Session Summary
and
Research Recommendations

Outline

- **Summaries of Contributions**
  - ***Progress in Divertor and SOL Studies in the MAST Tokamak***
    J-W. Ahn
  - ***First Results of NSTX Fast Divertor Camera***
    N. Nishino
  - ***Heat Flux and Radiated Power in the NSTX Divertor***
    S. Paul (post session)
  - ***Surface Conditioning Techniques and Their Effect in NSTX***
    C.H. Skinner
  - ***CDX-U Operation With a Liquid Lithium Limiter***
    R. Majeski
- **Research Recommendations**

• Boundary plasma research focus in MAST: ST physics, tokamaks, and ITER preparations

- **SOL width scalings: several dependencies on plasma parameters**
- **Importance of mirror force term in ST: $|\nabla_{//}B/B|$**
- **Far ranging radial efflux during ELMS: additional first wall erosion if exhibited in ITER**
- **ELM losses nearly 100% to LFS: in-out ratios in SND devices probably dominated by // transport in SOL**
- **ELM losses may be consistent with Cowley model: Non-linear superposition of ballooning modes**
- **Target power loading mitigated by divertor detachment and toroidal asymmetric divertor biasing**

First Results of NSTX Fast Divertor Camera

N. Nishino

• **Photron camera applied in the presence of NSTX fields: did not require fiber optic bundle; yielded very clear images**

- **Preliminary data with two views at rates up to 40,500 fps.**
- **Resolved in the divertor region that correlated with different types of ELM's as seen in the Dα signal**
- **These filamentary features resembled the striations etched on the divertor tiles**
- **Future work: Get images from midplane view simultaneously with those from the GPI camera, and attempt tomographic reconstructions of the structures they observe**

• Power flux to outer divertor is three times flux to inner divertor, radiated power is comparable to inner divertor

• 50% Higher divertor heat flux in L-mode than H-mode with same NBI power

• Dα up to five times brighter in inner divertor - partly due to gas injection on the high field side of the plasma

• Divertor detachment has not been clearly observed

• Main impurities: carbon and oxygen
No metallic impurity accumulation

• T_e profile in the edge/SOL is flat at ~ 20 eV and n_e profile has a very long decay length (~ 4 cm)

- High temperature bake-out (350°C) is clearly needed to expedite the removal of H_2O and CO from NSTX graphite PFC's

- Boronization using HeGDC with 90% He and 10% deuterated trimethylboron (TMB, I.e. $B(CD_3)_3$) enables significant improvement in plasma performance

- Daily HeGDC and inter-discharge HeGDC (5-10 min) are required for impurity and density control during high power operations

- TMB fueling experiments are showing promise for real-time maintenance of boron films and the effects of cladding the plasma in a low-Z mantle

- **Implementation of liquid lithium PFCs has been shown to be feasible**

- **Liquid lithium PFCs are found to reduce recycling and impurities**
  - **Enhanced tokamak performance**
  - **Effect still observed in CDX-U nearly a year after original Li loading**

- **Cleanup, recovery was straightforward**

- **A new tray was installed earlier this year**
  - **New filling technique to be implemented (PISCES-B group, UCSD)**
  - **New discharge cleaning techniques**

- **Proposed the extension of these experiments to a device with full lithium walls - the Lithium Tokamak eXperiment (LTX)**

Research Recommendations

- **<u>MAST / NSTX Comparisons</u>**
  - **Divertor Power Loading**
    - **Measure NSTX divertor loading with different powers to the SOL and different incident field angles, attempt to overlap with MAST regime**
  - **ELMS:**
    - **Determine if difference in NSTX ELMS is due to higher power to SOL**
  - **Detached Divertors**
    - **Determine if divertor detachment related to recycling area on inner divertor and importance of upstream source terms**
- **<u>Wall Conditioning</u>**
  - **Compare hot (350°C) and cold (24°C) Boronization of walls**
  - **Investigate the effectiveness of extensive Helium Discharge Conditioning to put walls into pumping state**
  - **Test Lithium Pellet Injection with pumping walls (e.g.,TFTR)**

Questions and Comments

Comment-1: The striations on the tiles probably came from CHI. The power density during ELM's is probably not sufficient to cause them.
Response-1: This could be right if it hasn't been seen on other machines. We may consider looking during CHI during the up coming run, but we have to think about the window coating issue.

Comment-2: Recommendation: Better characterizations of ELM's on MAST and NSTX are needed. It isn't clear what the differences really are between the two machines.
Response-2: Concur.