PHYSICS OPERATIONS WITH THE DIII-D PLASMA CONTROL SYSTEM

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The DIII-D device began operation in 1986, and a fully digital plasma control system (PCS) [1] utilizing two parallel CPUs running a Linux kernel modified in-house for real-time operation was implemented in 1995. Over time, the success of the PCS in exploiting the inherent versatility of the DIII-D device led to a philosophy of using the PCS to control all available plasma system actuators. Demand has increased the PCS size to 19 CPUs. This has made the PCS a very powerful physics tool that is at the core of physics operations at DIII-D. We will provide an overview of the many systems (plasma shaping coils, auxiliary heating and momentum input systems, fueling systems, magnetic error field control, etc) managed by the PCS and the ways they can be utilized to further plasma physics research. The complexity of the DIII-D device and all the systems the PCS must control makes proper setup of the PCS for new experiments a daunting task. A cadre of physicists specially trained in PCS operation forms the Physics Operations staff at DIII-D. They are the interface between experimental plans and successful execution, and as such are a critical component of each experiment. We will briefly examine some of the tools and procedures physics operations uses to explore new ground, such as the TokSys control design and modeling environment, and the “smart” PCS setup checklist, which greatly reduces human error in reconfiguring the PCS for a new experiment. Finally, we will discuss some of the human elements of control room interactions between the three main operational components at DIII-D: the physics operator, who is specially trained in PCS operation, the session leader, who leads the experimental effort, and the chief operator, who is charged with the operation and safety of all hardware systems.

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[1] J.R. Ferron, et al., “A Flexible Software Architecture for Tokamak Discharge Control Systems,” Proc. of the 16th IEEE/NPSS Symp. on Fusion Engineering, Champaign, Illinois (Institute of Electrical and Electronics Engineers, Inc., Piscataway, 1996) Vol. 2, p. 87