

Solenoid free plasma startup in HIT-II and NSTX by Coaxial Helicity Injection***Speaker: Roger Raman**

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Current startup without a central solenoid is essential for the viability of the Spherical Torus concept, and even some advanced tokamak designs eliminate the central solenoid in order to improve reactor performance. This points to the fundamental importance of developing methods for solenoid-free current startup. Results from the

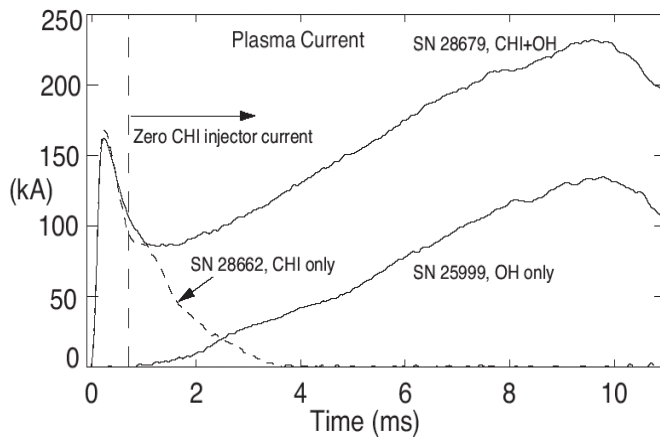


Figure 1: The dashed trace is a CHI only discharge. The vertical dashed line shows the time at which the CHI injector current is reduced to zero. CHI current persistence beyond this time is due to the existence of a closed flux equilibrium. It is this closed flux plasma that is inductively driven in shot 28679. For comparison, an Ohmic only discharge under identical pre-programmed loop voltage time history (total 30 mV.s consumed) is also shown (shot 25999).

time it induces a negative loop voltage on the CHI startup plasma. These results point to the very robust nature of the CHI startup process. The startup method described here is referred to as *transient* CHI startup, during which the flux boundary conditions are held fixed. Transient CHI startup does not require producing a high quality field null under very dynamic conditions, which will be difficult in reactors containing blanket structures. The results from HIT-II and from recent experiments to implement transient CHI on NSTX [3] will be reported.

[1] T.R. Jarboe, *Fusion Technology* **15**, 7 (1989)

[2] R. Raman, T.R. Jarboe, B.A. Nelson, et al., *Phys. Rev. Lett.*, **90**, 075005-1 (2003)

[3] R. Raman, T.R. Jarboe, D. Mueller, et al., *Nuclear Fusion*, **41**, 1081 (2001)

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Helicity Injected Torus-II (HIT-II) [1] on the transfer of a Coaxial-Helicity-Injection (CHI) produced discharge to inductive operation are reported. Figure 1 shows plasma current traces from a CHI initiated discharge and a reference Ohmic only discharge. In the CHI initiated case, nearly 100kA of useful closed flux current is produced, which is retained during the inductive ramp. In a sequence of discharges without performing wall conditioning between shots the CHI started discharges are found to be considerably more reproducible than the inductive only cases [2]. CHI discharges can also be initiated when the central transformer is pre-charged, or while the central transformer is in the process of being pre-charged during which