

PCMS: A Geometry and Discretization Aware Multi-physics Coupling Tool for Fusion Devices

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Coupling of fusion device codes to engineering analysis codes present unique challenges in the physical and temporal scales the computations must take into account, range of coordinate systems, high dimensionality of phase space, and geometric complexity. These challenges require new approaches that enable efficient coupling on exascale supercomputers and afford adherence to physical constraints such as conservation of moments that are required for stable coupling schemes. In this talk, we introduce developments in the Parallel Coupler for Multimodel Simulation (PCMS) to support physics preserving coupling of fusion codes (e.g., neutrals, gyrokinetic microturbulence, neutronics) to each other and to traditional engineering analysis codes such as finite elements. Key aspects include the handling of geometries ranging from engineering and parameterized CAD models to physics-based geometries such as DESC, VMEC, and geqdsk. Additional features include the handling of conservative field transfer methods in up to five dimensions and dealing with the distributed coordination and control of partitioned, exascale simulations. In addition to presenting an overview of the key functionalities in PCMS, this talk will demonstrate specific example couplings achieved.

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