Summary of MHD and AT Research Issues Identified at the FIRE Physics Meeting May 1-3, 2000

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I. Conventional Operating Modes

1. What are the consequences of the (1/1) ideal MHD instability localized near q=1?
   i. What is the expected sawtooth behavior at FIRE parameters?
   ii. Can and should we consider delaying this by early heating, faster ramp-up, shape programming, pellets?
   iii. Can we verify models on present experiments?
   iv. Relevance of Porcelli/Rosenbluth paper [Plasma Phys. Control. Fusion **38** (1996) 2163]
2. Neoclassical Tearing Modes
   i. How do the seed island and saturated island scale with parameters? Can we separate seed island effects from collisionality in todays experiments ?
   ii. Is feedback stabilization by ECD or LHCD advisable?
3. The effect of H-mode profiles on MHD stability
   i. Can ELMS be identified as n~ 5-10 peeling modes
   ii. Role of bootstrap currents
   iii. Role of triangularity in modifying ELM behavior
   iv. Relation between high edge temperature and stability
4. Requirements for error fields, need for correction coils and relation to locked modes

II. Reversed Shear / AT operating modes

1. Stability of no-wall advanced mode for the entire discharge.
   i. Do these obey the $\beta_N < 4\,\ell_i$ limit observed in DIII?
   ii. Are they consistent with the high edge shear shown to be beneficial on DIII?
   iii. Can q_edge be decreased to reduce ripple loss
   iv. How important is R/a ? Can the j-profile be made consistent with LHCD + BS for FIRE?

2. Wall stabilized advanced modes
    i. Rotation and feedback requirements
    ii. Feedback on n=1 or n > 1 also?
    iii. ICRF vs. ECCD + LHCD
    iv. CD power requirements
    v. Timescales and methods for current profile control
    vi. Self-consistent and time-dependent analysis
    vii. Interaction of LHCD with α-particles
3. Can we better define a spectrum of AT modes from low-risk to high-payoff?

III. Other advanced modes
1. Define a mode with off axis CD to raise q0
2. Edge current drive to improve stability?

IV. Machine parameters
1. Better justification for the pulse length in FIRE
2. Re-examine choice of R/a, I/ab, and tradeoffs
3. Can we define an upgrade sequence that would minimize risk and cost?
4. What ripple loss is acceptable? Can Ferromagnetic inserts or other technique bused to reduce ripple
5. Benefits between 11.5 and 12 T should be clarified.

V. Disruption Effects
1. Generate "worst case" disruption scenarios with TSC, including halo currents
    i. Fast radial
    ii. Slow vertical
2. Need model/guidelines for toroidal asymmetry of halo currents
3. Investigate feasibility of rapid PF rampdown during disruption for mitigation of disruptions
4. Predictions for runaway electrons during disruptions

VI. Equilibrium and Control
1. What values of $\ell_i/2$ and β_P are possible for a fixed shape in FIRE
2. What values of κ and δ are allowed in the machine as designed?
3. Implications for PF system of single null requirement
4. Power requirements for vertical control system
5. Shape control system