Neutral Atom, Molecule and Edge-plasma Modeling for ITER

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Accomplishments in the last three years....

Over the past three years, eleven refereed journal publications[1-11] have resulted in part from this grant. These can be arranged into three categories: (1) Erosion/re-deposition calculations of current machines and proposed designs, (2) Analysis of proposed long-pulse or burning plasma operating regimes, and (3) Analysis of neutral behavior in current experiments. Each paper is listed below along with a very short synopsis of the importance or significance of the work in each category. Since refereed work in significant journals is the purest distillation of written results, the entire papers are included after these brief descriptions.

A. Erosion / Re-deposition


This work carried on in conjunction with Dr. Jeff Brooks and Argonne National Laboratory has highlighted the difficulty in attached plasma regimes using a Be surface covering. At those attachment points erosion is unacceptably high and dooms the concepts. Carbon walls were shown to have too high of tritium retention in the co-
deposited layers. Only W had acceptable erosion lifetimes and contamination for the throat of the divertors on a machine such as ITER. Validation work to DIII-D was also described.

B. Burning Plasma or Long-Pulse Operating Regimes


These papers examined various operating regimes of ITER and TPX. In ITER it was shown that the completely detached solutions were unlikely to be obtained and indeed, they were abandoned as the most likely operating scenario in favor of the impurity enhanced semi-attached regime. In TPX the vertical target plate was shown to be superior for long-pulse neutral gas handling.

C. Neutral Behavior in Current Experiments


In TFTR, the importance of including the sputtered D atoms from the D-saturated carbon walls was shown. Doppler broadening spectra could not be matched without including this component, first envisioned as a modeling result. The positive effects of Li-conditioning was also explained and the D-alpha emission matched by conducting thorough neutral modeling.