plasma, may expect different scaling trends

$\Rightarrow$ Want to identify optimal discharge(s) to focus extensive non-linear gyrokinetic simulations for validation (JRT12)







(2) β & Li scan to investigate impurity, momentum & electron transport – (JRT12)

- Microtearing simulations predict little particle or momentum transport
- Microtearing expected to dominate at high β_e, ν_e (& Z_{eff})
- Other modes (ITG/TEM/ETG) should become more important at lower β_e, ν_e, Z_{eff}

- Part 1 – β scan to isolate microtearing (or at least some disparate values of β, maybe willing to sacrifice variation in other parameters)
  - shots for impurity puff+ME-SXR experiments
  - shots for perturbed momentum transport (departure from NC)

- Part 2 - Vary Li ($\rightarrow Z_{eff}$) as it has a significant stabilizing influence to ETG (slightly destabilizing to microtearing)
  - shots for impurity puff+ME-SXR
  - shots for perturbed momentum transport (departure from NC)

- High-k, BES, FIReTIP, polarimetry (if available), reflectometers (depending on n_e profile)
- Simultaneously analyze electron transport (JRT12)