Proposal and Attendance Form for NSTX Research Forum 2001

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Please write in the boxes below a one-page abstract of your proposal to be presented:

Title: Measurement of Toroidal Rotation Due to Tangential CT Injection

Abstract: Future burning plasma devices will not be able to use the toroidal momentum imparted to them by neutral beam injection, as neutral beams will not be needed for plasma heating. A fuelling system based on Compact Toroid injection could, in addition to fuelling the discharge, provide momentum to the burning plasma to induce toroidal rotation. However, a test to verify this rotation mechanism has never been conducted.

In a reactor, a CT injector will operate at about 10 to 20Hz injecting about 2.2mg toroids with a velocity of about 300km/s [R. Raman and P. Gierszewski, *Fusion Engineering and Design*, 39-40 (1998) pg. 977-985]. For the case of tangential CT injection, this is roughly equivalent to the momentum imparted to the plasma by a 500keV, 40MW neutral beam system. The NBI system will however inject only 5% of the fuel injected by the CT while consuming 20 times more power. These numbers become even more favorable for a ST based reactor as the corresponding toroidal field will be much lower than for a large aspect ratio tokamak. For example, the required CT energy density for NSTX is 2% of that needed for a similar cross-section machine operating at 2T.

The University of Washington has access to the CTF-II injector. This device was used to successfully fuel a 1.4T tokamak discharge. Several publications have resulted from work related to this injector including the above report commissioned by the ITER project as an ITER task. The device is capable of producing 20 to 200microgram CTs with velocities ranging from 100 to 300km/s. Tangentially injecting one CT should provide the equivalent of a 40ms, 1MW, 80keV NBI pulse, conditions that should be sufficient for measuring plasma rotation.

Other experiments that can also be conducted include:

1. Injection of CTs doped with other elements to study transport.

2. Injection of Argon CTs to determine if the torus discharge can be quenched on time scales faster than the time scales for a vertical displacement event. This is of relevance to quickly quenching a reactor plasma discharge in the event of an uncontrollable VDE.

3. Study of Magnetic Reconnection processes resulting from the injection of a magnetized CT into NSTX.

These experiments are applicable to STs and other conventional aspect ratio tokamaks. Most of them can be conducted in a piggy back mode at the tail end of a normal plasma discharge.

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