PPPL and General Atomics Team Up to Make TRANSP Widely Available

Plasma transport analysis, which is the study of how plasma particles, heat and momentum drift across magnetic field lines, is a necessary first step for understanding how well fusion reactors are performing. Teams of scientists from the Princeton Plasma Physics Laboratory (PPPL) and General Atomics (GA) have joined forces to bring PPPL's premier transport code TRANSP to beginning users and experts alike. Using the workflow manager OMFIT[1] developed by GA scientists, the team has created a TRANSP module that streamlines the data preparation for TRANSP analysis and also couples TRANSP to other widely used software. "From a technical point of view, OMFIT is a workflow manager that can couple physics codes, execute them in complex workflows, and provide them with streamlined interfaces", states GA's Orso Meneghini (photo). "Perhaps more importantly," he adds, " OMFIT is a growing community effort, which is gathering the contribution of many physicists across domestic and international institutions, and is supporting the research of over two hundred scientists worldwide."

In recent years, the number of TRANSP users on DIII-D at General Atomics has expanded dramatically from a handful to nearly 40 researchers by the end of 2016. While most are new users, legacy users have also migrated to the OMFIT platform. "What used to be a complex and cumbersome process to generate TRANSP runs that was mastered by only a few has now become available to all users with powerful and intuitive drivers and visualizations," says Brian Grierson (photo), a PPPL researcher on DIII-D who developed the TRANSP module in OMFIT, along with Shaun Haskey and Nikolas Logan, both of PPPL. "Through OMFIT, we have developed a community based platform for developing scientific analysis software, where expert users can develop and oversee critical physics analysis and have the results available for the wider community," says Logan.

The work by PPPL and General Atomics is rapidly paying off. Multiple scientists presented TRANSP analysis results obtained through OMFIT at the recent IAEA

Fusion Energy Conference in Kyoto, Japan. “I used the new OMFIT workflow to efficiently analyze transport in an ITER-like DIII-D discharge with TRANSP,” states Chris Holland of the University of California, San Diego. “The TRANSP output and uncertainty analysis was then used as input for massively parallel multi-scale GYRO simulations.” The new TRANSP interface in OMFIT has already been used to study fusion plasmas in the U.S.-based tokamaks DIII-D, National Spherical Torus Experiment (NSTX) at PPPL, and Alcator C-Mod at MIT. The interface is now being employed in fusion experiments in Europe and Asia.

While TRANSP analysis of international tokamaks has been possible for over thirty years, the new interface through OMFIT has produced a new user base, modern visualization (Fig. 1) and increased productivity. “We set out to make TRANSP data preparation and post-processing run the same on any tokamak, and this has fostered collaboration across institutions worldwide,” Grierson says.

[1] http://gafusion.github.io/OMFIT-source/

Acknowledgement: Supported by DOE DE- AC02-09CH11466 (Princeton University), and DE-FC02- 04ER54698 (DIII-D) DE-FG02-95ER54309 (General Atomics Theory) and DE-SC0012656 (General Atomics AToM SciDAC). DIII-D data shown in this paper can be obtained in digital format by following the links at **ttps://fusion.gat.com/global/D3D_DMP.**

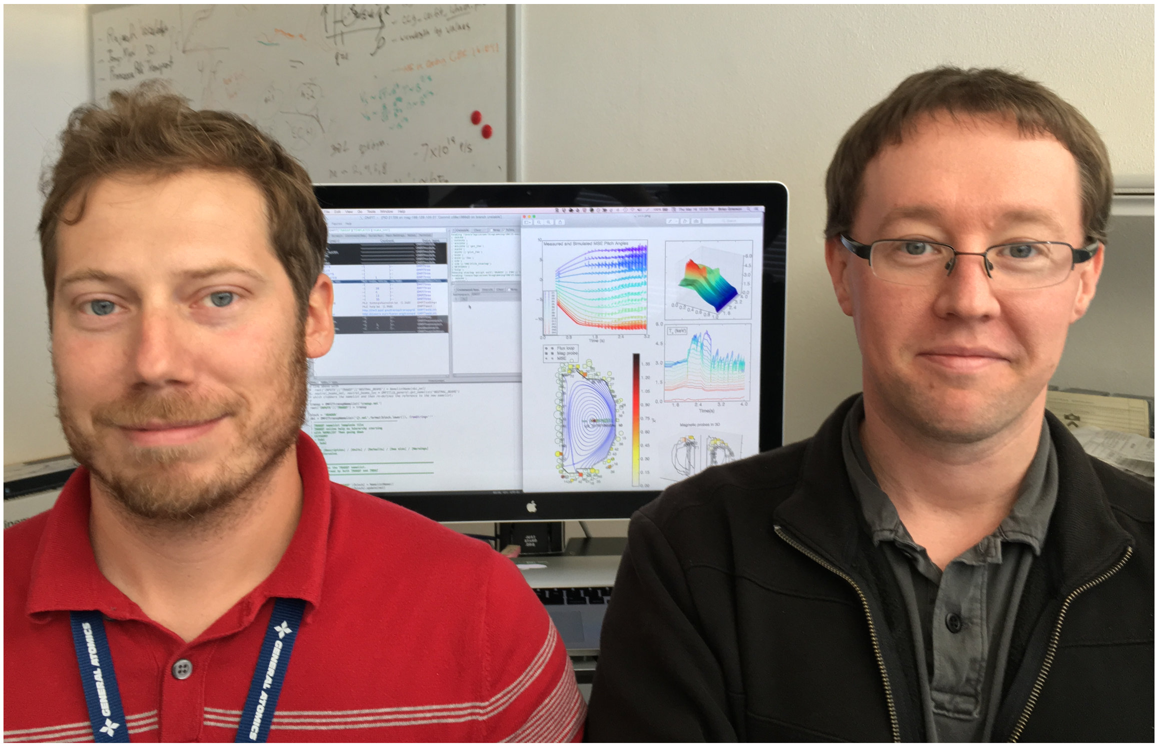

Photo: Dr. Orso Meneghini of General Atomics (left) and Dr. Brian Grierson of Princeton Plasma Physics Laboratory (right) viewing output from TRANSP compared to DIII-D tokamak data (Photo Credit: Shaun Haskey)

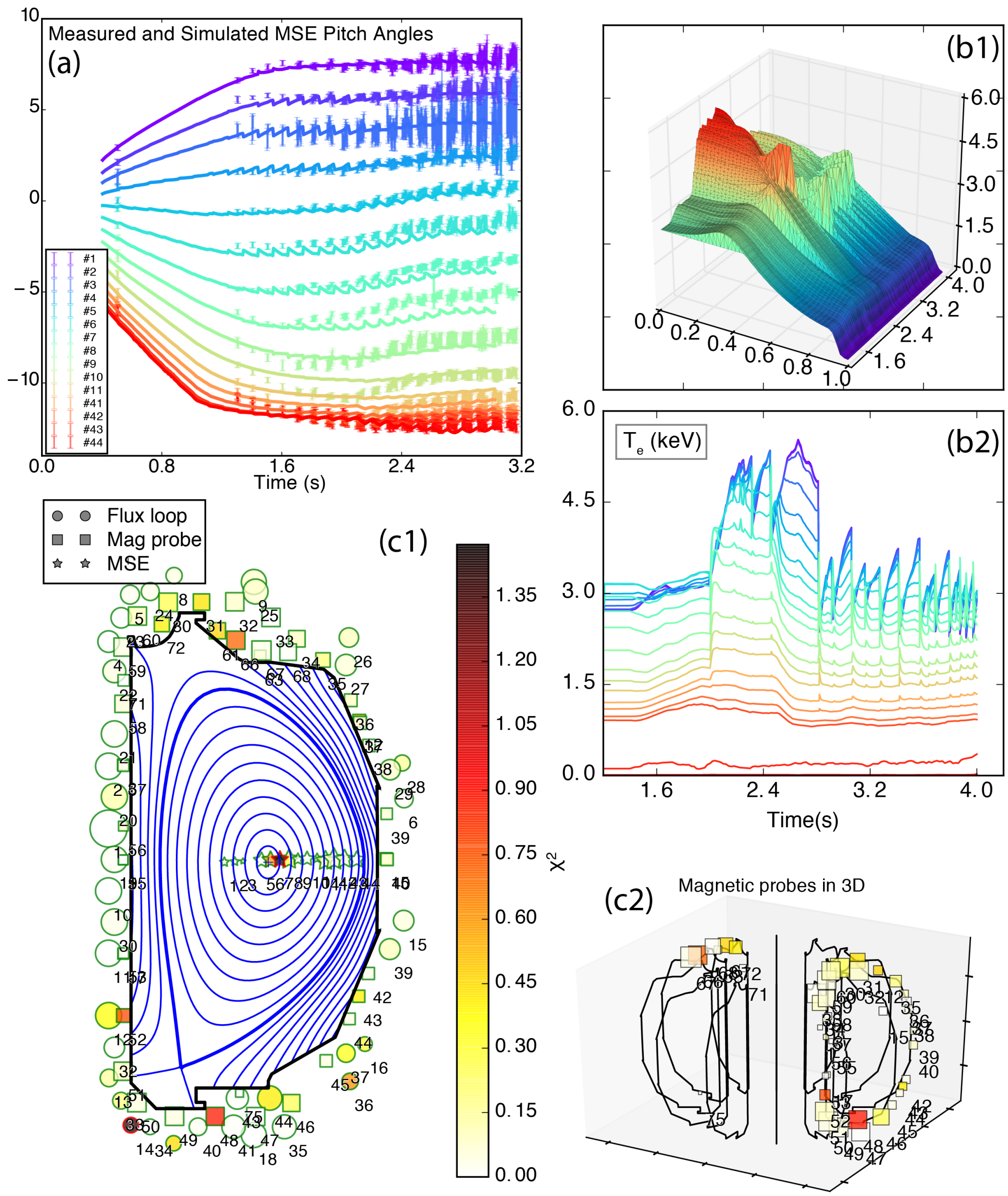

Fig. 1 Visualization of tokamak measurements and TRANSP simulations of DIII-D through OMFIT. Shown are (a) measurements and TRANSP simulations of magnetic pitch angles, (b1,b2) visualization of the electron temperature profile undergoing "sawtooth" oscillations in a TRANSP simulation and (c1,c2) location and fit quality χ^2 of a kinetic magnetic equilibrium constrained by TRANSP pressure profile.