

Advanced Scenario Current Profile Tailoring Via T_e Control During the Current Ramp

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- Motivation

Both experimental and theoretical studies have shown that both stability and confinement are improved in discharges with very low \rightarrow negative magnetic shear in the core region. The typical tokamak current profile is governed by conductivity profile and is there strongly peaked on axis, leading to high magnetic shear. Must intervene during current ramp to prevent this.

- Background:

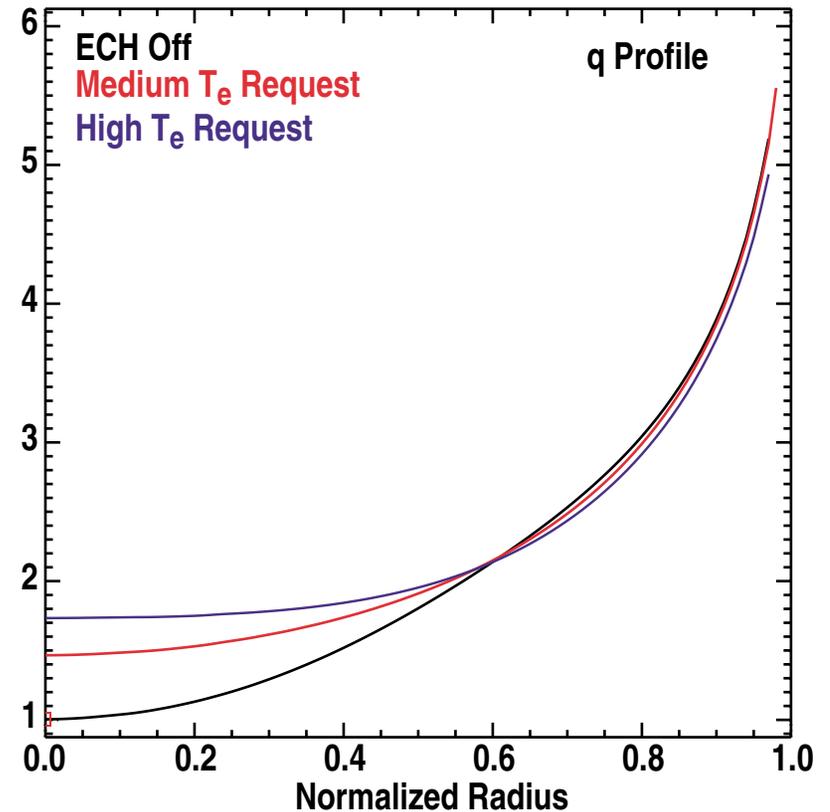
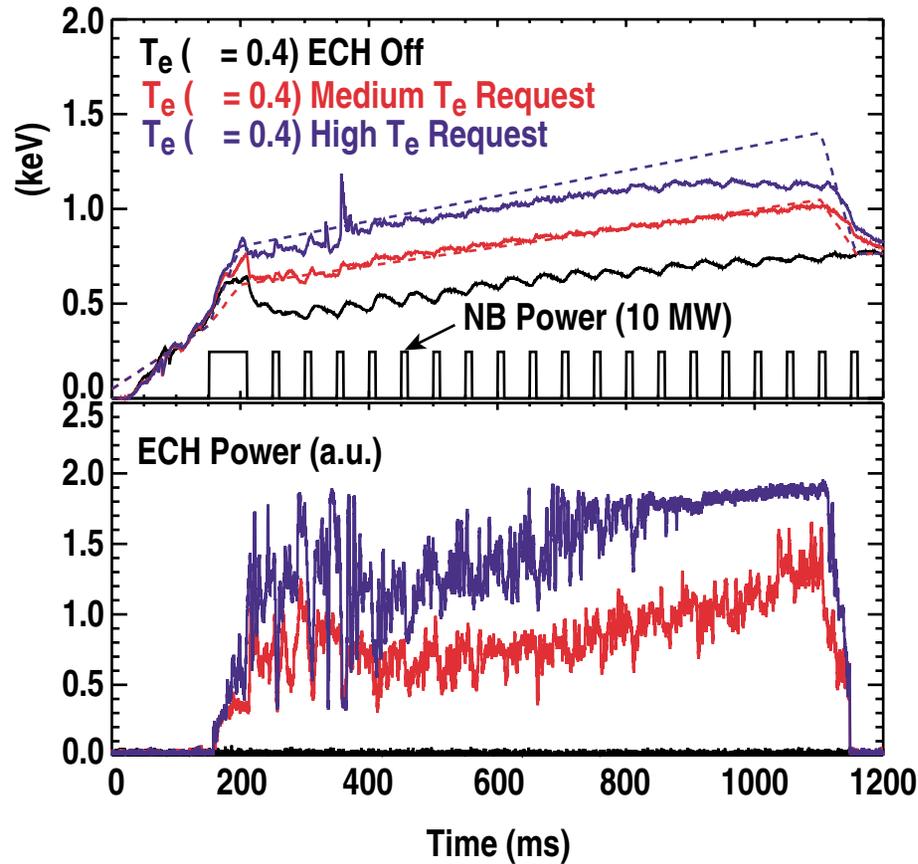
Experiments on DIII-D have shown:

- 1) Control of T_e is the primary determining factor in poloidal flux penetration during the current ramp
 - careful control of T_e during the current ramp leads to reliable access to the same current profile for Advanced Tokamak studies
- 2) Triggering of an H-mode early in the current ramp is the most effective means of accessing $q_{min} > 2$ with moderate shear reversal ($q_0 - q_{min} \sim 0.5$)

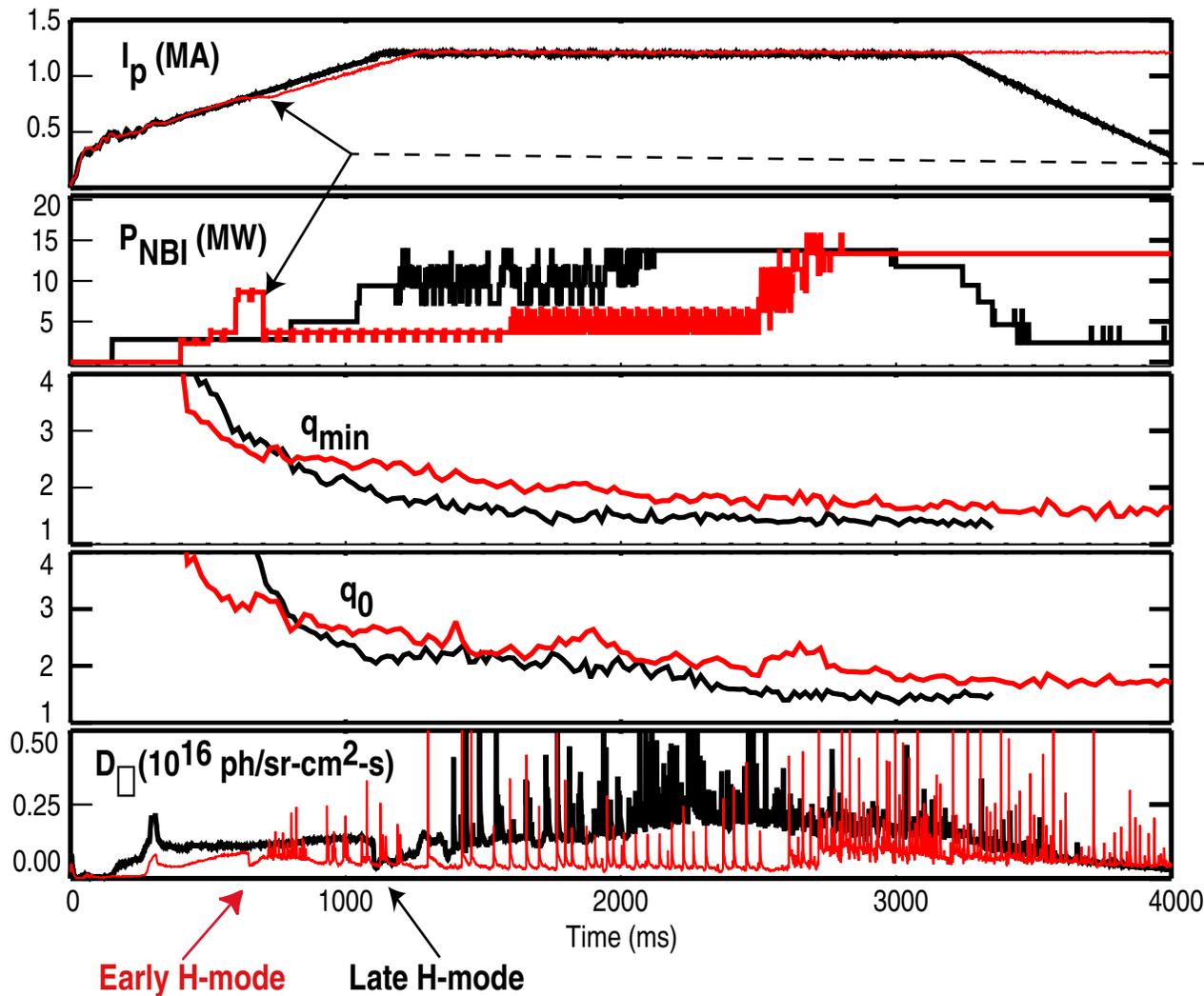
- Proposal

- 1) Utilize available heating tools (NBI and HHFW) during the current ramp to raise T_e to determine extent current profile can be modified via these means.
- 2) Develop a technique for triggering a H-mode transition during the current ramp. Possible techniques include increased heating, plasma shaping, slower I_p ramp, inner wall gas puffing, etc.

DIII-D STUDIES SHOW THAT SYSTEMATICALLY INCREASING T_e DURING THE CURRENT RAMP RESULTS IN LESS CURRENT PENETRATION



Triggering an Early H-mode Allows Access to Higher q_{\min} Without Strong Shear Reversal



In DIII-D, H-mode induced by short step up in P_{NBI} concurrent with a brief period with $dI_p/dt = 0$

$q_{\min} > 2.5$ at end of current ramp with modest central shear with $q_0 - q_{\min} \sim 0.5$

Note that access this approach allows access to many different q_{\min} values with the same central shear