



# CHI performance Improvement

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Integrated Scenario Development  
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# Outline

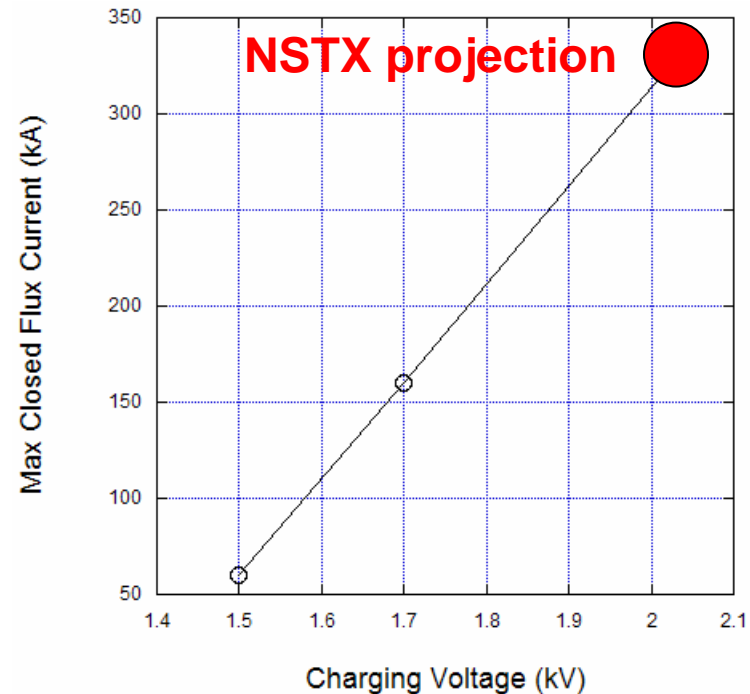
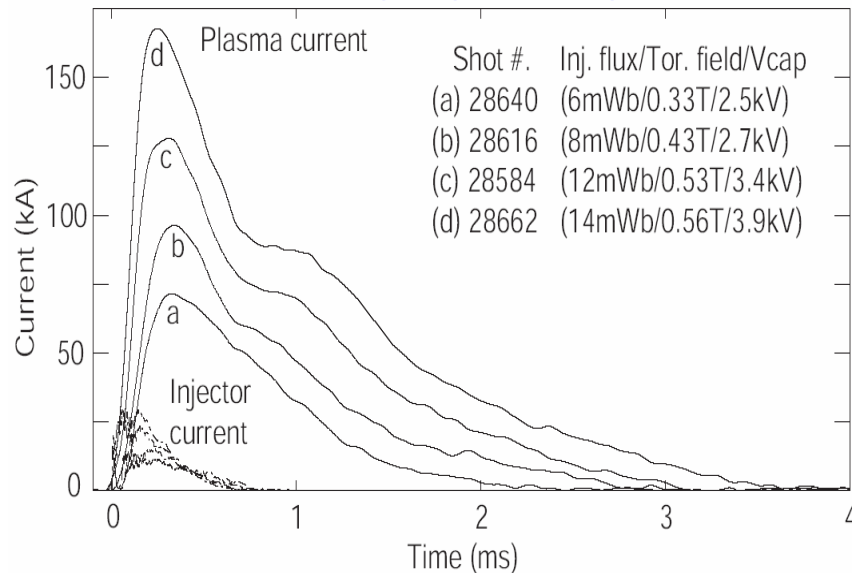
- Increase the current of Transient CHI plasmas
  - Couple to induction
  - Produce a reference startup plasma for other XPs
  - Couple to RF and NBI (work with the RF group)
- CHI startup with outer PF
- Insulator and voltage design improvements
- Edge current drive
  - Relaxation current drive

# Increase the current of Transient CHI plasmas



- Results indicate 300kA should be possible in NSTX at 2kV
  - Planned for 2008

Closed-flux current increased with capacitor charging voltage in HIT-II

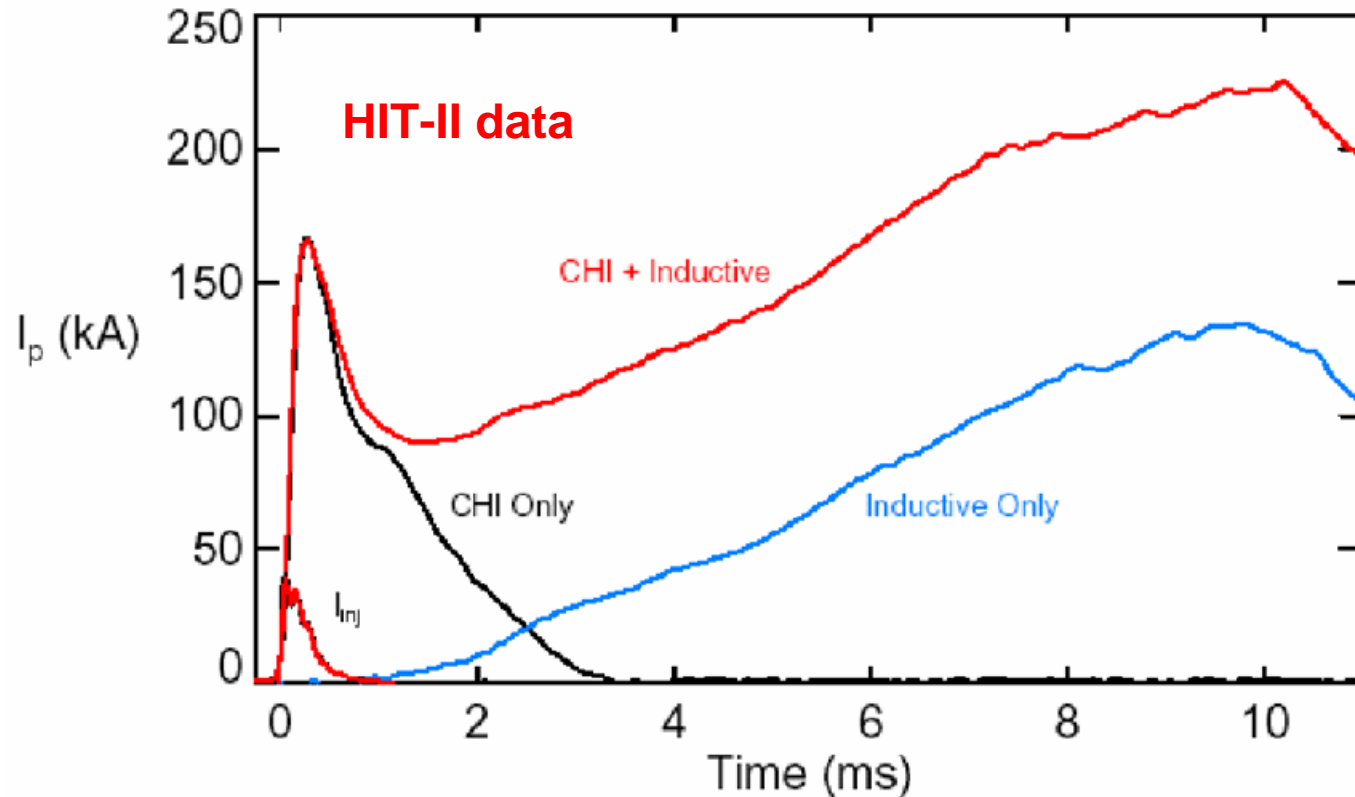


- Improvements to NSTX voltage capability in addition to inclusion of some vertical field should allow extension to 500kA (Work in progress)

# Couple to Induction (as demonstrated on HIT-II)



Results from HIT-II show nearly all CHI-produced closed flux current is retained in the subsequent inductive ramp



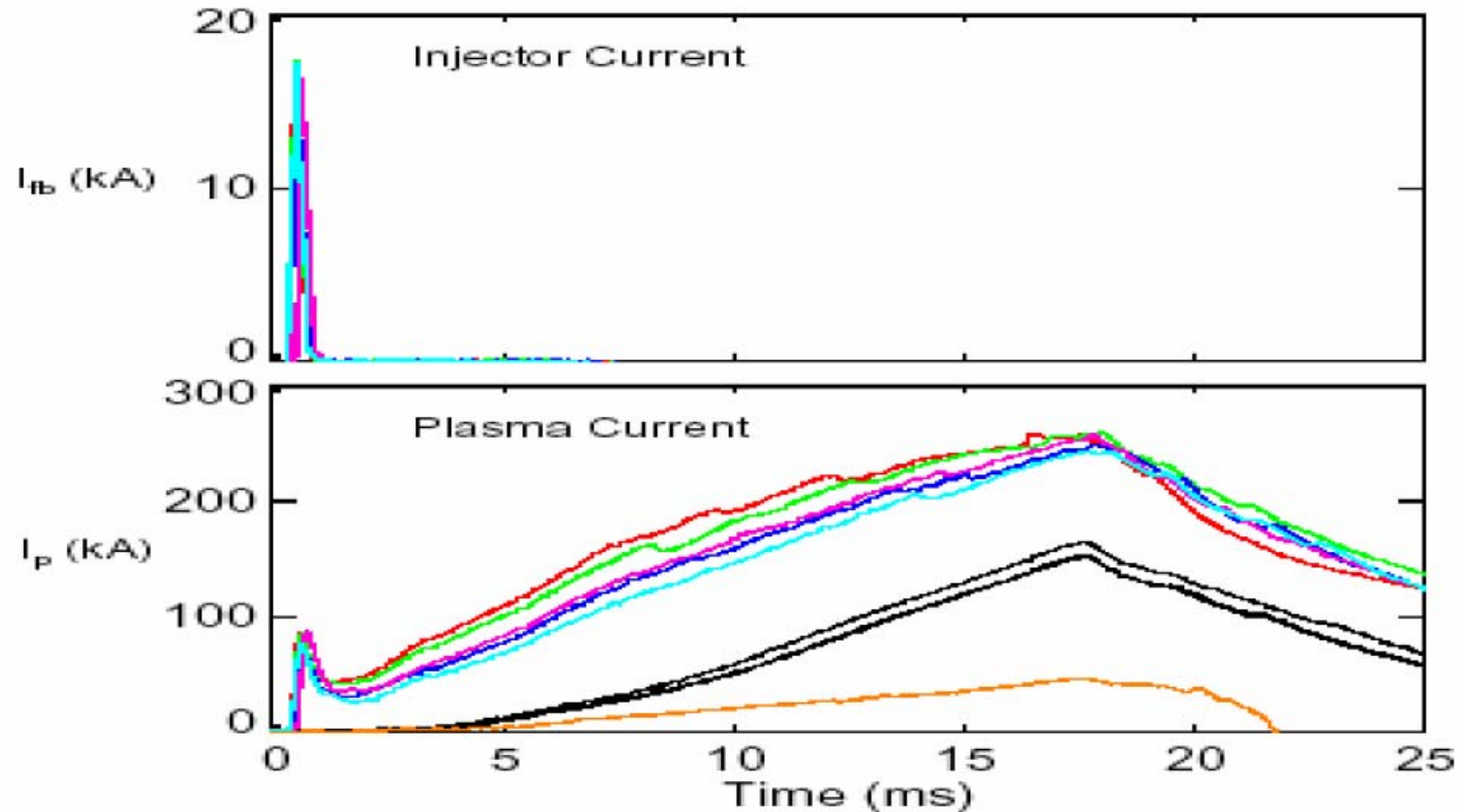
Both discharges have identical loop voltage programming

Produce reference discharges (as demonstrated on HIT-II)  
Use 200kW ECH for further V-S savings and to couple to RF



HIT

CHI Started shots: 27517 19 21 23 25  
Induction only shots: 27518 20 22 24

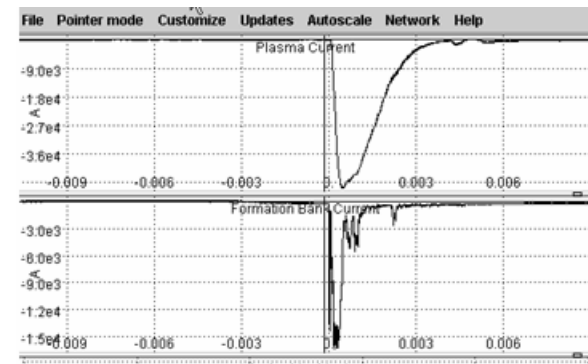
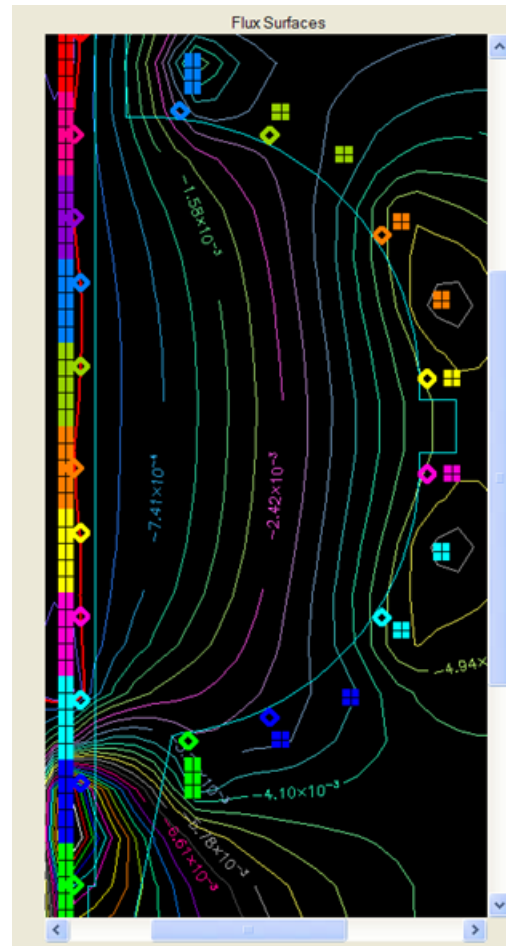


Improves performance and saves volt-seconds

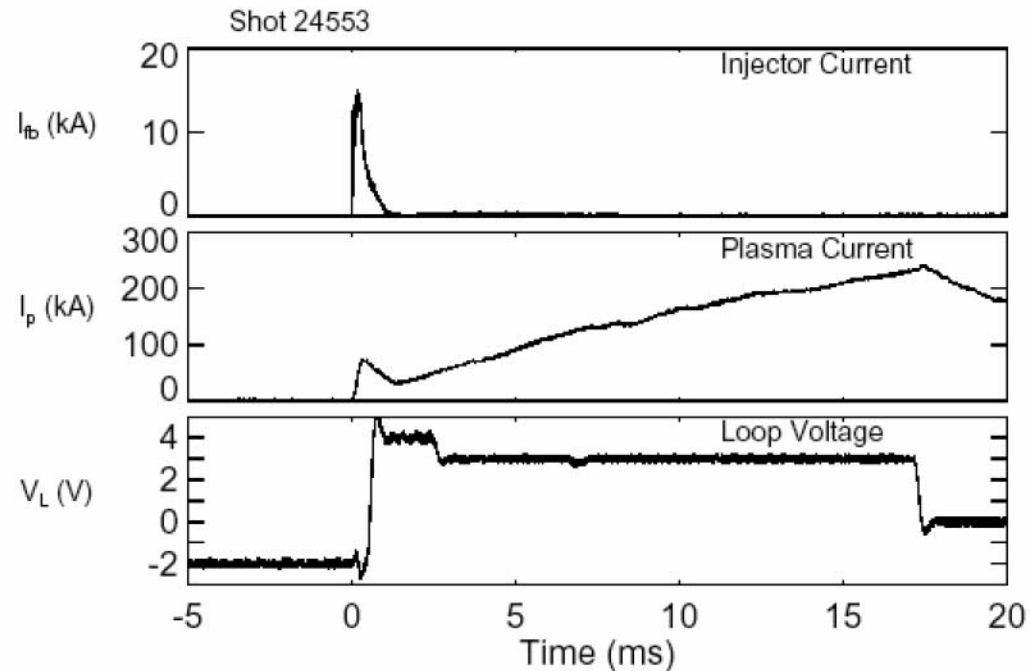
# Pre-charge using vertical field (as demonstrated on HIT-II)



HIT-II data



# CHI discharges in HIT-II can be started when the CS is in the process of being pre-charged



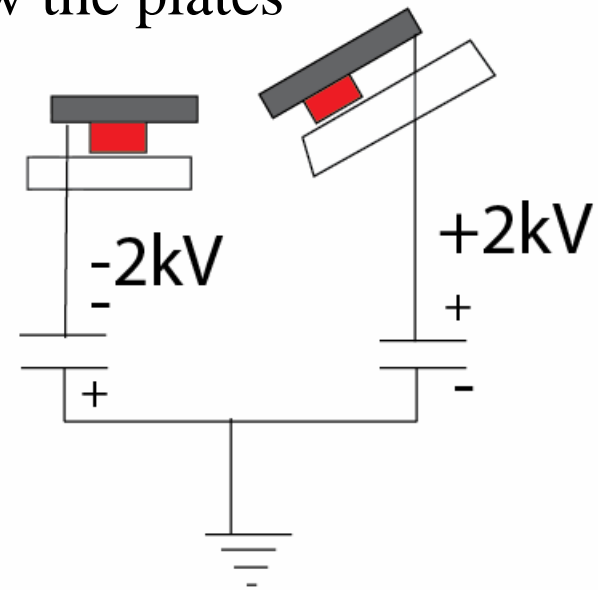
- Important for a burning plasma reactor that may contain a small central transformer

**HIT-II data**

# Voltage increase to 4kV possible without exceeding 2kV IV to TF limits



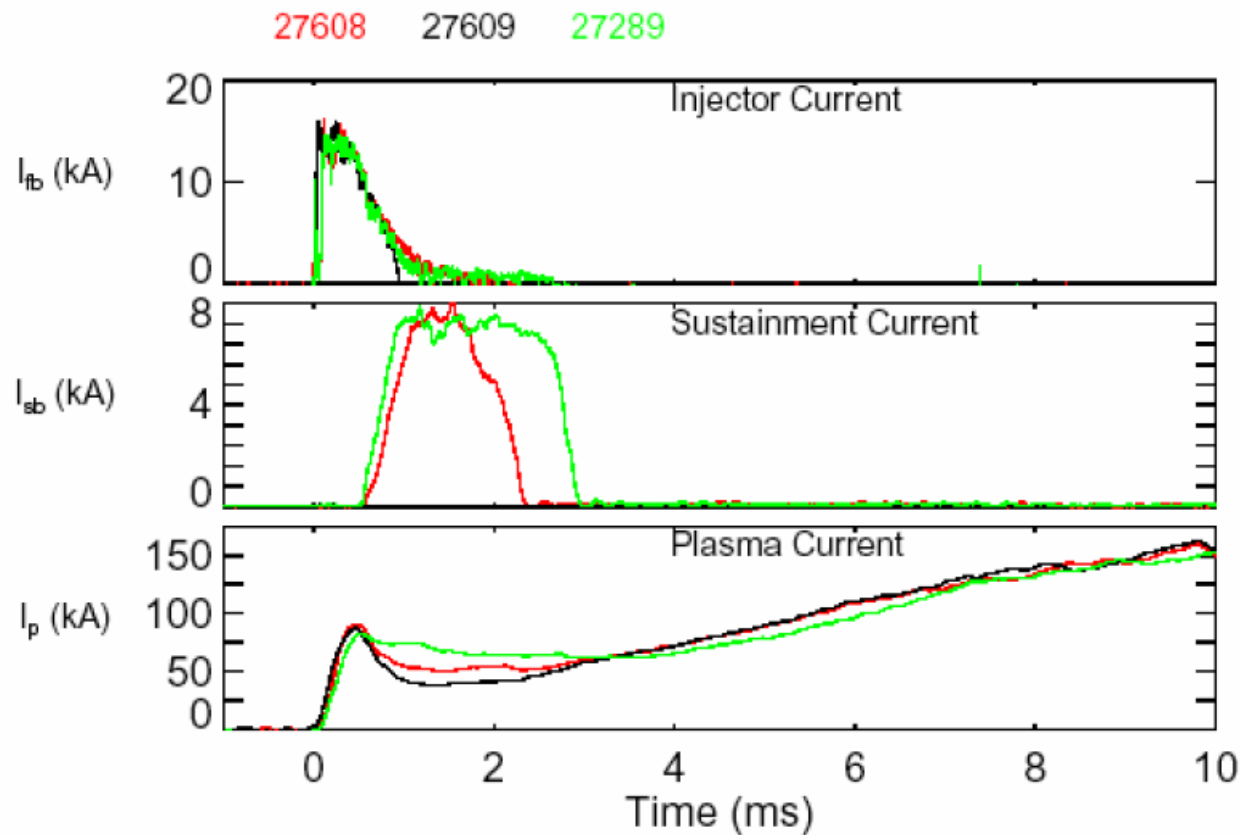
- Inner and outer vessel both grounded
- Portions of inner and outer divertor plates insulated
  - Simpler - non-vacuum insulator
  - Similar to ring electrode used in DIII-D to drive 30kA electrode current
- Lithium can help pump the region below the plates



**HIT-II data**



# CHI Edge current successfully driven in HIT-II discharges but current profile not diagnosed



**HIT-II data**

# CHI Edge current successfully driven in HIT-II discharges but current profile not diagnosed

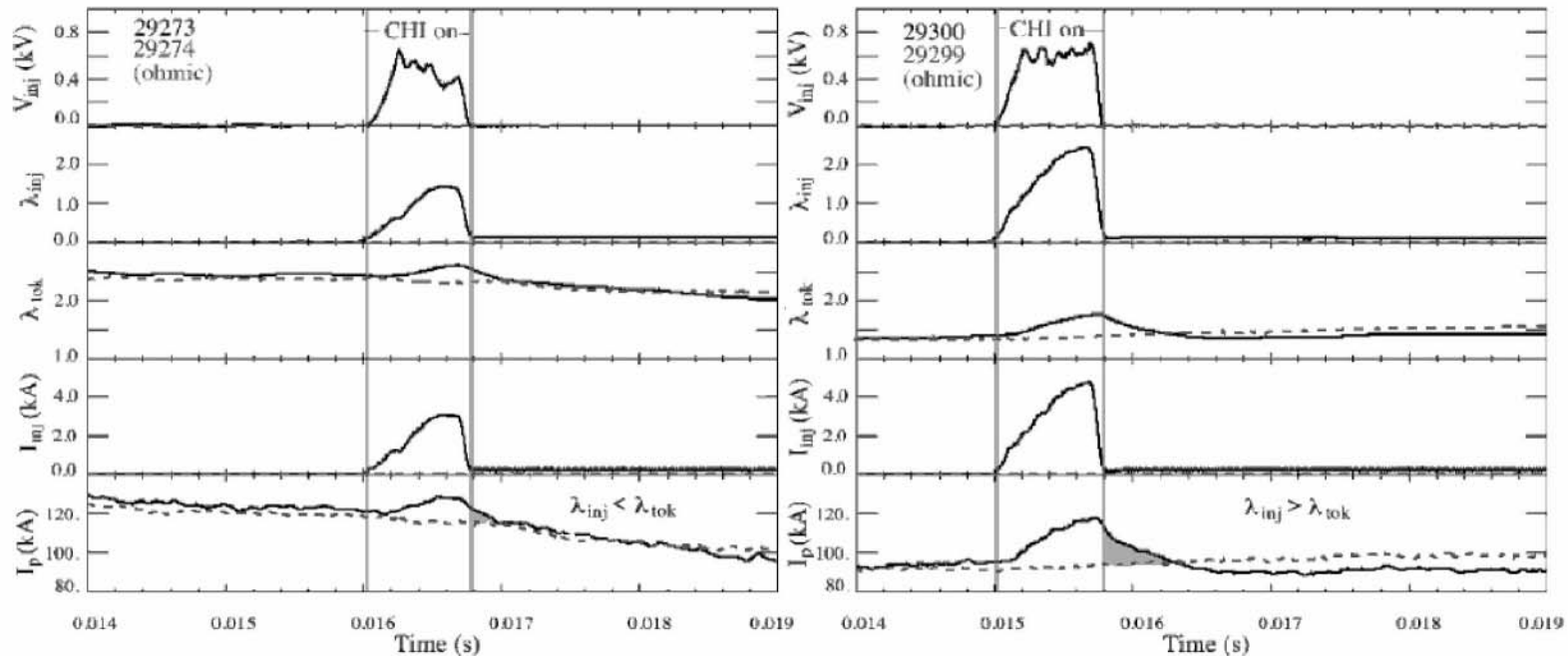


FIG. 3. Injector voltage, injector  $\lambda$ , tokamak  $\lambda$ , injector current, and plasma current for two levels of CHI edge drive,  $\lambda_{inj} < \lambda_{tok}$  (left) and  $\lambda_{inj} > \lambda_{tok}$  (right). For each case, a reference Ohmic only discharge is shown with a dashed line.

## HIT-II data

Use results from Edge current drive studies for higher current relaxation current drive studies

# Demonstration of high current capability in NSTX opens up new exciting possibilities for CHI in NSTX



- Higher levels of Transient CHI startup current
  - Coupling to induction
  - Reference startup plasma for other XPs
  - Coupling to RF and NBI RF group)
- CHI startup with some outer PF
- Insulator and voltage design improvements to extend CHI capability and simplification of insulator design
- Edge current drive for edge current profile control
  - Relaxation current drive a possibility