

Linear gyro-kinetic analysis with GYRO code for shot 77922

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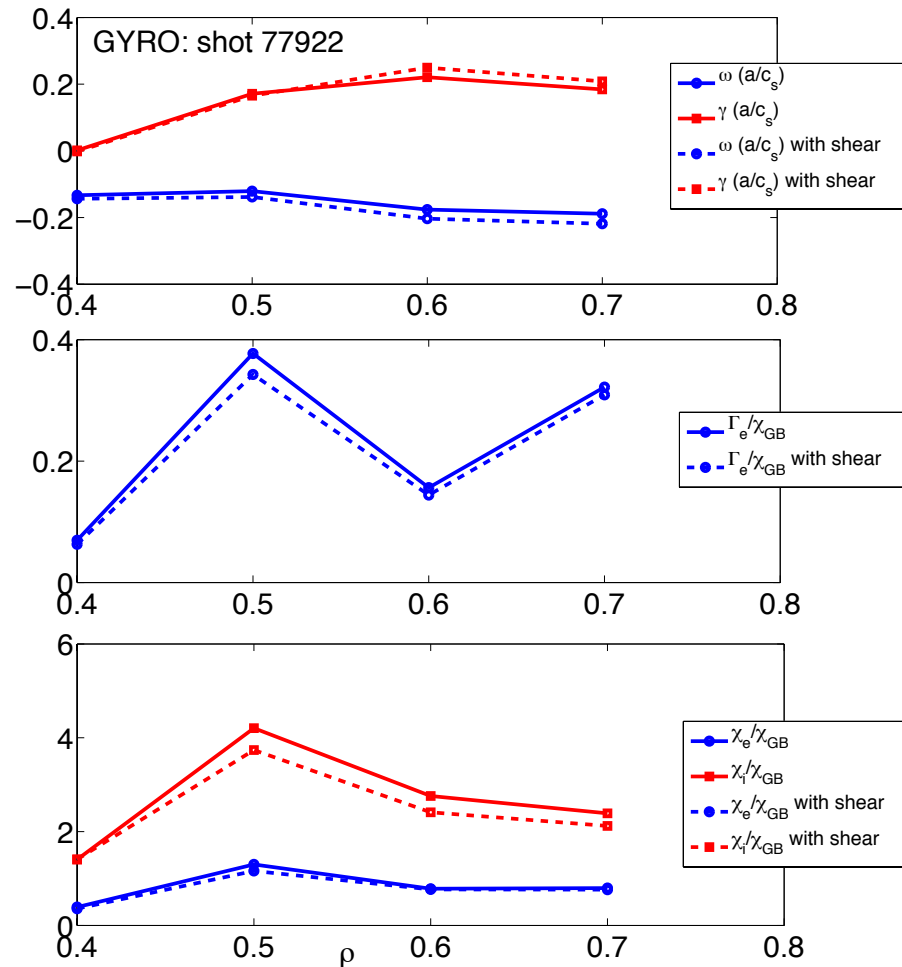
Electrostatic only

- 1) No strong impact from ExB shear
- 2) ITG is the dominant instability
- 3) Ion heat flux is higher than electron heat flux

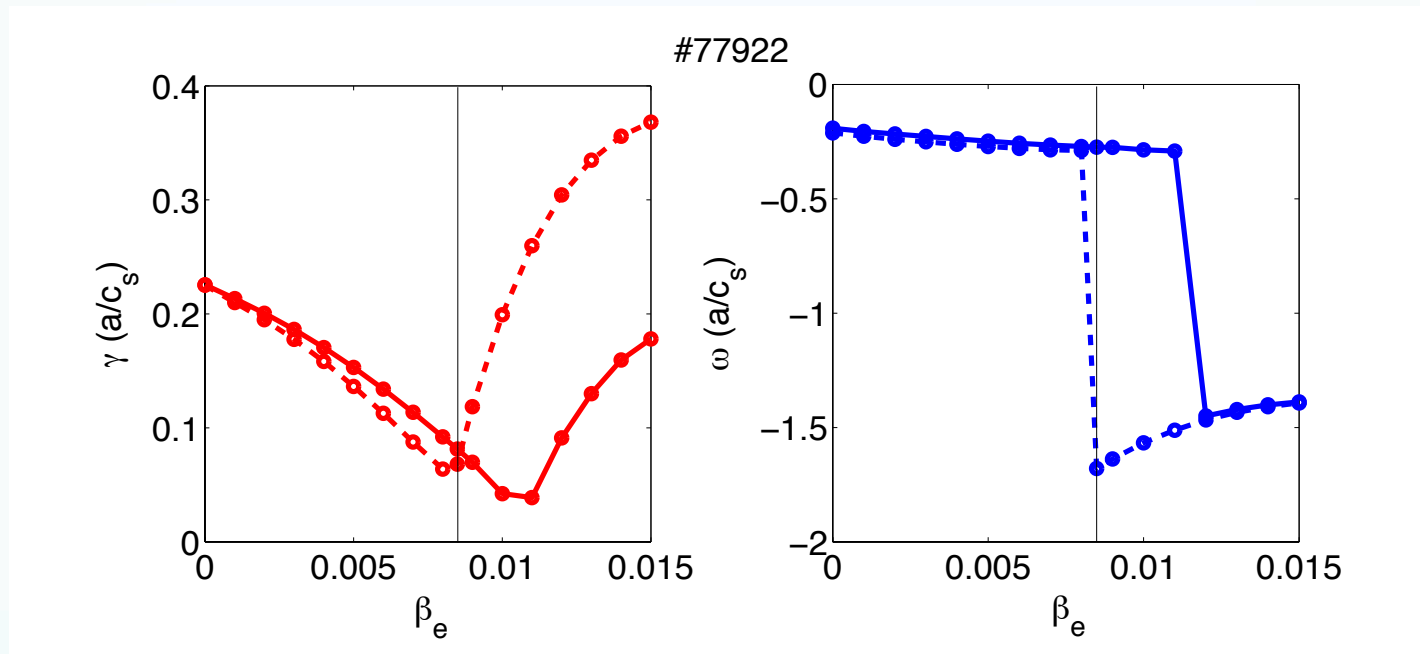
Definition

$E \times B$ shearing rate, γ_E , in units of c_s/a .

$$\gamma_E = -\frac{r}{q} \frac{\partial \omega_0}{\partial r} \text{ where } \omega_0 = -c \frac{d\Phi}{d\psi}.$$



Electromagnetic

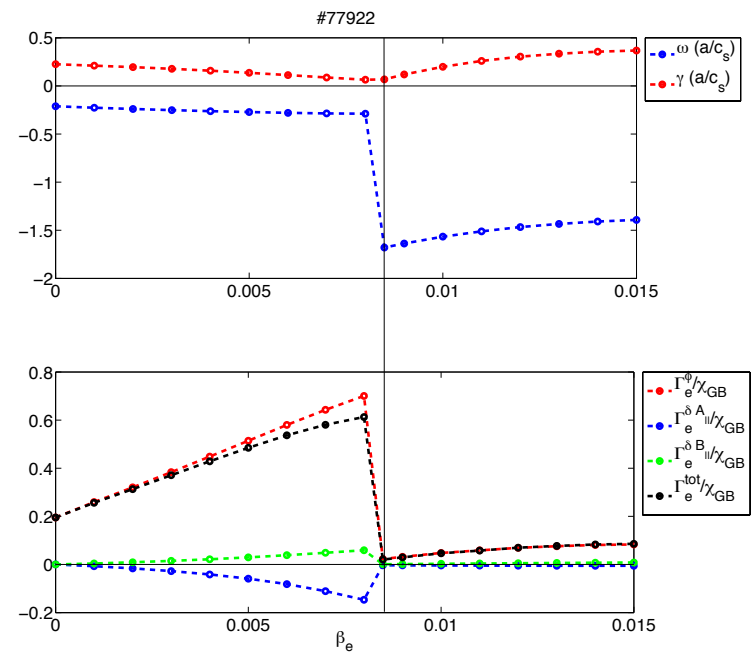
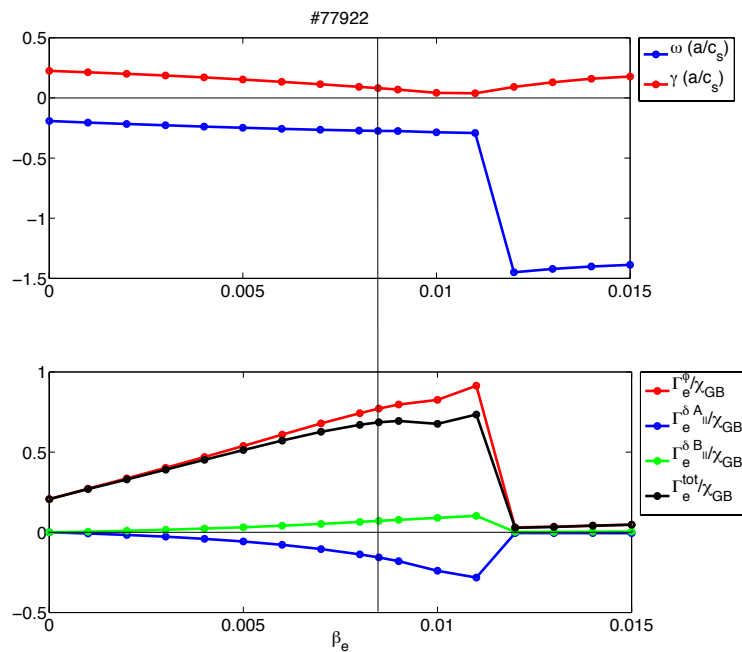


1) Stabilization of ITG mode by shear and Beta_e

2) ExB shear shifts the onset of the KBMs to lower Beta_e (close to exp values)

Electromagnetic

With ExB shear

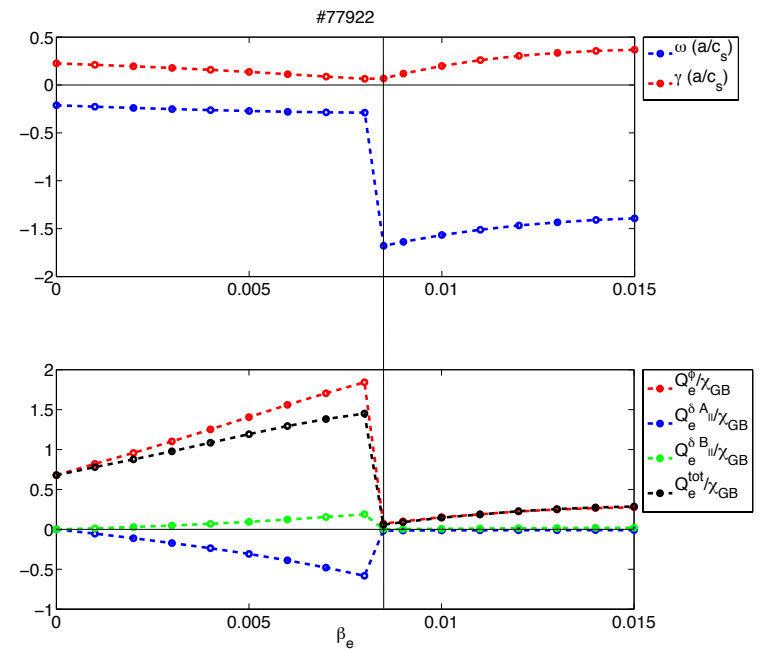
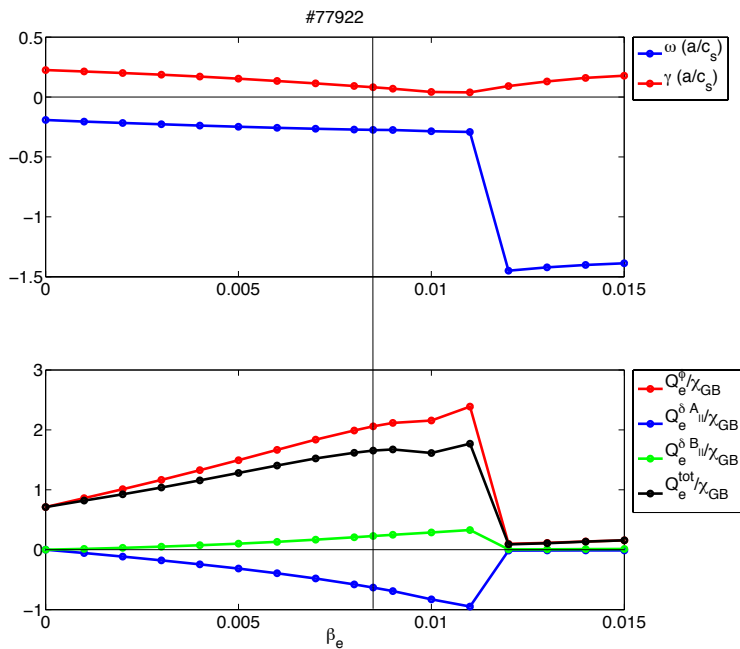


1) Total particle flux follows the electrostatic contribution

2) Opposite singe for $A_{||}$ and phi

Electromagnetic

With ExB shear

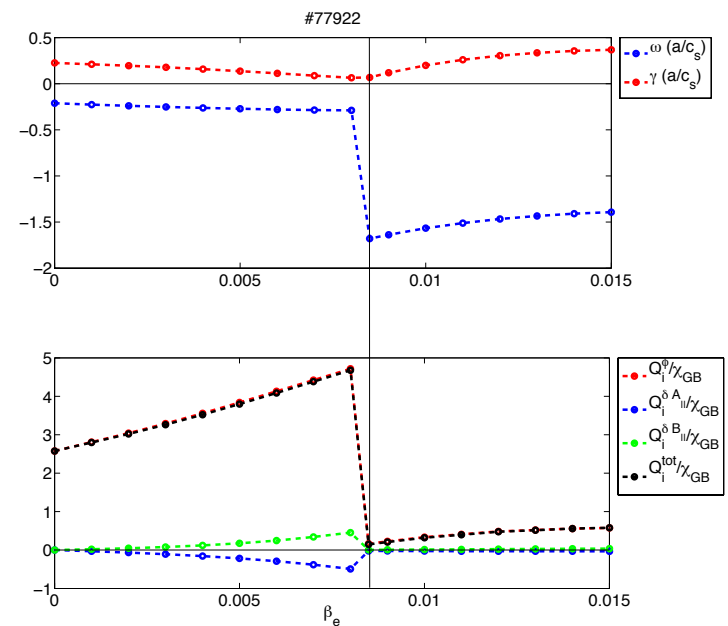
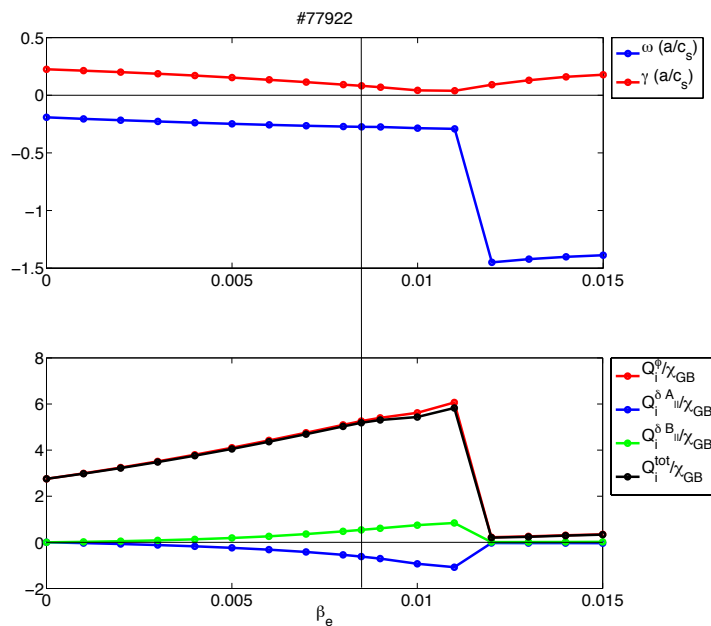


1) Total particle flux follows the electrostatic contribution

2) Opposite singe for $A_{||}$ and phi

Electromagnetic

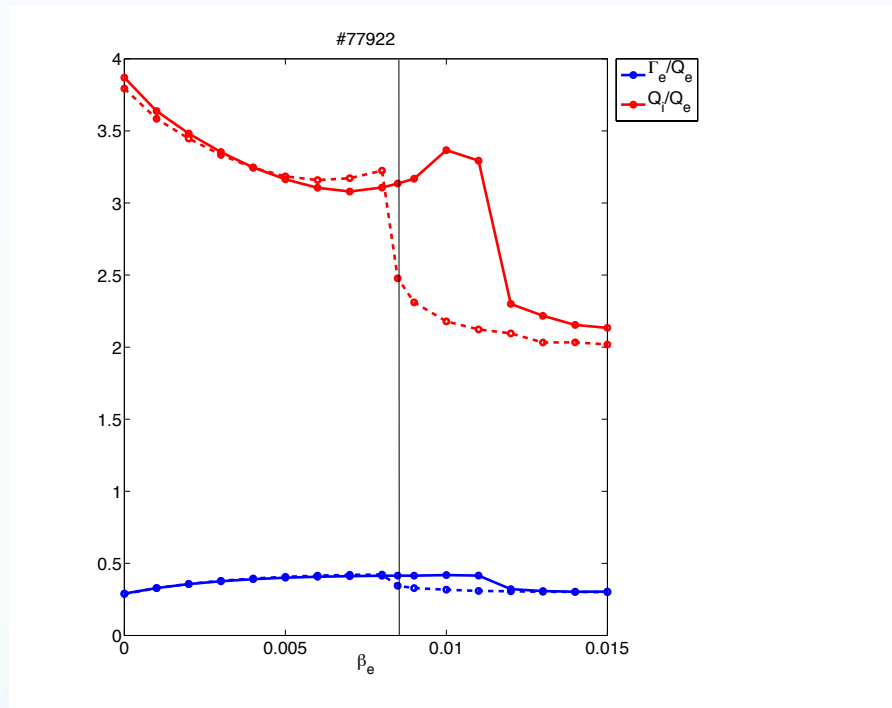
With ExB shear



1) Total particle flux follows the electrostatic contribution

2) Opposite singe for $A_{||}$ and phi

Electromagnetic



- 1) Linearly lower particle and heat flux ratios in KBM regime
- 2) ExB Shear shifts the onset of the KBMs to lower Beta_e (close to exp values)

Hybrid scenario in ASDEX Upgrade and DIII-D

Nucl. Fusion **50** (2010) 025023

C.F. Maggi *et al*

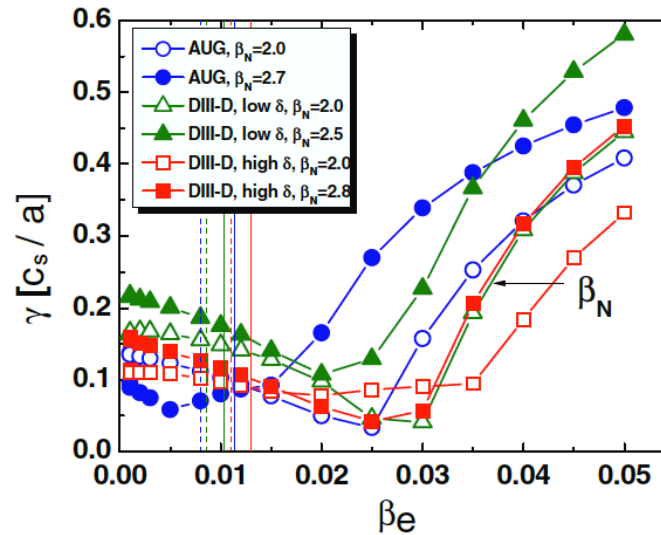


Figure 14. Growth rate of the most unstable mode at $\rho_{\text{tor}} = 0.5$ versus β_e for AUG (blue), DIII-D high δ shape (red) and DIII-D low δ shape (green) as the input power/beta is increased. The most unstable mode changes from ITG at low values of β_e to micro-tearing at intermediate β_e , to kinetic ballooning at high values of β_e in the gyrokinetic simulations, as listed in table 1. Open symbols correspond to lowest power and closed symbols to highest power in each beta scan. The vertical lines intercept the values of β_e at the operational points (same colour convention), dashed lines corresponding to lowest power and solid lines to highest power in each beta scan. The arrow indicates the increase in β_N in the experiment, from low power to high power in each scan (from right to left in the plot).

Hybrid scenario in ASDEX Upgrade and DIII-D

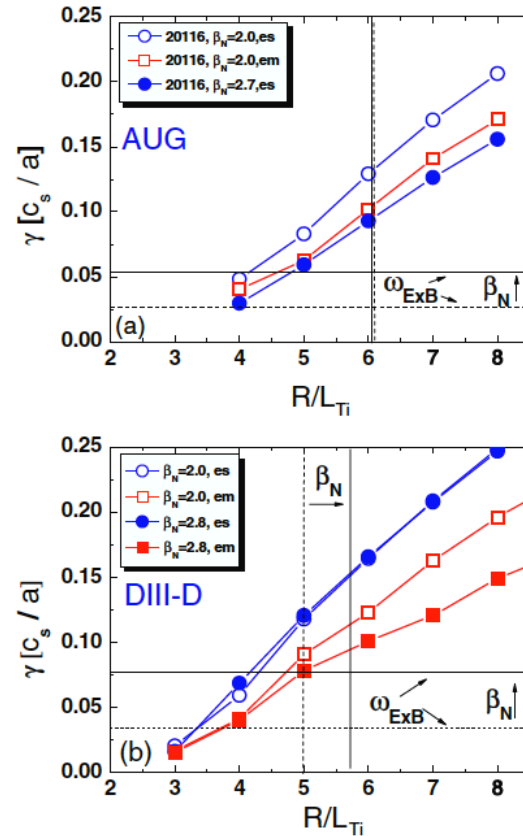


Figure 15. Linear growth rate of the most unstable mode (ITG mode) versus R/L_{Ti} at $\rho_{tor} = 0.5$ for the low and high power phases of (a) the AUG hybrid #20116 and (b) the DIII-D hybrid scan at high δ shape (#128250 and #128249). Circles correspond to the electrostatic calculations, squares indicate the calculations including electromagnetic effects. Vertical lines mark the variation in R/L_{Ti} in the experiment from low power (dashed line) to high power (solid line). Horizontal lines mark the $E \times B$ shearing rate, calculated according to [29], for the low power (dashed line) and high power (solid line) cases.