NSTX
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Demonstration of Solenoid-free Plasma Startup Using Transient CHI

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APS Meeting Talk Outline

Experimental Results

- **Experiments in NSTX have now unambiguously demonstrated the coupling of Transient CHI started discharges to induction from the central solenoid.**

- **The coupled discharges have ramped up to high current and transitioned to an H-mode demonstrating the compatibility of this method with high-performance plasma operation.**

- **The scaling to larger machines is also attractive.**

- **We will improve on last year's results by improving the magnitude of CHI produced current and the current that is coupled to induction by reducing the amount of low-z impurities.**
  - **More aggressive cleaning of the lower divertor**
  - **Increased use of Lithium to increase the Li/O ratio in CHI produced discharges**
  - **Possible use of disruptions on the upper divertor to clean it up to some extent**
  - **Absorber field nulling coils to reduce stray poloidal fields in absorber**

Modeling Results

•To understand and assess the full potential of the transient CHI method to NSTX and to future machines we have used the Tokamak Simulation Code (TSC) to simulate NSTX CHI discharges.

•Simulations show that the plasma evolves in much the same way as observed experimentally.

•Generation of closed flux in TSC is as a result of an effective toroidal loop voltage induced by the CHI ejected poloidal flux that decreases as the injector current is reduced to zero.

•The code has been able to show consistency with earlier theory for the scaling of CHI produced current with the injector and toroidal fluxes.

•These results in conjunction with experimental work on HIT-II and NSTX, two machines with different sizes, suggest that the amount of injector current required to pull the injector flux into the vessel increases with the injector flux but decreases with the toroidal field indicating that the scaling to future machines with stronger toroidal field is favorable.

•Extrapolation to an ST-CTF indicates CHI is capable of multi-MA level current startup in a ST-CTF.