CHI & Alternative Startup: Proposals for FY'04 Experiments

Transient CHI (Raman) - *Priority 1*

- Continuation of previous experiment but using capacitor bank (under development)
- Plan to use HHFW for breakdown assistance
- PF3L current critical to control "pinching off" CHI discharge to form closed flux
- **5 days** *after installation and commissioning of CHI capacitor bank*

CHI added to Inductive Discharge (Mueller) - *Priority 1*

- Continuation of previous experiments which were hampered by diagnostic noise problems
- Some success in HIT-II but limited by rapid density rise: characterized scaling limitations
- Requires MSE or Dynamo Probe for definitive results
- **2 days** initially *after diagnostic interference eliminated*

Assessment of Absorber Insulator and Need for Nulling Coils - *Priority 1*

- Use original extended CHI scheme (rectifier supply) and ramp current to ~400kA
- **1 day** *(could be run early before CHI capacitor bank becomes available)*

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Outer PF startup (Ono & W. Choe, KAIST) - *Priority 2*

- Get region of poloidal field null for 2 – 3 ms with outer coils PF2, PF3, PF4, PF5
- Ideally need bipolar PF5 but for initial experiment may be able to use PF4 for equilibrium
- **1 day for XMP** for null formation; **3 days for XP** to develop breakdown and rampup

Outer PF ramp from near zero current (Menard) - *Priority 2*

- Simulation shows null with significant loop voltage and possible formation of closed flux
- ECH to ionize; form plasma with HHFW (match local LH frequency); puff to ~ $10^{18}m^{-3}$
- RF heating provides the extra degree of freedom (through both pressure and resulting bootstrap current) to match both force balance and flux balance in rampup
- **2 days for XP** to develop breakdown and some current; **1 day (min)** for rampup

Solenoidless startup (Y. Takase, U. Tokyo, given by Menard) - *Priority 2*

- Scenario 2A: reversed B_Z at breakdown; flux for 0.65MA (tried on JT-60U with LHH, ECH)
- Scenario 2B: outboard null with PF2, 3, 5 (no PF4); flux for 0.16MA (similar to Choe/Ono)
- Scenario 3: Similar to MAST merging-compression with external coils only
- **2 days for S2A & S2B; 2 days for S3**

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HHFW Rampup in Solenoid-free Current Ramp (Kessel) - *Priority 2*

- Induction to 50 – 150 kA then clamp; apply HHFW as heating & CD source (NBI may follow)
- TSC simulation of build up to 0.5MA if density can be controlled appropriately
- **1 day to setup initial condition; 1 day to develop HHFW rampup** *(following possible ISD work?)*

FRC in NSTX (Zweben) - *Priority 3*

- Inductive startup at very low TF (<1mT) with intense preionization by *ECH* @ 30MHz
- Build up current with NBI
- **1 day** *dependent on analyses of machine safety and interlock issues*

Total Requested Experimental Time

Priority 1: **8 days** (including 5 after commissioning of CHI capacitor bank)

Priority 2: **13 days** (not including PF4 commissioning time;
may be possible to streamline HHFW breakdown development)

Priority 3: **1 day**

CHI & Alternative Startup: Diagnostic development

Ji: **Dynamo Probe investigation of CHI plasmas**

- Measure fluctuations to discriminate between 2D and 3D reconnection models
- Probe head not yet constructed (additional collaborator funding required)
- **Piggyback on experiment adding CHI to inductive plasma in FY04**

Wurden: **Magnetic Mapping of CHI with Hypervelocity Dust**

- Provide high velocity tracer particles in CHI plasma ($M/Z \sim 10^6 - 10^7$)
- Under development – not ready for deployment yet

CHI & AS: Supporting Experiments, Theory & Analysis

Redd: **HIT-II**

- Summary of HIT-II results and possible contributions to NSTX CHI
  - Scalings, *e.g.* λ scaling of threshold for adding CHI to induction
  - Scenario development

Schaffer: **CHI Equilibrium Modeling with EFIT**

- EFIT coded for open line current: good convergence (to different equilibrium) on NSTX test cases
- Available for FY04 experiments

Schaffer: **Helicity Studies**

- Propose using reciprocating probe to measure simultaneous electrostatic potential and B fluctuations to measure helicity transport

Brennan: **Equilibrium & Stability Analysis Methods Including Open Field Lines**

- Apply NIMROD to analyze resistive linear and nonlinear stability using open-field-line EFIT equilibria of NSTX CHI plasmas

CHI & AS: Supporting Experiments, Theory & Analysis

Tang: **MHD Modeling of CHI Plasmas**

- Application of 3D MHD to include helicity transport by instabilities generated by current gradient
- Including analysis for transient CHI case: shows importance of narrow footprint for flux closure

West: **Solenoid-free Startup in NSTX and DIII-D**

- Immediate plan is apply DINA (resistive MHD and transport) code for analysis and modeling without need for finite initial current
- Already benchmarked on DIII-D, TCV, JT-60U position control and disruption modeling