#982
EX6-6R

THE ROUTE TO HIGH PERFORMANCE, DEMO RELEVANT, NEGATIVE TRIANGULARITY TOKAMAK OPERATION ON TCV

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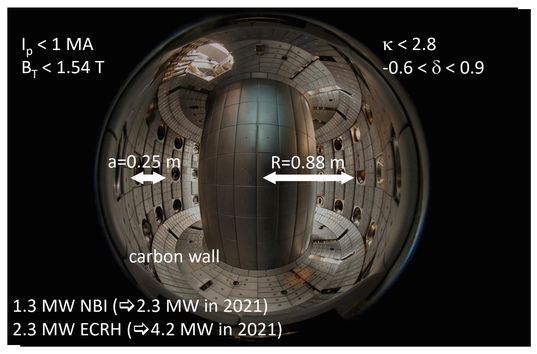
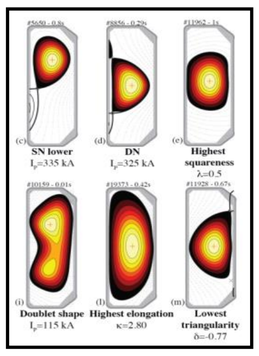
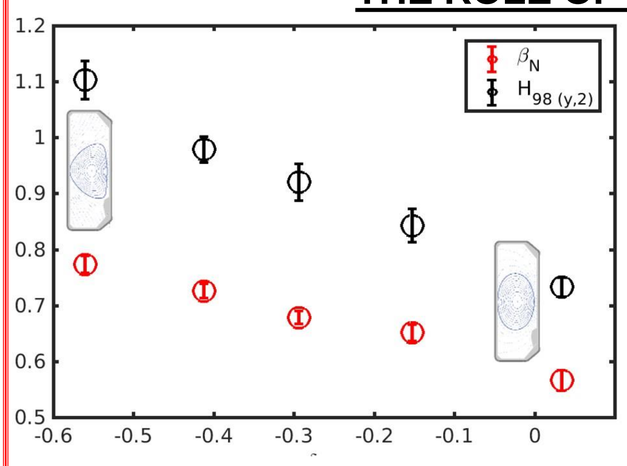
TCV



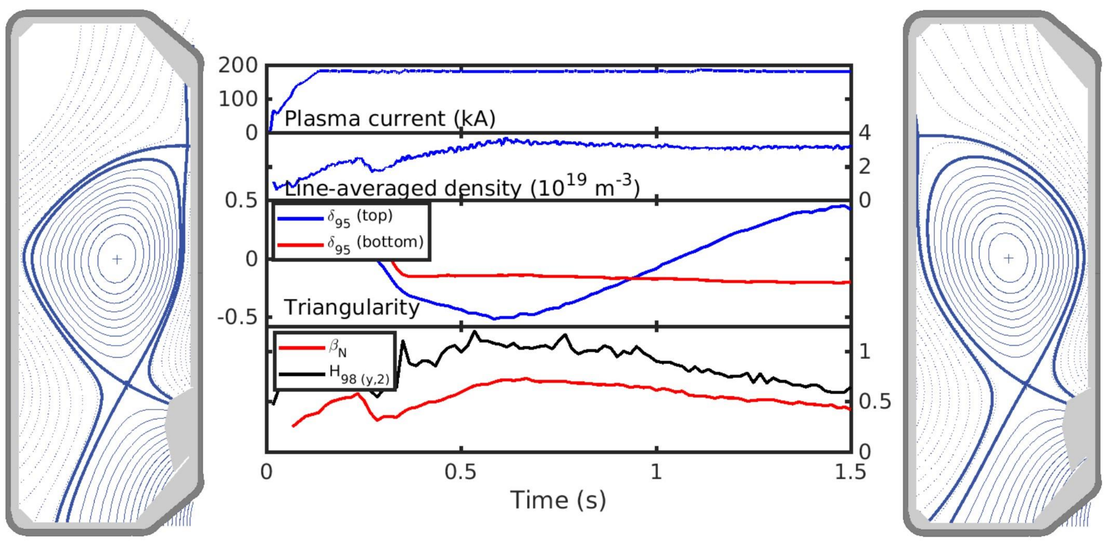


- $\mathbf{I_p}$ < 1 MA, $\mathbf{B_T}$<1.54 T
- $\mathbf{R_0}$ = 0.88 cm, a = 0.25 cm
- $\mathbf{P^{X2}_{ECH}}$<2.4 MW, $\mathbf{P^{X3}_{ECH}}$<1.4 MW, $\mathbf{P_{NBI}}$<1 MW
- 16 independent shaping coils: **negative δ**

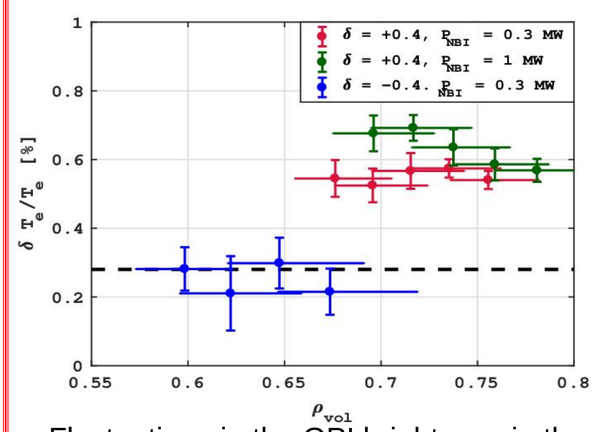
THE ROLE OF SHAPING



- Fundamental role of NT explored
- linear improvement in $H_{98(y,2)}$ as δ becomes increasingly negative
- true to the minimum value of δ achieved (≈ -0.6)
- no saturation of the confinement has been observed.

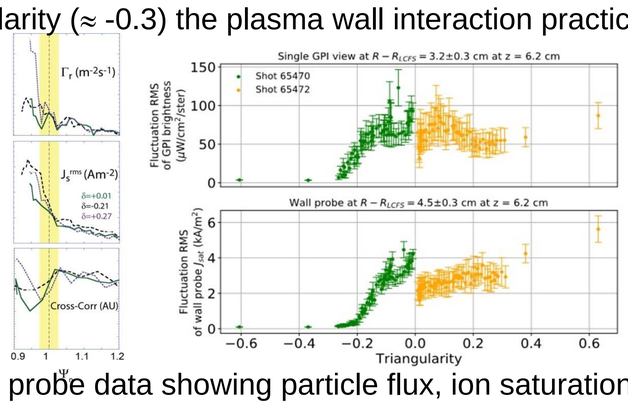


CORE PLASMA & SOL TURBULENCE CHARACTERISITICS

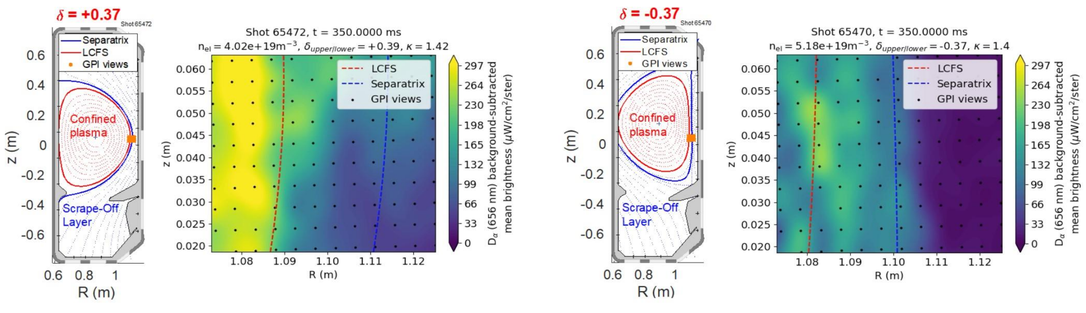


- TPCI & CECE show that both n_e & T_e fluctuations are reduced at δ<0 over a large fraction of the radius
- No significant dependence on heating method or T_e/T_i

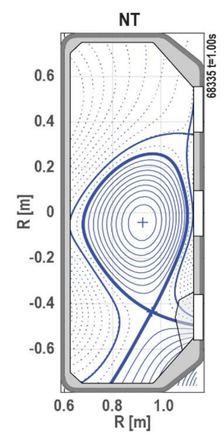
Fluctuations in the GPI brightness in the SOL and outer-wall mounted LP data (bottom) showing the fluctuations in the ion saturation current. At sufficiently negative triangularity (≈ -0.3) the plasma wall interaction practically stops.

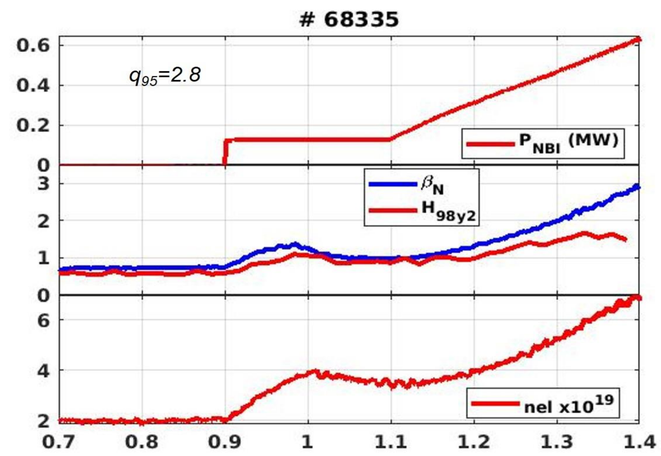


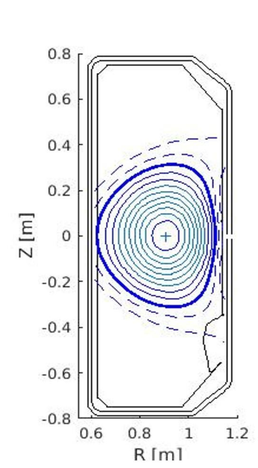
Reciprocating probe data showing particle flux, ion saturation current and cross phase between density and potential fluctuations. There is a large drop in the particle flux in the SOL in NT.

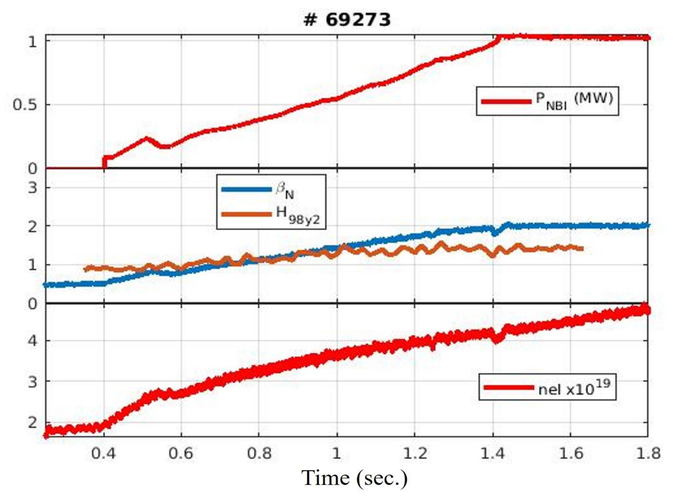


HIGH PERFORMANCE







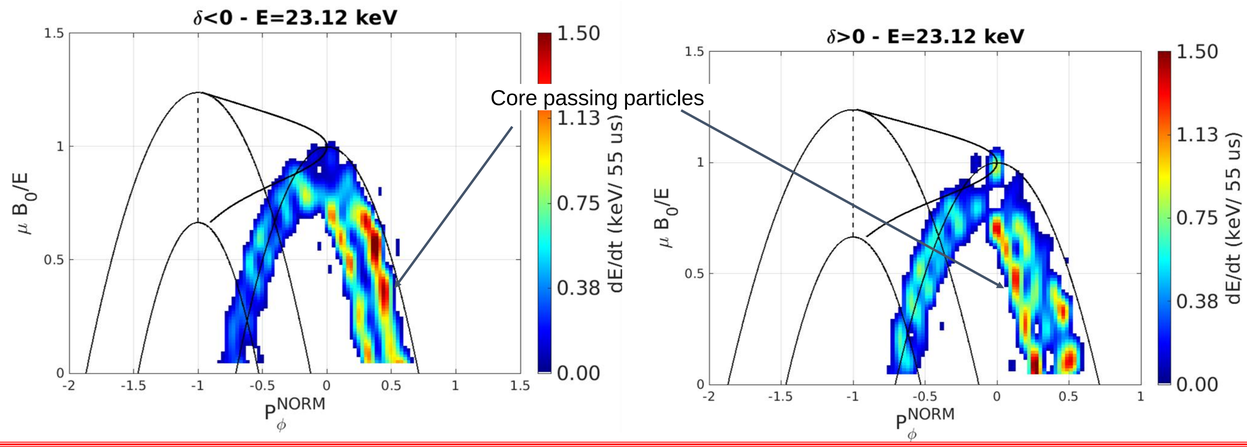


- $\beta_N \approx 3$ before disrupting NTM's are prevalent at low q_{95} on TCV
- High β, L-mode operation in NT is easily maintained
- No confinement degradation is observed as additional heating power is increased.

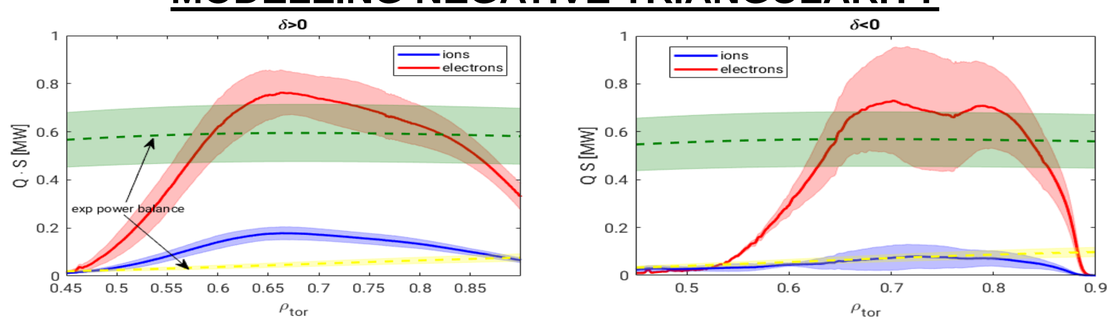
Fast Ions and Sawteeth in Negative Triangularity

For core-localized modes like sawteeth, the fast particles in negative triangularity are more impacted by the perturbation.

In the figures on the left, the color indicates the intensity of the average kick in energy the particles feel with a sawteeth. In negative triangularity, the perturbation is stronger in the core and the confinement is more impacted in this case



MODELLING NEGATIVE TRIANGULARITY



- Experimental comparison with equal ECRH power
- Gradient-driven GENE simulation yields fair agreement with experimental heat flux (TEM-dominated)
- As δ→0 in the core, local (flux-tube) simulations do not reproduce confinement improvement
- Heat flux overestimated by up to 4x by local run at δ<0
- Global effects do not seem important for δ>0 in these TCV scenarios