

Combined H-mode / ITB scenario development on NSTX

C. E. Bush¹, R. Maingi¹, S. Kaye², S. Zweben²,
R. Maqueda, S. Kubota, V. A. Soukhanovskii, and
D. Stutman

- 1. Oak Ridge National Laboratory
- 2. Princeton Plasma Physics Laboratory

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Combined ITB and H-mode may result in better Performance

Review & Motivation

- Obtained high performance H-modes ($t_E \sim 120$ ms)
- Plasma performance may be improved with combination of ITB core and H-mode edge
- H-Mode power threshold experiment done at a single set of parameters
 - P_b at threshold ~ 840 kW
 - P_{th} multimachine scaling $\Rightarrow 60$ kW
- Must expand the operating space to investigate further
- New capabilities – Better n_e profiles at edge
- Use mostly NBI- But also expect to use RF

Experience with Combined ITB and H-modes Scenario

- DIII-D obtained combined ITB/H-mode using counter injection with n_e control
 - Began with very low density H-mode regime
 - Now have the quasi-double barrier (QDB) mode
- On TFTR -- obtained ITB in ERS mode
 - Found $W_{\text{ExB}} \gg g_{\text{Lin}}$ at transition due to large excursion in V_{pol}
 - $E \nparallel B$ shear maintained low transport until “turned off”
 - no ERS with H-mode edge attempted
- But
 - obtained H-mode edge in supershot and high b_{pol} plasma
 - highly conditioned walls to control n_e (especially edge)
 - improved with I_p rampdown (more with Li condition)

Low edge neutrals, bi-directional NBI

Experience with Combined ITB and H-modes Scenario

(continued)

- JET-pellet enhanced mode combined with H-mode
 - used large central heating using either NBI or ICRH
 - clear evidence of ITB in optimized shear discharges
- In most cases, no consensus in a P_{th} for ITB formation
 - DIII-D — get QDB $P_{th} \sim 2.5$ MW with co-NBI but 9 MW for counter-NBI
 - JT-60 found the opposite, with co-NBI a disadvantage
 - However, in general all found ExB shear favorable and part of the process, whether ω_p , V_q or V_f driven
- New capabilities on NSTX
 - Better conditioning and better control of n_e
 - new 350 ∞ bake; inner wall gas puff

Experimental Approach

- Determine impact of machine improvements and operating capabilities
- Obtain longer duration H-modes (emphasis on NBI)
- Reduced IRE, better conditioning, I_p control
- Obtain and document fiducial H-modes
 - (a) ELM-free; (b) ELMy
- Expand the n_e , b_t , S , I_p space for NSTX H-modes
- Make power threshold determination with LSND
- Begin with highly conditioned machine, use inboard puff
- Heat H-mode core with NBI and/or RF
- Use I_p ramp-down and I_p control to get ITB
- Test other methods of triggering (lower P_{th} ?) L-H transition