GA–A23920

# SUMMARY OF NTM-RELATED PRESENTATIONS AT US/JAPAN WORKSHOP

by
M.S. CHU

MARCH 2002

GENERAL ATOMICS

## DISCLAIMER

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- **NTM Physics and Extrapolations to ITER (S. Günter)**
  - Ion bootstrap current inside small islands evaluated
  - Scaling of NTM offset by power ramp down experiment
  - A high confinement regime at high $\beta$ found despite NTMs
    - ★ Next to investigate dynamics of MHD tearing modes in plasma

- **NTM Stabilization Requirements (S. Günter)**
  - ac modulation of ECCD has only a marginal improvement over dc case
  - Optimum position for ECCD changes during discharge, radial feedback necessary
  - Confinement deteriorates due to ECH
    - ★ Next to investigate stabilization of 2/1 mode, transport effect due to ECH and tearing mode

- **Development of Real-Time NTM Stabilization System (A. Isayama)**
  - Real-time NTM stabilization system developed and checked out
    - ★ Next to demonstrate real-time stabilization of NTM and investigate possible upgrade

- **Effect of ECH/ECCD on Sawtooth Oscillations in NB-Heated Plasmas in JT–60U (A. Isayama)**
  - Co-ECCD drastically reduced sawtooth period below $T_e(0)^{1.5}$ and increases energy expelled by sawteeth
  - Counter-ECCD increases sawtooth period follow $T_e(0)^{1.5}$ law and reduces energy expelled slightly

- **Comparison of Tearing Mode Suppression Theory and Experiments from DIII–D (T. Luce)**
  - Complete stabilization of 3/2 during sawteeth
  - Effect of $\Delta'$ noted
  - ECCD current drive theory verified
  - Closed loop feedback operation demonstrated
    - ★ Next to investigate stabilization of 2/1

- **Steady State Electron ITB in Fully Non-inductive TCV Discharges (J. Lister)**
  - Strong ITB observed during ECCD
  - Incremental confinement of the third gyrotron power is ohmic

- **ECH Power Needed to Stabilize NTMs in ITER (G. Giruzzi)**
  - Upper port injection necessary, but sensitive to injection angle
  - Large toroidal angle (≥25°) leads to large gain in efficiency
  - Frequency tuning an alternative
  - The rough estimate is $P_{EC} \cong 30$ MW ± 50%
    - ★ Next more validation of model against experiment and 3D MHD simulation

- **Comparison of EU and RF Simulations of ECE Power for NTM Stabilization (A. Zronkov)**
  - Upper port ECCD more favorable by 30%
  - 30 MW of $P_{EC}$ is needed
    - ★ Next to perform optimization, noncircular tokamak effects, and compare with Giruzzi's model

- **Performance of the ITER-ECRF Launchers (B. Lloyd)**
  - Detailed calculation of ITER-ECRF upper launcher performed
  - BANDIT–3D code used
  - 20 kA may be driven from each launcher (8 MW) at r/a ~ 0.8
  - Sensitive to local $T_e$, rational surface location, geometry/steering range
    - ★ New system could be proposed

- **Comparison of Optimized ECCD for Different Launch Locations in a Tokamak Reactor Plasma (F.W. Perkins)**
  - $j_{cd}/j_{bs}$ should be regarded as a fundamental parameter
  - 20 MW, $\Delta\theta$ = 1.7° cone, computed ECCD levels comparable to NTM stabilization criteria
  - Stabilization of (2/1) NTM requires upper port launch
  - Principal uncertainty lies in equilibrium bootstrap current arising from density gradients

- **Simulation of NTM Stabilization by ECCD (N. Hayashi)**
  - 1.5 D tokamak simulation code (TOPICS)
  - $\Delta'(W)$ from cylindrical model
  - EC current moves the rational surface, tracking of rational surface location important
  - When detecting island center is difficult, high EC current and broad EC current profile are effective
    - ★ Next to vary island width, electron density, and mode number; study effect of polarization term and compare with experiment