Proposed Initial Feedback Operation on NSTX CHI Plasmas and Transition to Ohmic

NSTX Research Forum Nov. 2001

B. A. Nelson, T. R. Jarboe, R. Raman

29 November 2001

1 Proposed Feedback Method for CHI Only Discharges

In past CHI operation, both the injector voltage and poloidal field coils have been programmed.

For CHI feedback operation we plan to:

- Feedback control the CHI injector voltage to maintain a desired time history of I_p (detailed algorithm to be determined)
- Program (feed-forward) poloidal field coils (including ψ_{inj} except as detailed below) to match the above I_p time history
- Eventually feed-back control ψ_{inj} to optimize λ_{inj} (maintaining it larger than $\lambda_{\text{tok}} = \mu_o I_p / \Phi_{\text{TOR}}$ at all times)

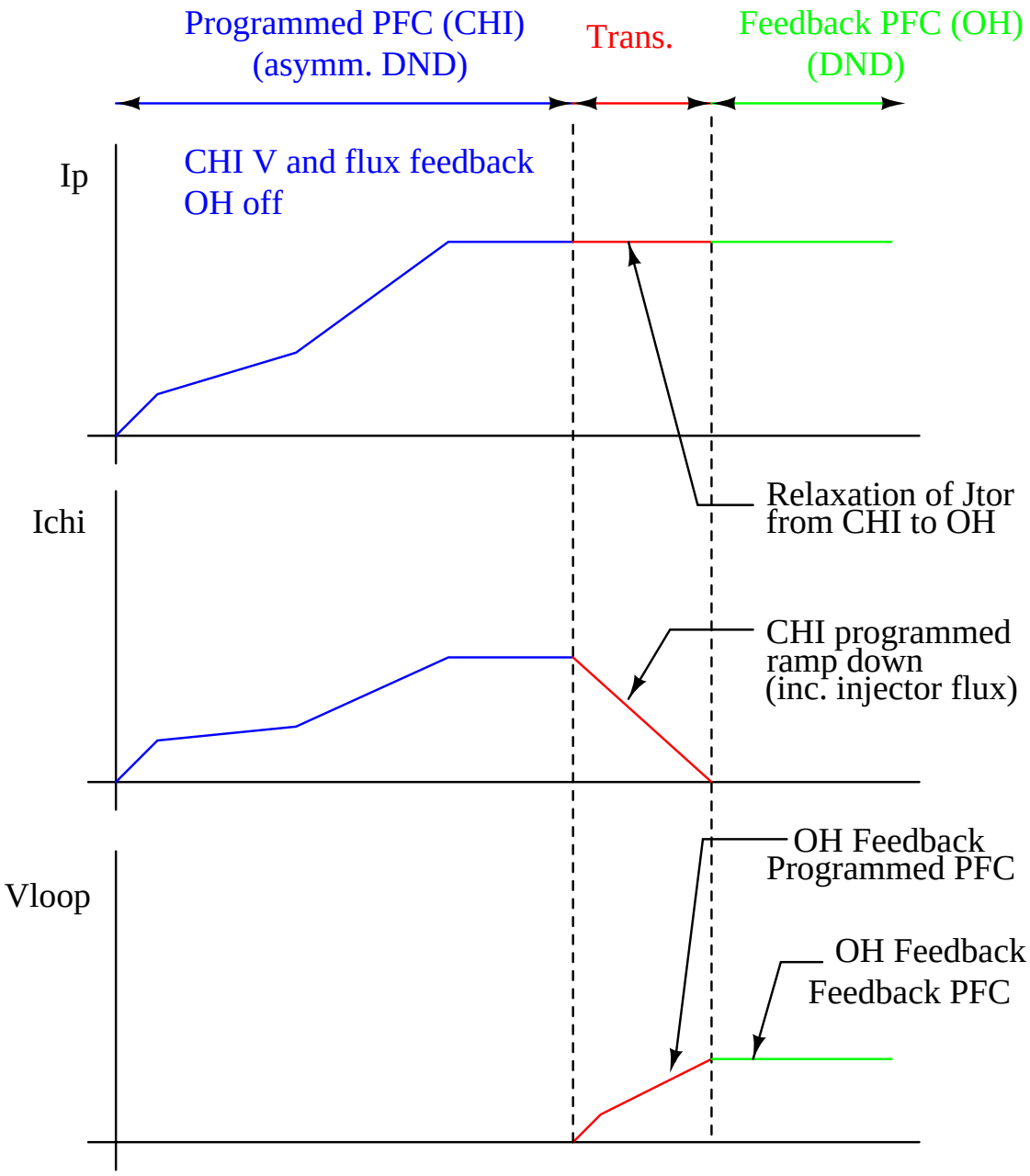
2 Proposed Method for Transition from CHI to Ohmic Discharges

To transition from CHI to Ohmic discharges, flux boundary conditions are best starting with an "asymmetric" DND for CHI, then transitioning to symmetric DND on Ohmic. PFC PF1B will provide the lower X-point location

for CHI (I_{PF1B} is the same direction as I_p and also as $I_{\mathrm{PF2L}} \sim I_{\mathrm{PF2U}}$). The DND configuration will become "balanced" when I_{PF1B} is ramped to zero.

Three phases of operation will thus be involved in the transition from CHI to Ohmic discharges:

1. CHI Startup and Sustainment:
   - Program PFCs for "asymmetric" DND
   - Feedback CHI voltage
   - Feedback ψ_{inj} using PF1B (as described above)
   - OH coil used as inner "bumper" field (but no V_{loop})
   - Bring I_p up to 500 kA
2. Transition from CHI to Ohmic:
   - Program PFCs to transition from CHI values to typical Ohmic equilibrium values, forming a symmetric DND
   - Ramp CHI voltage (or current) and injector flux to zero, maintaining $\lambda_{\mathrm{inj}} > \lambda_{\mathrm{tok}}$
   - The OH coil will feedback V_{loop} to maintain I_p (note the PFCs are *programmed* during this phase)
   - Expect I_p relaxation features as current profile transitions from CHI (hollow) to Ohmic (peaked)
3. Ohmic operation:
   - Continue OH V_{loop} feedback to I_p
   - Use equilibrium feedback control on PFCs for Ohmic drive to higher I_p


Programmed PFC (CHI)
(asymm. DND)
Trans.
Feedback PFC (OH)
(DND)
Ip
CHI V and flux feedback
OH off
Ichi
Relaxation of Jtor
from CHI to OH
CHI programmed
ramp down
(inc. injector flux)
Vloop
OH Feedback
Programmed PFC
OH Feedback
Feedback PFC