Development and Assessment of "X-point limiter" Plasmas

M. Bell, R. Maingi, K-C. Lee

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- Coping with both steady-state and transient (ELM) heat loads is a critical issue for ITER
- Is there an alternative to the "conventional" poloidal divertor?
  - Divertors are used because they are associated with the H-mode, *but*
  - H-mode can be obtained reliably without an X-point on the boundary
    - *e.g.* JET in its early investigation of H-modes (1980s) – best τ_E
    - Critical factor seems to be *high magnetic shear in the edge*
    - *e.g.* H-mode ("pesky" - *RJG*) in TFTR with I_p rampdown, high β_P
- Rebut has suggested that the "X-point limiter" would a better approach (*e.g.* Alfvén prize address at EPS Conference, Rome, 2006)
  - There is a separatrix but it is just *outside* the LCFS
  - Contact point of limiter with LCFS is close to and just inside the X-point
  - Flux expansion near poloidal field null and tangential contact spread heat load
- Experiment in NSTX would be relevant both to ITER and ST development

Discharges Produced with X-Point Close to Inboard Divertor Plate

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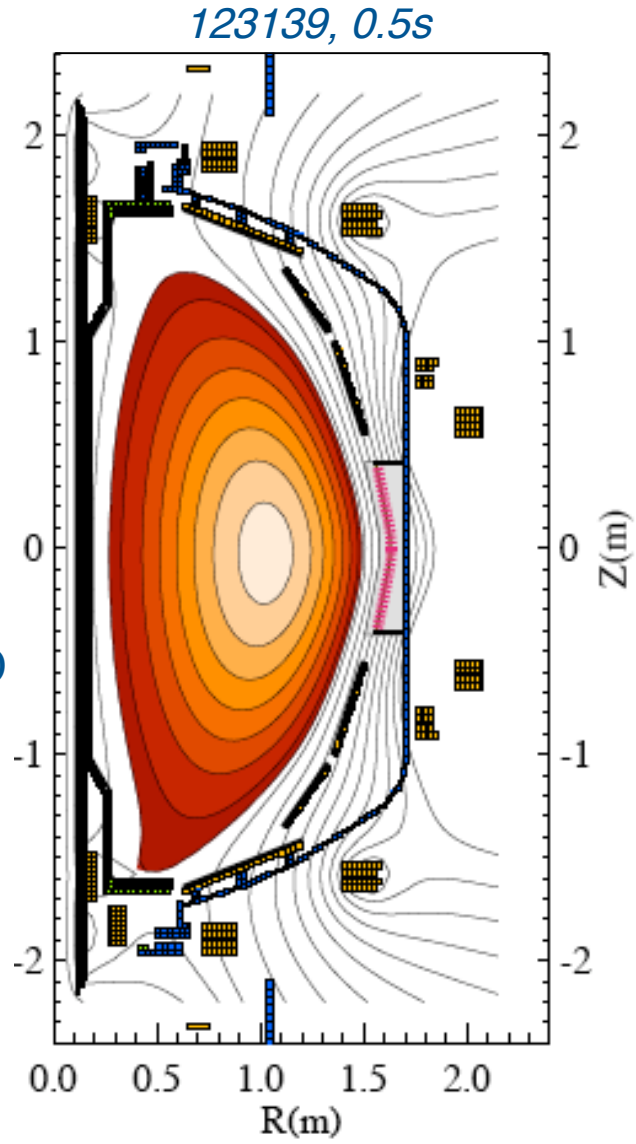
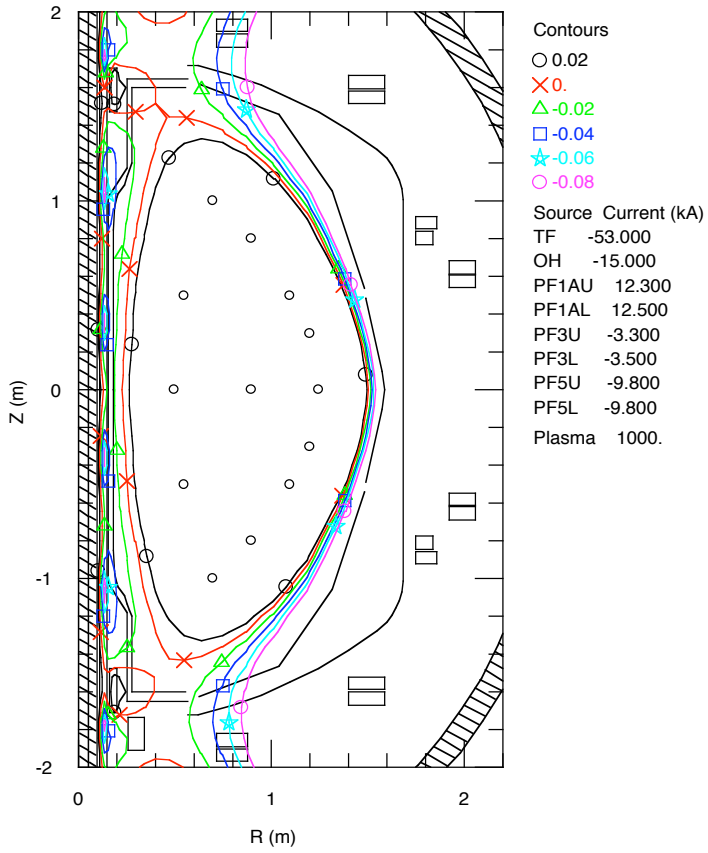
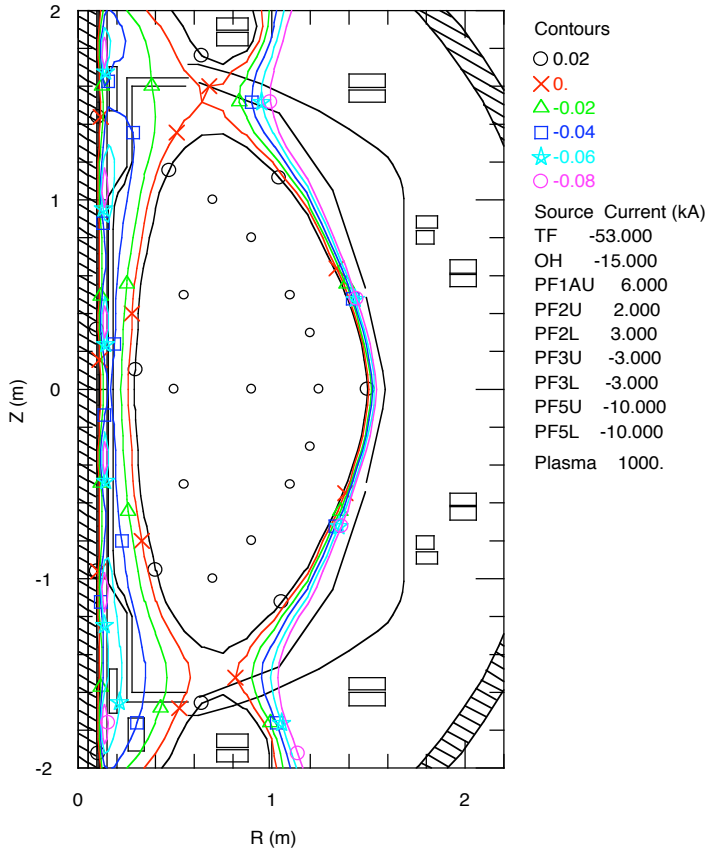
- *Example*: 1MA, 0.45T, 4MW NBI
  - H-mode transition at 0.15s
  - From XP-820 “EBW coupling” on 4/4/07
- Advantageous to bring contact point of LCFS onto **outer lower** divertor plate
  - Avoid loading edge of inner plate
  - Discharges would contact at proposed location of LLD
  - Triangularity will be lower



Use PF2 Coils Rather than PF1A to Produce X-Point

- Filaments produce reasonable approximation to reference shot
- With same plasma current distribution, shifting divertor current from PF1AL to PF2L produces close to desired condition
- Increasing PF2L (and PF2U) raises X-point above outboard plate





Experiment Expected to Require ≤1 Run Day

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- Develop target at 1MA, 0.45T, 4MW using PF2 coils rather than PF1A
  - Use rtEFIT control of outer gap and preprogrammed I_{PF2L}/I_p ratio
  - May need to use PF1A coils to compensate for OH fringing field
- Scan X-point through outboard limiter surface
  - Adjust HFS gas to promote H-mode transition
- Uncertainty is state of "conditioning" of new contact area
  - Repeat shots to assess whether this is evolving
- Assess H-mode threshold and confinement scaling in NB power scan
  - Assemble full kinetic data for analysis
  - Measure heat loading on both divertors
- Consider repeating some conditions when LITER operating
- Experiment provides proposed X-point height scan (K-C. Lee)
- Also provides useful data for milestone:
  R(08-3) Study variation and control of heat flux in SOL