RECENT AND FUTURE UPGRADES TO THE DIII-D TOKAMAK

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Research on the DIII-D tokamak focuses on support for next-generation devices, such as ITER, by providing physics solutions to key issues, and advancing the fundamental understanding of fusion plasmas. To support these goals, the DIII-D facility is planning a number of upgrades to provide the needed plasma control and diagnostic measurement capabilities. In the neutral beam system, an additional ion source was recently brought on line, providing an additional 2.5 MW of plasma heating for a total beam-heating capability of approximately 20 MW. Also, one of the neutral beamlines is currently being modified to enable injection of 5 MW of beam power at an angle to the horizontal of up to 16.5° for off-axis current drive experiments. The electron cyclotron heating (ECH) system has recently completed the commissioning of a sixth gyrotron and is using new launcher controls that enable real-time poloidal motion by the plasma control system. A 1.2 MW depressed collector gyrotron is being added in 2011 and a higher power 1.5 MW tube is also planned. A new launcher incorporating mirrors with higher power and pulse capability will be used, along with higher efficiency transmission line components. The fast wave heating system plans to increase the transmitter output for two of the three transmitters by 50% up to 2 MW from each launcher in future experiments. In addition, an upgraded reflectometer is planned for improved understanding of the antenna loading and new diagnostics are planned for better arc detection. Inside the vacuum vessel, new control coils are being mounted on the centerpost wall to further investigate the stabilization of edge localized modes and other MHD instabilities. The coils will also be used in experiments to investigate the H-mode transition, density pump-out, and non-resonant magnetic perturbations. The extensive suite of diagnostics on DIII-D is being upgraded as well, with the recent addition of a new fast ion loss detector (FILD) to look at escaping fast ions, a new fast ion D_α (FIDA) system that measures the population of fast ions in the core of the discharge, a 320 channel electron cyclotron emission imaging (ECEI) system that can detect small perturbations in the electron temperature in the plasma core and two new Doppler backscattering systems that can identify flows and rotation within plasma density fluctuations. Future diagnostics planned include a visible and infrared periscope system for viewing the heat flux to the wall, 10 additional chords of Thomson scattering to diagnose the pedestal width in the separatrix region, and an additional FILD detector. The plasma control system has recently upgraded to a cPCI-based digital and analog I/O system and algorithms have been developed for feedback control of the ECH power deposition location during the discharge and control of a column of runaway electrons. A more detailed description of these DIII-D system upgrades and the new tokamak physics research capabilities they allow will be presented.

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