Microstability analysis: experimental test of expected key parameters

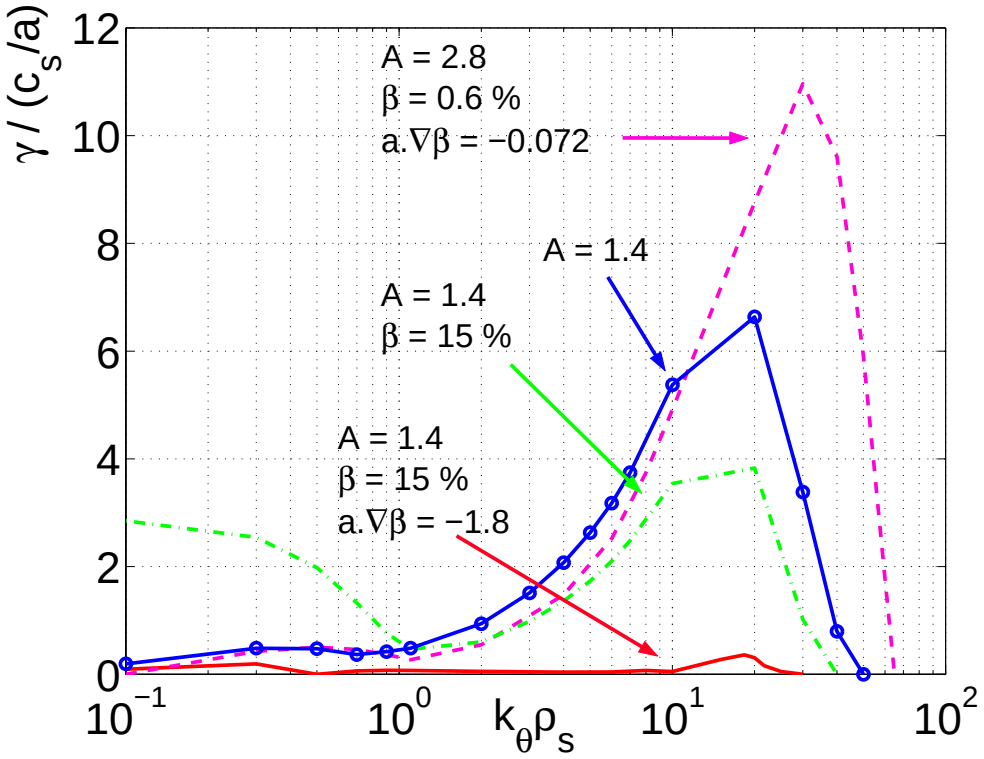
- Tool: linear gyrokinetic electromagnetic flux tube code
  solve Vlasov+Maxwell eq. : initial value code GS2

- Purpose:
  - identify unstable modes
  - isolate key parameters for stabilization

- Proposed parameters to be tested in NSTX
  - β'
  - T_e/T_i
  - Aspect ratio

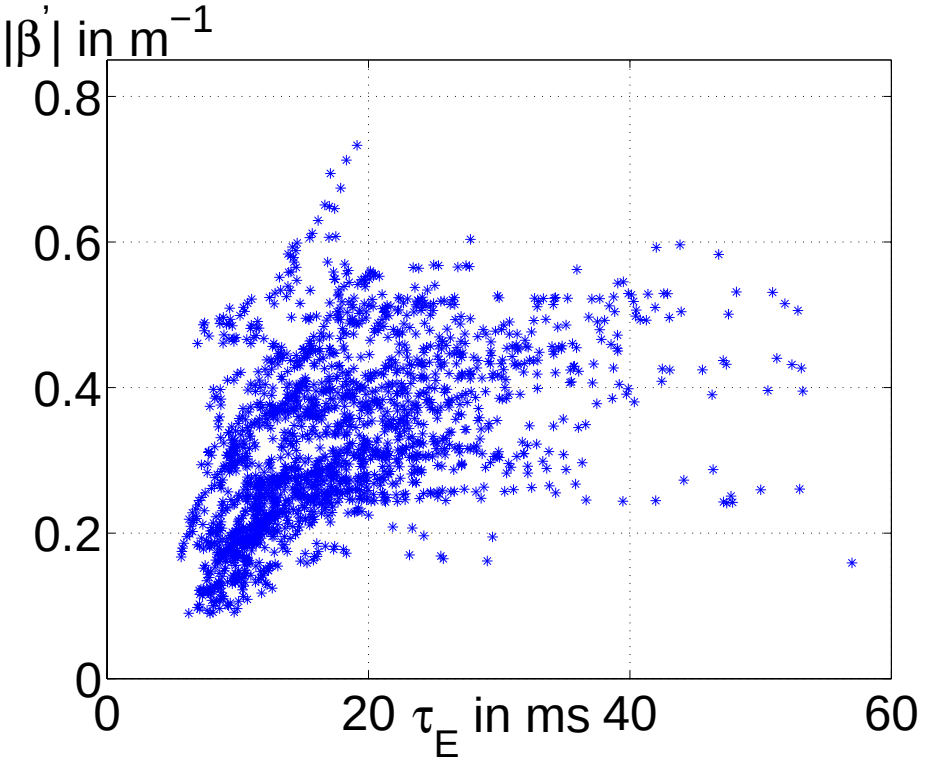
Theoretical and experimental impact of β'

Analytic eq.
fixed gradient lengths
no collisions



Higher β' strongly stabilizing

32 NBI plasmas
2nd 1/3 in time sequence
line averaged β' versus τ_E $\beta = P/(B_{local}^2/2\mu_0)$



Seems that τ_E ↗ with higher |β'|

Test of impact of β' on confinement

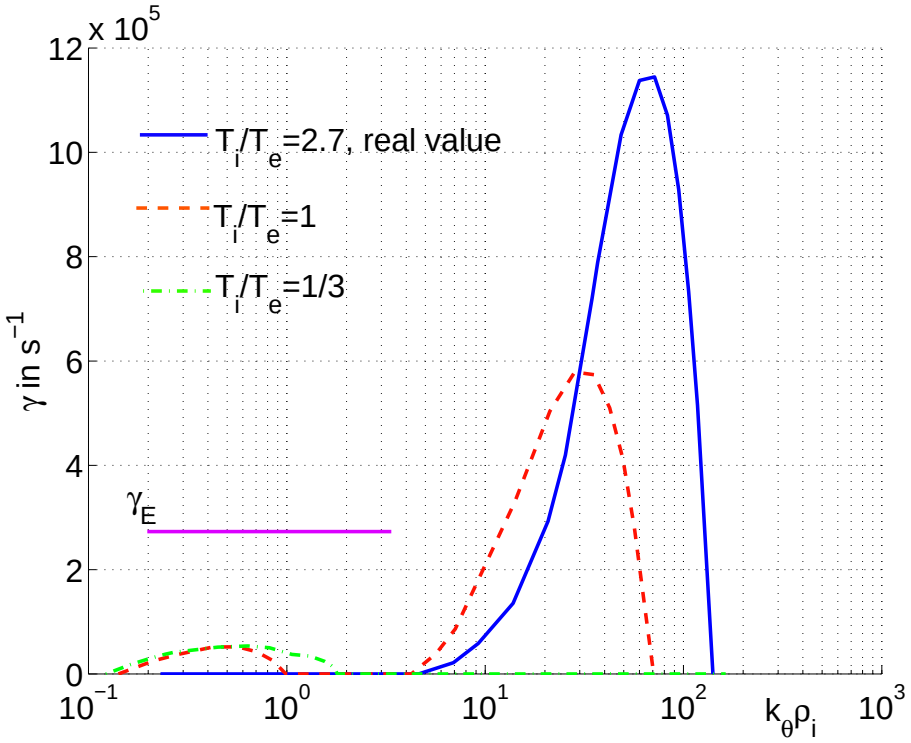
Ideally: varying β' while keeping everything constant

- B_T/I_p scan at fixed P(r)
- P' increase at fixed B
  - by NBI power increase, but changes ExB shear
  - by HHFW power increase

Theoretical and experimental impact of T_i/T_e

- High T_i/T_e: destabilizing for ETG, stabilizing for ITG

#104001 at
0.28 s and r/a=0.575



- NBI, $T_i(0)/T_e(0) \sim 1.4$, no ITG, strong ETG consistent with inferred ion transport << electron transport
- HHFW, $T_e(0)/T_i(0) \sim 8$, χ_i/χ_e higher than in NBI. But higher Z_{eff}, lower ExB shear, etc so not conclusive

Test of impact of T_i/T_e on confinement

Ideally: varying T_i/T_e without changing Z_{eff}, n_e, nor the gradient lengths R/L_{Te} and R/L_{Ti}

- Fixe P_{add} and vary the balance between NBI and HHFW: pb with simultaneous change of ExB "polluting" the impact of T_i/T_e on the ratio electron/ion transport

- With HHFW alone, with at least Z_{eff} fixed

Theoretical impact of A

- Former studies:
  - Lower A found stabilizing Rewoldt et al q_{95} and β id. I_p and $B_T \neq$
  - No effect of A Kotschenreuther et al $\beta \neq$ kept near β_c, stabilization due to higher ExB shear if B lower
- At fixed β in an ST:
  - expect more trapped particles due to higher r/R: spend time on bad curvature side: destabilizing
  - passing particles spend more time on good curvature: stabilizing
- Clear need for experimental data

Test of impact of A on confinement

Comparison DIII-D/NSTX since about same cross-section, but different R

- Same $n_e(r)$, $Z_{eff}(r)$, $T_e(r)$, $T_i(r)$, in order to have same P(r) and same collisionality
- Same q(r), or at least same q_0 and line averaged q
- Unavoidable B_T or $I_p \neq$, but β as similar as possible
- Ohmic discharge to isolate microstability issues from heating efficiencies issues