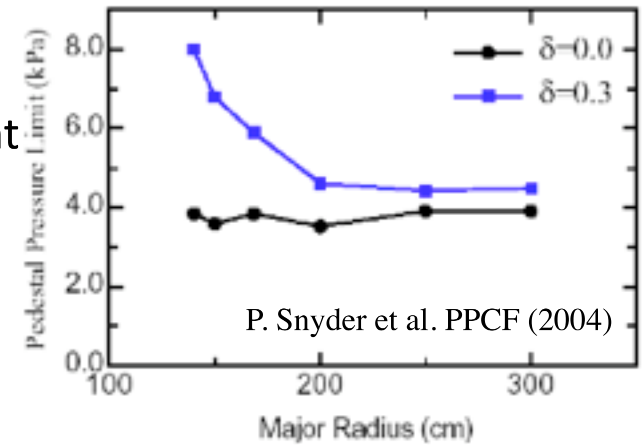
Effects of the Triangularity on the Pedestal Structure at fixed X-point height in ELMy Discharges

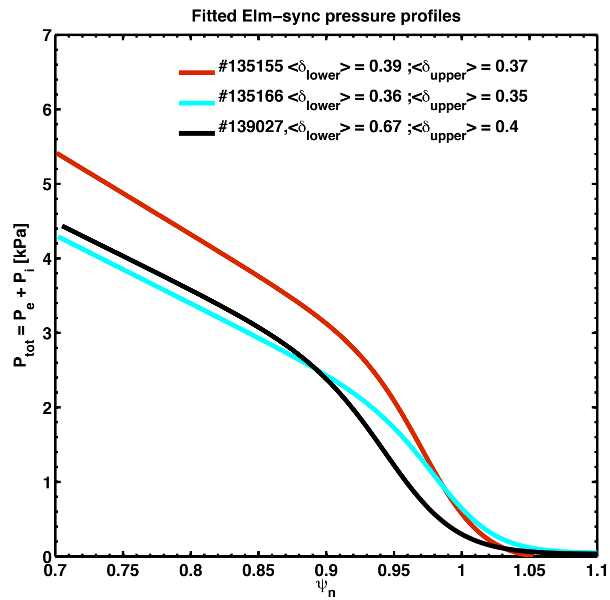
A. Diallo, A. Sontag, R. Maingi,
S. Gerhart, and E. Kolemen

XP Team Review

Pedestal Structure and Stability are Tightly Coupled through the Plasma Shape

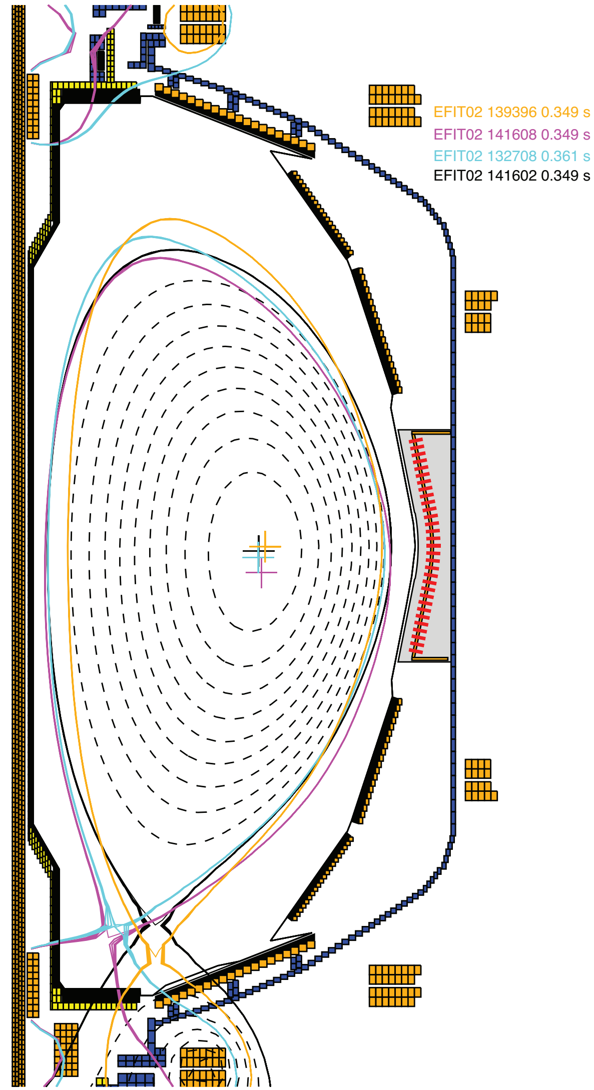
- XP 1044: Experiments of pedestal structure scaling have been performed to show:
  - normalized poloidal beta scales with current consistent ITER98 scaling
  - no clear scaling of the pedestal height with Bt.
  - pedestal height does not ALWAYS saturate before the ELM crash
  - what is the effect of plasma shaping on the pedestal structure?
- The effect of plasma shaping is well known to be a key ingredient in MHD stability. Its role in setting the pedestal width and height has yet to be quantified.
  - In large aspect ratio tokamak, the pedestal pressure limit increases with triangularity
  - Data from XP942 confirms the increase of the pedestal height with average triangularity
  - Extend Sontag developed discharges (XP942) to add a crucial component the X-point control and document the pedestal structure.





XP Goal: Scan both bottom and average triangularity and quantify their effects on the pedestal structure

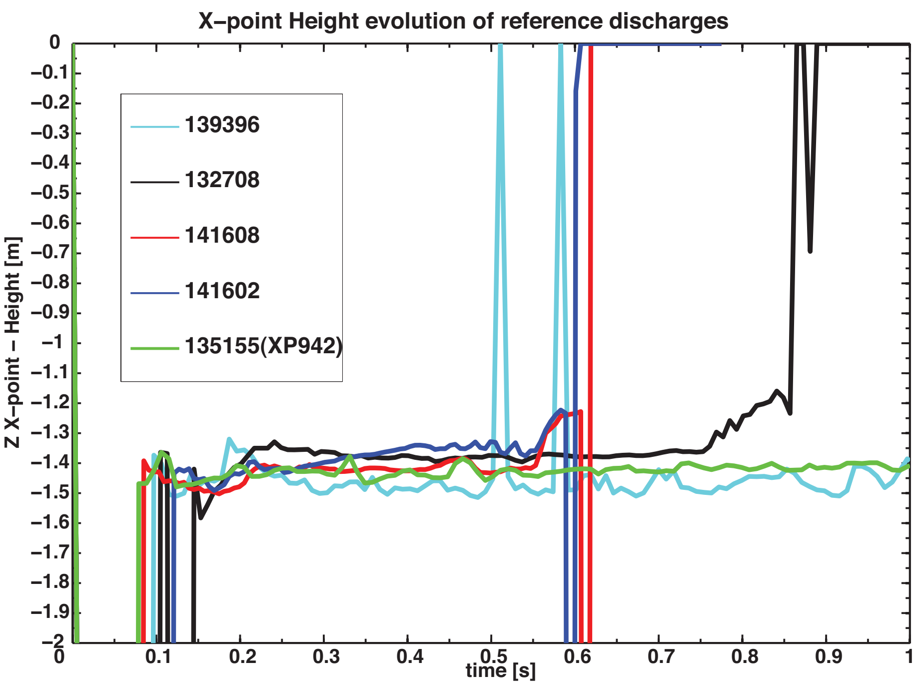
- This XP targets FY 2011 Joint research Milestone on pedestal physics
- Perform systematic scan of the bottom triangularity at fixed X-point height to quantify the dependence of the triangularity on the pedestal structure
- Questions this XP might address:
  - How does the pedestal height and width depend on the bottom triangularity?
  - Is the pedestal buildup during an ELM cycle depending on the shaping?
  - Which of the two knobs (bottom or average triangularity) has the dominant effect on the pedestal structure?
  - Can we determine the range of values in triangularity enabling to transition from the peeling to peeling-ballooning dominated drive in the stability curve?
  - What are the fluctuation characteristics during an ELM cycle for high and low triangularity?

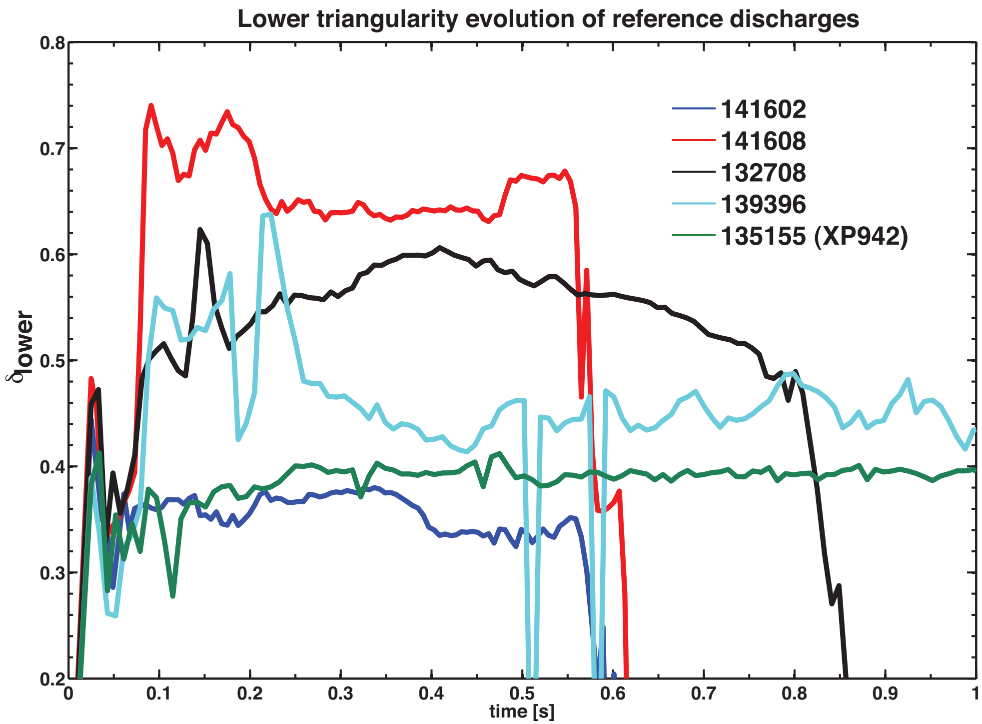


2 Sessions-Run Plan (in order of priority)

- Session 1: Shape development (in ELM free case) [1/2 day]
  - Reference 135155 discharge at **low** triangularity (0.3-0.4) [5 shots]
    - Ip = 800 kA, Bt = 4.5kG
    - Biased down: drsep = -0.5 cm
    - Keep top triangularity between 0.3 and 0.5
    - Include the X-point height and strike point controls
  - Establish a **high** triangularity discharge(0.7-0.8) [5 shots]
    - Keep the same top triangularity as above
  - Establish a **medium** bottom triangularity(0.5-0.6) [5 shots]
  - If time permits, vary the top and bottom triangularity independently keeping the average triangularity constant at 0.8-1
    - Set bottom triangularity at minimum achieved earlier (0.3-0.4) and top triangularity at 0.5-0.6 [3 shots]
- Session 2: Pedestal structure documentation [1/2 day]
  - Note that, once the discharges are established, we might need to tweak the gas and beam timings to obtain regular ELMy discharges.
  - For each shape by stepping the beam power from 5MW to 3 MW [2x3 shots]
  - Document the effect of toroidal velocity on the pedestal structure by applying low/gentle levels of n=3 braking (300A & 600A). [2x3 shots]

Target Discharges X-point height and Lower Triangularity





- Shot 135155 shows fairly constant X-point height and lower triangularity.

Diagnostic Requirements

- Need
  - MPTS
  - CHERS
  - Filterscope
  - MSE
  - USXR (edge channels)
  - EFIT
- Desired
  - GPI
  - Reflectometry
  - Tangential SXR Edge channels