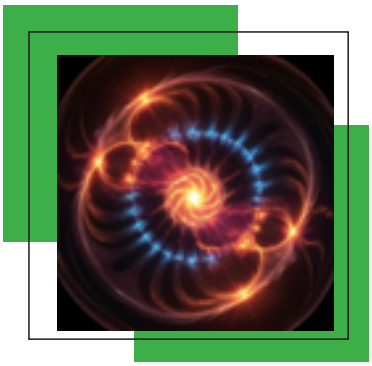
institute for pure & applied mathematics

Multi-Fidelity Methods for Fusion Energy



March 9- June 12, 2026

Scientific Overview

The pursuit of fusion energy as a clean and virtually limitless power source has gained renewed momentum, particularly following significant advancements in inertial confinement fusion and magnetic fusion energy technologies. Recent experiments have demonstrated the potential for producing more energy than consumed through nuclear fusion, prompting substantial investments from the U.S. federal government and the private sector. However, the realization of commercially viable fusion power faces substantial mathematical and computational challenges. Current high-fidelity kinetic models, while effective in balancing physics and predictive capabilities, demand immense computational resources, making them impractical for essential tasks like real-time plasma control and experimental design. Multi-fidelity methods that tightly integrate both high-fidelity and lower-fidelity models to optimize computational efficiency while maintaining physical accuracy, promise to be game-changing. These methods are essential for tasks like uncertainty quantification and design optimization, which are crucial for rapid progress in fusion research.

This IPAM Long Program aims to unite mathematicians, physicists, computer scientists, and engineers to collaboratively tackle the challenges and opportunities presented by multi-fidelity modeling in fusion energy research. By leveraging the common language of mathematics, the workshop seeks to expand the community of mathematicians engaged in fusion energy, bringing together areas such as nonlinear dynamics, numerical analysis, machine learning, and uncertainty quantification. The program will provide a platform for sharing knowledge and innovations, ultimately striving to build a multidisciplinary community capable of advancing fusion energy towards practical implementation.

Long Program Schedule

- Opening Day: March 9, 2026
- Multi-Fidelity Methods for Fusion Energy Tutorials : March 10-13, 2026
- Workshop I: Multi-Fidelity Methods for Fusion Plasma Physics : March 23-26, 2026
- Workshop II: Learning Models from Data for Multi-Fidelity Fusion Plasma Physics : April 13-17, 2026
- Workshop III: Fusion Device Design and Engineering : May 4-8, 2026
- Workshop IV: Multi-Fidelity Methods to Enable Robust Optimization and Real-Time Control of Fusion Processes : May 18-22, 2026
- Multi-Fidelity Methods for Fusion Energy Culminating Retreat at Lake Arrowhead : June 7-12, 2026

Organizers

Emily Belli (General Atomics)
Jonathan Citrin (DeepMind)
Ionut Farcas (Virginia Tech)
Jeffrey Hittinger (Lawrence Livermore National Laboratory)
Lise-Marie Imbert-Gerard (University of Arizona)
Frank Jenko (Max Planck Institute for Plasma Physics)
Elizabeth Paul (Columbia University)
Benjamin Peherstorfer (New York University)
Cristina Rea (MIT)
Tim Wildey (Sandia National Laboratories)

Particpation

You may apply for financial support to participate in the entire fourteen-week program, or a portion of it. We prefer participants who stay for the entire program. Applications will be accepted through **October 10, 2025**, but offers may be made up to one year before the start date. We urge you to apply early. Mathematicians and scientists at all levels who are interested in this area of research are encouraged to apply for funding. Supporting the careers of women and minority researchers is an important component of IPAM's mission and we welcome their applications. More information and an application is available online.

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For more information, visit the program webpage:
www.ipam.ucla.edu/mfe2026