Plasma Surface Interactions

Bridging from the Surface to the Micron Frontier through Leadership Computing

This project is complete. We have a new SciDAC-4 project that builds on this work: Plasma Surface Interactions: Predicting the Performance and Impact of Dynamic PFC Surfaces

Project Summary

Gaining physics understanding and predictive capabilities to describe the evolution of plasma facing components (PFC) requires simultaneously addressing complex and diverse physics occurring over a wide range of length and time scales, as well as integrating extensive physical processes across the plasma - surface - bulk materials boundaries. This requires development not only of detailed physics models and computational strategies at each of these scales, but computer science algorithms and methods to strongly couple them in a way that can be robustly validated through comparisons against available data and new experiments. Therefore, the objective of this project is to develop robust, high-fidelity simulation tools capable of predicting the PFC operating lifetime and the PFC impact on plasma contamination, recycling of hydrogenic species, and tritium retention in future magnetic fusion devices, with a focus on tungsten based material systems. Deploying these tools requires the development of a leadershipscale computational code, as well as a host of simulations that span the multiple scales needed to address complex physical and computational issues at the plasma - surface interface and the transition below the surface where neutron damage processes in the bulk material dominate behavior in multiple-component materials systems. Successful development will enable improved prediction of PFC performance needed to ensure magnetic fusion energy development beyond ITER.

Team

	Institution	Principal Investigator	Additional Participants
Argonne NATIONAL LABORATORY	ANL	Barry Smith (bsmith@mcs.anl.gov)	Shashi Aithal, Danqing Wu *Alumni:* Milad Fatenejad (U Chicago), Jungho Lee, Vijay Mahadevan, Tim Tautges
GENERAL ATOMICS DIII-D NATIONAL FUSION FACILITY	GA/DIII-D	Phil Snyder (snyder@fusion.gat.com)	Rui Ding, Houyang Guo, Adam McLean (LLNL on assignment at DIII-D) *Emeriti:* Vincent Chan
Los Alamos NATIONAL LABORATORY EST. 1943	LANL	Xianzhu Tang (xtang@lanl.gov)	Jim Ahrens, Sham Bhat, David Higdon, Li-Ta "Ollie" Lo, Danny Perez, Luis Sandoval, Arthur Voter, Blas Uberuaga
OAK RIDGE National Laboratory	**ORNL***	**Brian D. Wirth* (wirthbd@ornl.gov)**	Alexander "Sasha" Barashev, David E. Bernholdt, John Canik, Ozgur Cekmer, Ane Lasa, Philip C. Roth, German D. Samolyuk *Alumni:* Stanislav Golubov, Crystal Jernigan, Jeremy Meredith, Roger Stoller *Emeriti:* Jay Jay Billings, Sophie Blondel (now at UTK)
Pacific Northwest NATIONAL LABORATORY	PNNL	Rick Kurtz (rj.kurtz@pnnl.gov)	Howard Heinisch, Giridhar Nandipati, Kenny Roche, Wahyu Setyawan
UCSanDiego	UCSD	Sergei Krasheninnikov (skrash@mae.ucsd.edu)	Jerome Guterl, Roman Smrinov
ILLINOIS	UIUC	David Ruzic (druzic@uiuc.edu) and Davide Curreli (dcurreli@illinois.edu)	Jon Drobny, Peter Fiflis, Kishor Kalathiparambil, Kyle Lindquist, Ivan Shchelkanov
UMASS AMHERST	UMass	Dimitrios Maroudas (maroudas@ecs.umass.edu)	Lin Hu
MU	U Missouri	Karl Hammond (hammondkd@missouri.edu)	Ian Naeger, Zhuocen Yang, James Gentles, Ashton Rohrich, Derek Ruff *Alumni:* Chase Skawinski, Gabriel Ort, Marissa Zirges

	U Tennessee - Knoxville	Brian Wirth (bdwirth@utk.edu)	Sophie Blondel, Mary Alice Cusentino, Tim Younkin *Alumni:* Eric Yang, Donghua Xu *Additional UTK collaborators are supported through the OFES Fusion Materials Program.*

* Lead Institution and Lead Principal Investigator

Sponsor

This project is part of the Scientific Discovery through Advanced Computing (SciDAC) program, and is jointly sponsored by the Fusion Energy Sciences (FES) and Advanced Scientific Computing Research (ASCR) programs within the U.S. Department of Energy Office of Science. The period of performance is 2012-08-01/2017-07-31.

Key Partners

Program or Sponsor	Project	PSI Point(s) of Contact	Partner Point(s) of Contact
SciDAC Institutes	FASTMath – Frameworks, Algorithms, and Scalable Technologies for Mathematics	Barry Smith (ANL), Vijay Mahadevan (ANL)	
	QUEST – Quantification of Uncertainty in Extreme Scale Computations	David Higdon (LANL) Sham Bhat (LANL)	Omar Knio (Duke), Habib Najm (SNL)
	SUPER – Institute for Sustained Performance, Energy and Resilience	Phil Roth (ORNL)	
	SDAV—Scalable Data Management, Analysis and Visualization	Jim Ahrens (LANL), Jeremy Meredith (ORNL)	
DOE Fusion Energy Sciences	Plasma-Surface Interactions Science Center	Brian Wirth (ORNL/UTK)	Donghua Xu, Zhangcan "Eric" Yang
International Atomic Energy Agency	IAEA Coordinated Research Program on Plasma-Wall Interactions with Irradiated Tungsten and Tungsten Alloys in Fusion Devices, 2013-2017	Brian Wirth (ORNL/UTK)	B.J. Braams (IAEA)

Getting Access to this Wiki

New participant in the project? Forgot your password? Follow these instructions.