

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

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Sponsor

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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)

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