CURRENT DRIVE, HIGH PERFORMANCE, INSTABILITY CONTROL AND PLANS FOR THE DIII-D GYROTRON INSTALLATION*

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A multi-faceted experimental campaign has concluded on the DIII-D tokamak. In the area of evaluation of electron cyclotron current drive (ECCD) efficiency, a new technique was developed using EC injection modulated at 10 Hz to create a periodic response in the motional Stark effect polarimeter leading to a direct measurement of the spatial profile of the ECCD. Experiments on high performance operation were performed in which off-axis ECCD was used to adjust the current density profile. Discharges with about 60% bootstrap fraction were created in this way, which scaled to ITER operation at Q=5-10. Noninductive operation with ECCD was also demonstrated. Preemptive injection of EC power at the q=2 surface was successful at preventing initiation of the m/n=2/1 neoclassical tearing mode and studies were performed on the control of the ECCD profile width required for stabilization of both 2/1 and 3/2 NTMs once the instabilities had developed. A series of measurements of the efficiencies of the separate elements of the ECH transmission system and thermal performance of the articulating launchers was performed.

The gyrotron complex on the DIII-D tokamak was used for 34 weeks of operation during the last experimental period. The entire complex is now shut down for a year while the DIII-D tokamak and the ECH systems undergo major modifications. The principal projects underway during this period are: rotation of one of the neutral beam lines to inject counter to the plasma current; installation of a new divertor; acquisition and installation of three new 110 GHz gyrotrons with the present 1.0 MW, 10 s performance specification; and installation and testing of a single stage 110 GHz depressed collector gyrotron having >1.0 MW long pulse capability. Following the modifications, the ECH system will comprise six production gyrotrons, plus the depressed collector prototype and a Gycom gyrotron held in ready reserve. Of these, six gyrotrons will be available for experiments at one time using the six transmission lines and three dual launchers. At least one of the launchers is expected to be capable of real time fast spatial scans at the resumption of operations.

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