Faster Fusion Science Computing Using Grid-Based Resources

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The National Fusion Collaboratory Project: http://www.fusiongrid.org/project/
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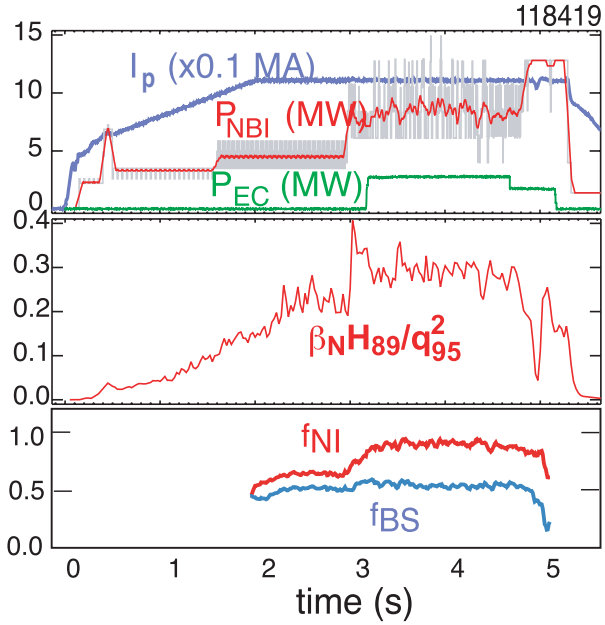
The code TRANSP, used for time dependent analysis and simulation of tokamak plasmas, is now only available as a FusionGrid service. This grid-based computational service is being used to support the Advanced Tokamak program at the DIII-D National Fusion Facility with the goal of developing the scientific basis for steady-state, high-performance operation in future devices such as ITER. Recent experiments combined with grid-based data analysis have demonstrated plasmas with nearly noninductive current (f_{NI}) limited in duration only by available hardware. These plasmas had a normalized fusion performance ($\beta_N H_{89}/q_{95}^2 \approx 0.3$) consistent with the requirement for ITER's steady-state operation. The modeling tools that were successfully employed to devise experiments in DIII-D have been applied to ITER indicating full noninductive operation is plausible for ITER's steady state scenario.

Running on a Linux cluster at Princeton Plasma Physics Laboratory (PPPL), this FusionGrid service has performed over 4200 simulations taking over 10,000 CPU hours for 10 different experimental fusion devices including two European sites. Deployment of TRANSP on FusionGrid frees scientists from the need to build and maintain local versions of a large and complex code, and at the same time, eases the burden on the code development team, which was previously required to provide support on a highly heterogeneous set of remote machines. Both the input data and output data of TRANSP is securely written and read from MDSplus data repositories. Monitoring and tracking of these runs has been accomplished through the deployment of FusionGrid's Monitoring System (FGM), which allows for asynchronous tracking of multiple Grid applications, and to provide logfile access through anonymous FTP. Detailed scientific information on the progress of each run can also be obtained graphically via FGM.



Utilizing FusionGrid's TRANSP computational service, data analysis has confirmed a nearly full non-inductive current (including 60% self-generated) operation with duration only limited by hardware. Diagnostic measurements of this DIII-D plasma confirm completely stationary operation at fusion performance levels required for ITER's steady state operation. Accepted for publication in Nuclear Fusion.