Contributions from low shear devices + further work

CWGM at NIFS

Oct. 2007

From previous CWGMs (Yamada, Ascasíbar):

-Validity of global scalings (w/r to iota-shear). What is hidden?

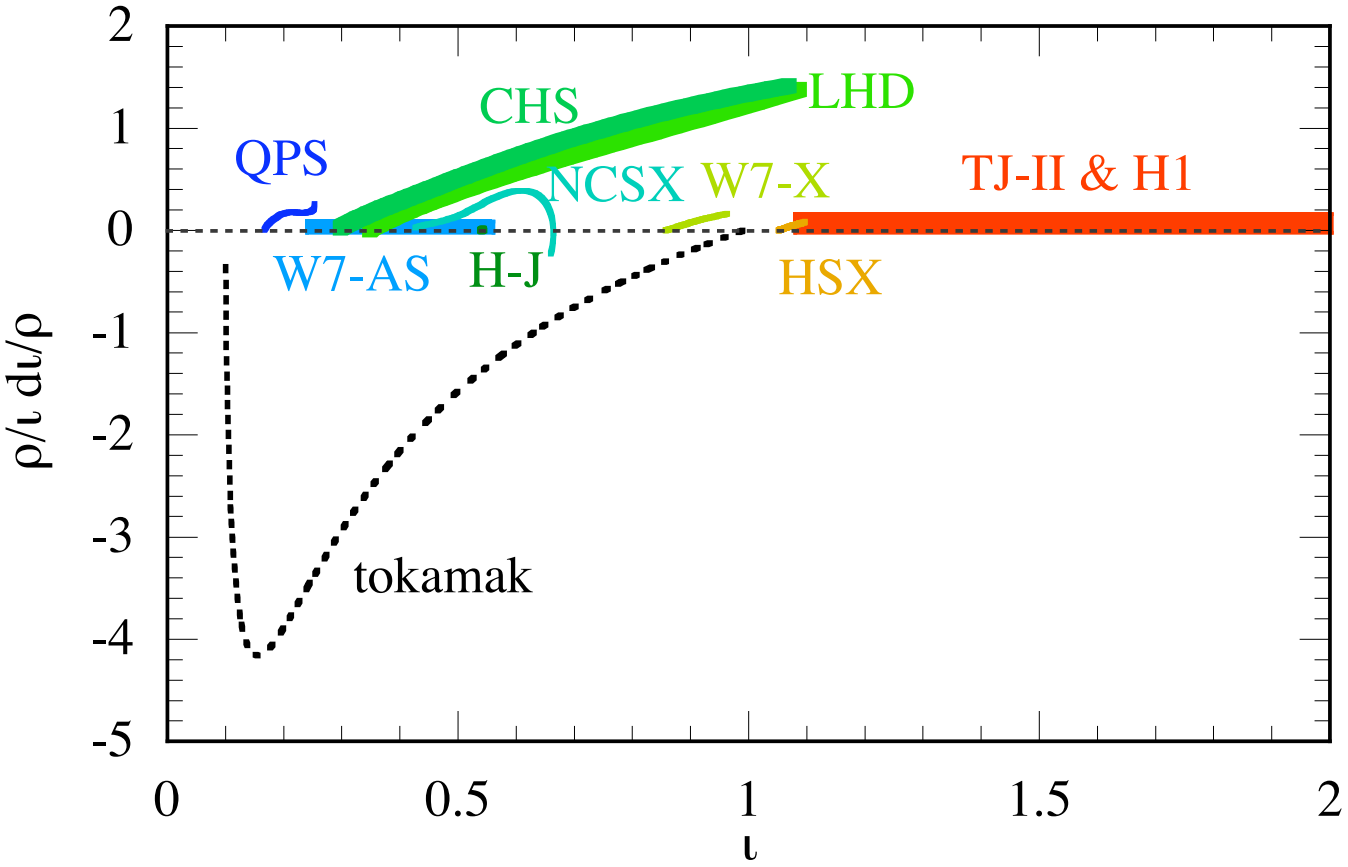
- Need for local studies

TJ-II results (Greifswald, June 2007): The presence of the lowest order rationals does not deteriorate confinement unless they "invade" the plasma. Moreover: their presence is locally coincident with lower effective heat diffusivity. This can be seen in stationary discharges through a fine scan of rotational transform preserving the iota-profile, or dynamically with induced currents and therefore changing shear. Therefore, the effect is robust versus shear. The fact that it can be traced out in most of the plasma (if not all) implies that it is also robust with respect to collisionality, gradients...

Summary (SW 2007--low shear)

- In the absence of magnetic shear, global confinement is deteriorated by the presence of low order magnetic resonances.
- Narrow optimum confinement windows are found in W7-AS and Heliotron-J close to low order rational values. In TJ-II, provided a small amount of magnetic shear, low order resonances trigger a variety of improved transport events. Fine configuration scans in this machine show that low order rationals retain heat fluxes at their radial location.
- Certain amount of shear allows for the presence of even the lowest order rationals within the confinement region. It is still unknown whether the amount of shear needed depends on the iota value.
- The beneficial effect of shear on confinement does not depend on the sign.
- (this work is just a starting point!)

E. Ascasíbar -- Summary of results from low shear devices regarding iota-shear; SW 2007



What should be plotted in this space? Suggestion: ability for optimum confinement (this is binary) --> then move to details (transport problem)

Looking to the future

•Documentation: Continuing effort in data quality improvement (validated profiles, errors, uncertainties, ...)

•comparisons between W7-AS and TJ-II: lower threshold for the shear? Does it depend on the iota-value?

•Tracking low order rationals experiments in TJ-II:

–issue: χ_e contour plot needs further confirmation and careful estimation of internal currents

–new experiments in the pipeline: slow increase in the flat top value of helical coil current (≈ 5 kA/s) -> dynamic change of configuration with fixed shear

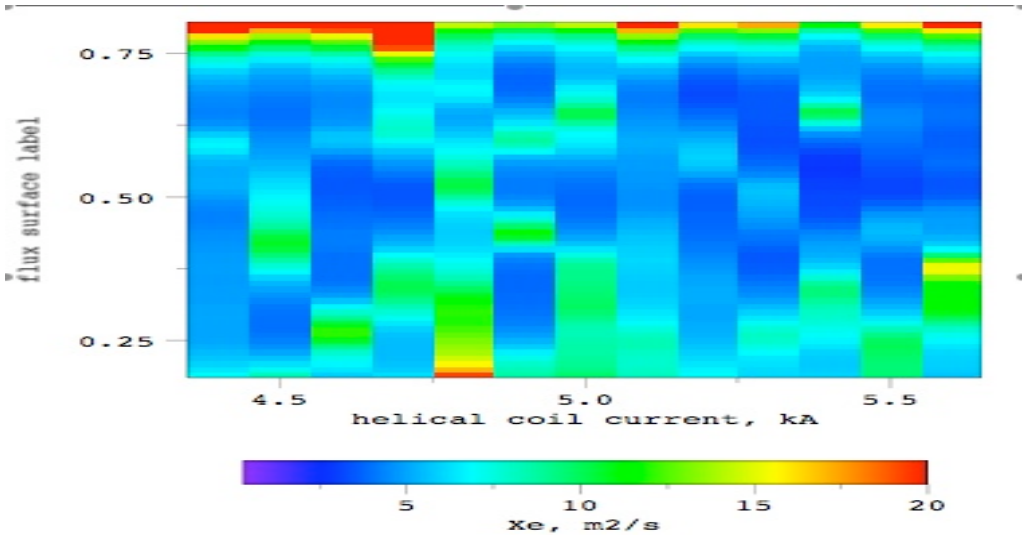
–will the effect survive in higher density NBI discharges?

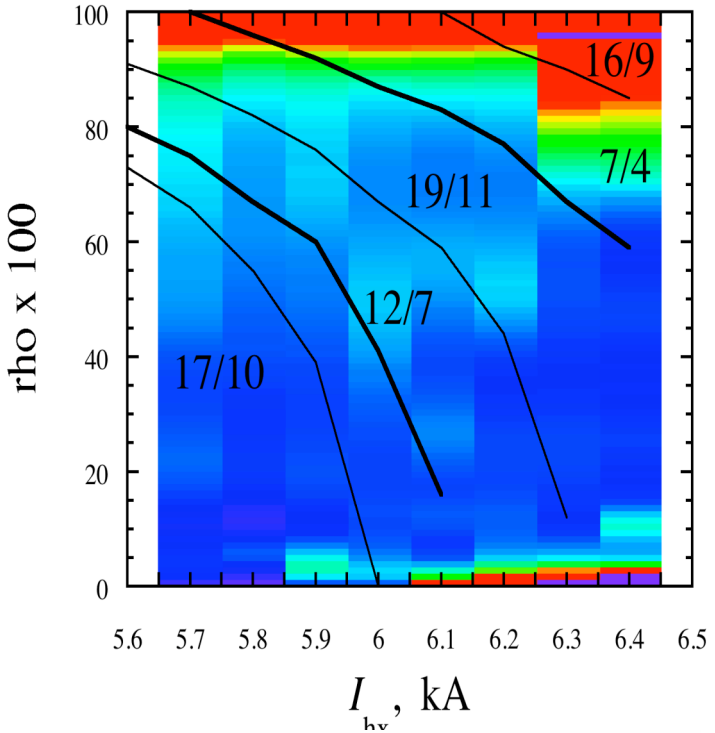
•Impact of large shear: Comparison with CHS, LHD needed. Is there a saturation or even degradation of confinement over a certain upper threshold?

•W7-X is the first device able to face the challenge of keeping the configuration free of low order rationals. ECRH provides an additional tool to compensate internal currents.

Tasks

- Outline for PFR joint paper
  - Expand Enrique's SW2007?
  - Include H-J & H-1 results?
- New contributions from low shear devices
  - Heliotron J: Work with new TS+SXR data?
  - H-1: turbulence/low collisionality?
  - W7-AS: Submerge into database?
  - TJ-II: Clarify role of resonances (ECRH) in particle and heat local balance; NBI plasmas.
- High shear joint contribution: fill in shear-iota space.





Low order magnetic **resonances** **modify** heat and, perhaps, particle **transport**. The effect is weak in low density ECRH plamas and not observed in relation with transport transitions, although it may be behind their explanation. Further studies are encouraged!