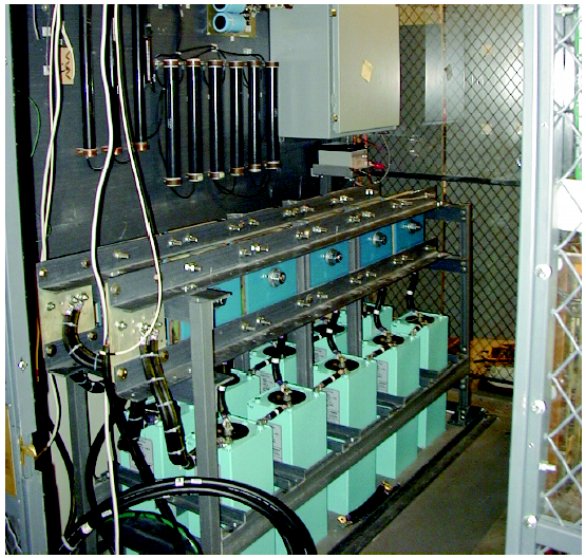
Capacitor Bank & MOV Upgrade for CHI in NSTX-U

NSTX- CHI capacitor bank



- 50mF, 2.0 kV capacitor bank (5mF x 10): 100kJ

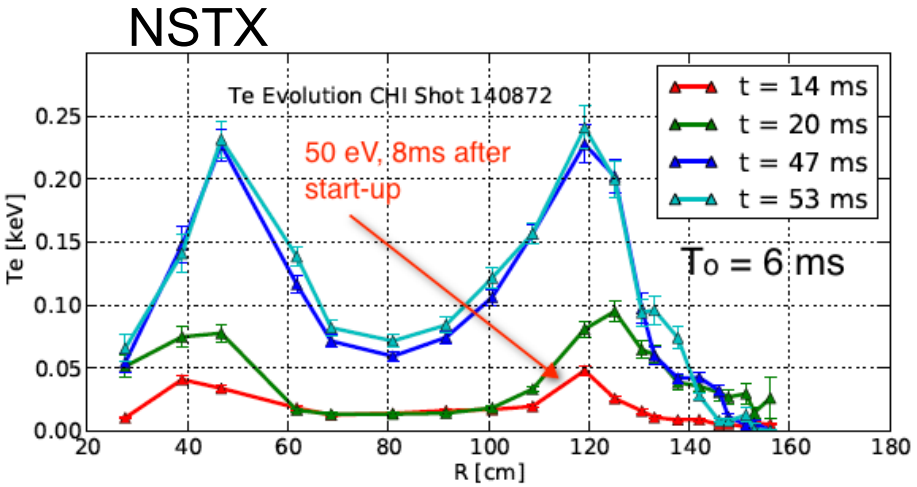
  45mF , 1.75 kV used in experiments

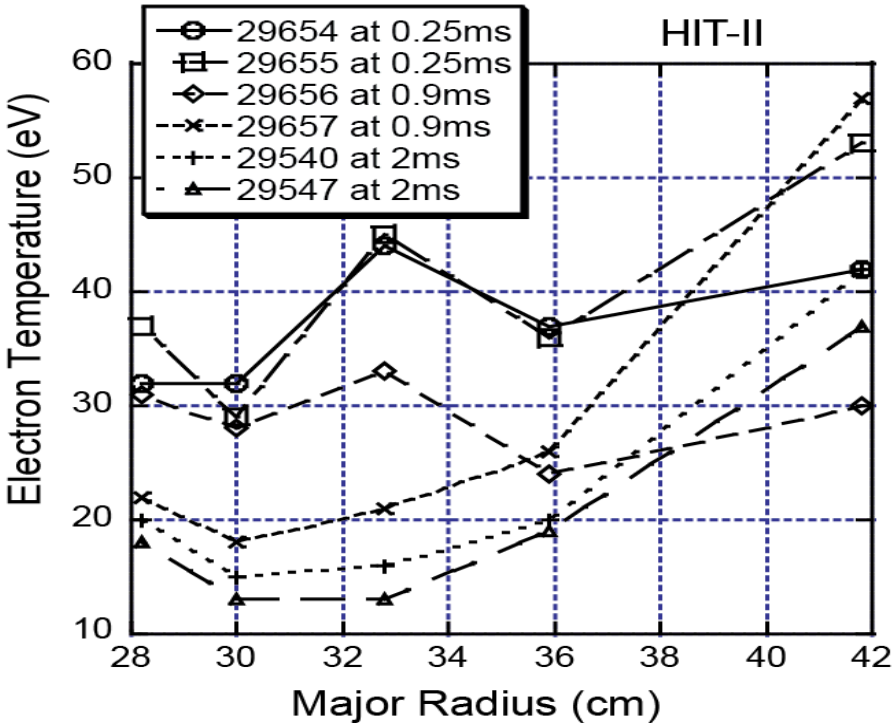
- Fast crowbar system to interrupt injector current
- Three modules
- MOVs limit voltage to 1.7kV

NSTX-U CHI capacitor bank requirements

- Cap bank should eventually support 1MA start-up
- 1MA plasma has 100kJ inductive stored energy: cap bank ~250-300kJ
- Configuration: 10 capacitors x 6 mF: 60 mF
- Capacitor voltage: 3kV (replace with bigger, higher energy density capacitors to minimize hardware reconfiguration)
- Cap bank energy: 270kJ (Peak currents >30kA)
- Consider increasing to 4-5 modules
- Retain and if necessary increase energy capability of crowbar system and energy dissipation resistors in cap bank
- MOVs need to allow 3kV cap bank operation (snub voltages above 3.6kV) – Needed for Day-1 Ops.
  - These are now being used to support standard inductive operations – need extra back-up MOV assemblies
- Assess if snubber capacitor/assembly needs improvements & if a second snubber system should be added
- Next 5-yr plan will consider IGBT switched power system (technology still developing)

1MW ECH & Upper Divertor Li for CHI in NSTX-U



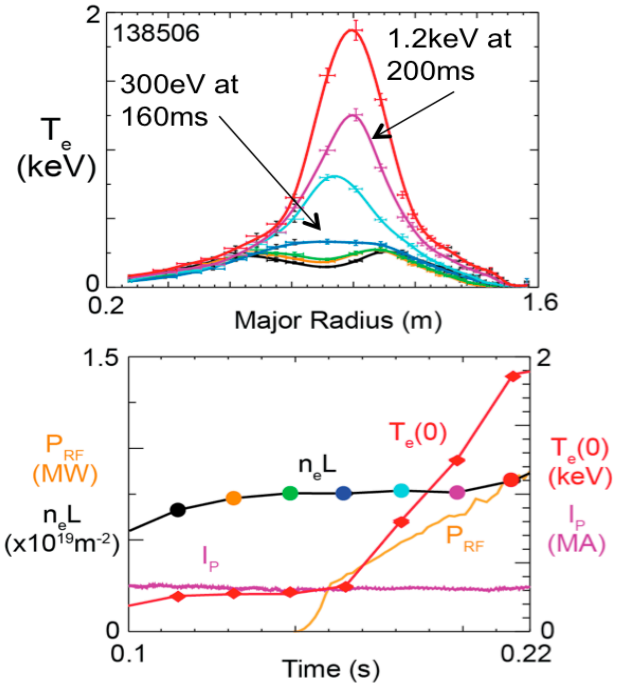


- Both NSTX and HIT-II have attained 50eV during the CHI phase
- At higher levels of start-up current, with improved electrode surfaces further increases in Te are likely
- During Inductive ramp-up, Te ramps-up fast (from 50 to 100eV in 6ms)
- These results and on-going simulations suggest that 0.5MW of coupled ECH power could increase Te by an additional 200eV during the current decay phase

- HHFW can increase Te of a 300kA plasma from 300eV to 750eV in 20ms & to 1.25keV by 40ms

- In a 500kA CHI target, 1MW ECH + HHFW should allow for direct coupling of CHI started currents to NBI-CD in NSTX-U

- This is a high-priority NSTX-U goal



Upward directed Li evaporator

- Reducing electron density in the absorber should make it more difficult for an absorber arc to initiate

- We had in the past considered the possibility of a cryo-pump in the absorber for this purpose

- FY11 CHI plans called for coating the upper divertor with Li using the Li dropper

- Recent experiments on NSTX have shown that DC rectifier sustained divertor cleaning discharges could not be sustained after extensive Li deposition on the lower divertor plates

- Rapid pumping by Li is hypothesized to be the cause

- An upward directed Li evaporator would help with absorber arc reduction and reduce the influx of impurities during an absorber arc

Upper CHI Injector Capability & Upper Mo Divertor Plates

- NSTX-U is up/down symmetric

-This allows for the possibility of initiating CHI from the upper divertor region

  - The gas injection system and a possible upper divertor ring bus for CHI current feed should be considered and implemented to allow this operational capability

- In the event that a cryo pump is installed in the lower divertor, CHI could be initiated from the upper divertor and the cryo pump would help reduce the incidence of absorber arcs (an appropriate design need to be worked out)

- Converting the upper divertor plates from carbon to Mo and coating it with Li should further reduce the amount of oxygen injected into a CHI discharge during an absorber arc