RECENT RESULTS FROM THE DIII–D TOKAMAK*

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The goal of the DIII–D program is to provide the integrated physics basis for commercially attractive steady-state fusion power plants. Our program is directed at developing advanced operating scenarios that provide increased fusion power density, improved power and particle handling of the divertor, and to demonstrate non-inductive current drive optimizing bootstrap current utilization. Recent work has made significant progress in all these areas and in the development of diagnostics and technology critical to the achievement of these goals and to the design of future devices. In the area of advanced operating scenarios, we have identified some of the features that contribute to better performance including control of the plasma shape, toroidal current profile, wall stabilization, and bulk plasma rotation and shear in the rotation and E_r profiles. One of the more promising scenarios is a second stable core VH–mode with low central shear in the safety factor. Experimentally, this discharge has been obtained with simultaneous values of high normalized β [$\beta_N = \beta/(I/aB)$ = 4.9%-m-T/MA] and a high confinement enhancement factor ($H = \tau_E/\tau_{ITER-89P}$=4). Fully non-inductively driven 600 kA VH–mode discharges have also been obtained at high q with over 60% bootstrap current fraction. The divertor research has focused on developing particle control, He ash removal, improved power handling capability, and improved characterization and modeling of the divertor plasma. Active pumping of the divertor region using an in-situ toroidal cryopump has demonstrated effective exhaust of both central and edge He. Cryopump operation has also successfully reduced the gas inventory in the walls and controlled plasma density in H–mode. The simultaneous reduction of heat flux to the divertor plates, density control, and H–mode confinement has been achieved by D_2 gas injection. Neon injection experiments are also in progress. An expanded research effort on disruption characterization and avoidance is also underway. Detailed measurements of the current profile, density and temperature profiles, halo current distribution, heat flux to the first wall and divertor, and ion energy have been obtained during disruptions. New device hardware and diagnostics have been added to improve our experimental capability. A six-section saddle coil for reducing error fields has been installed and has permitted stable operation at significantly lower plasma density. Real time measurements of the central q have been achieved using Motional Stark Effect measurement of internal magnetic field. The diagnostic set has been expanded and a pellet injector has been installed to complement both the divertor program and the study of basic transport processes. Work is in progress on the design of a radiative divertor to provide strong pumping and reduced heat flux to the divertor plates in a highly triangular plasma shape.

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