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Development of a scalable 3D full wave RF simulation (1): Petra-M platform[1] S. SHIRAIWA, PSFC, MIT, N. BERTELLI, E.-H. KIM, G.J. KRAMER, PPPL, C. LAU, ORNL, A. SELTZMAN, PSFC, MIT, B. VAN COMPERNOLLE, UCLA, J. C. WRIGHT, S. WUKITCH, PSFC, MIT, X. YANG, TAE Technologies, RF SCIDAC TEAM — In this and the following paper, we discuss the recent progress in developing the scalable 3D full wave RF simulation in the RF SciDAC center. A goal of the center is to develop an integrated RF full wave simulation to accurately predict RF actuator performance. Such a simulation needs to include 1) RF wave propagation/absorption physics in hot core region, 2) SOL turbulence effects on the wave propagation 3) interactions with background plasma profiles, and 4) RF rectified potential formation and resultant impurity generation in a seam-less, integrated manner. As the simulation model involves multi-physics coupling in the complicated 3D SOL geometry, a highly scalable RF wave field solver is required. Petra-M (Physics equation translator for MFEM) is an open source FEM analysis platform based on the scalable MFEM finite element library, allowing for FEM analysis from geometry/mesh generation, FEM assembly, equation solution, and visualization. Petra-M has been used for modeling various RF plasma wave problems in fusion devices including C-Mod, DIII-D, LAPD, and NSTX. It is also used on non-RF problems, such as the quench dynamics on HTS magnets. In this paper, we discuss the code structure and various capabilities Petra-M provides.

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