UCLA Department of Physics & Astronomy

COLLOQUIUM

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Introduction to the physics basis for burning plasmas in tokamaks: turbulent-transport

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The new strategic plan developed by the US scientific plasma physics and fusion community moves aggressively toward the deployment of fusion energy. The mature physics basis for net-energy tokamaks, recent technological innovations, and a burgeoning $2 billion-dollar industry have opened the door for the US to build a fusion pilot plant by the 2040s. In particular, the ability to predict turbulent-transport in tokamak plasmas has improved dramatically in just the last five years. This is thanks to new modeling tools, but also, to a multi-decade-long vision that emphasized direct fluctuation measurements and comparisons with state-of-the-art first-principles simulations, with leadership from UCLA. This seminar will introduce the physics basis for burning plasmas in tokamaks. A brief review of the nuclear physics and plasma physics relevant for net-energy fusion devices, and the fundamentals of tokamak confinement, will be presented in a manner accessible to advanced undergraduate students and first-year grad students. Then several exemplary transport model validation efforts led by students and scientists at UCSD, MIT and General Atomics will be described in detail, to illustrate how such studies directly influence the development of high-fidelity reduced transport models that are being used to predict fusion performance in the ITER and SPARC tokamaks; and will ultimately be used to help design a fusion pilot plant in the US.