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Experimental Inference and Simulations of Impurity Transport in High-Performance Tokamak Plasmas[1] FRANCESCO SCIORTINO, NATHAN T. HOWARD, EARL S. MARMAR, TOMAS ODSTRCIL, PABLO RODRIGUEZ-FERNANDEZ, NORMAN M. CAO, JOHN E. RICE, YOUSSEF M. MARZOUK, Massachusetts Institute of Technology, MATTHEW L. REINKE, Oak Ridge National Laboratory, C-MOD TEAM — High performance tokamak operation is strongly constrained by the purity of core plasmas. This motivates model validation across multiple transport channels to understand the behavior of heavy ions. We present novel methods to obtain impurity transport radial diffusion and convection coefficients using Bayesian inference via nested sampling in high-dimensional and multi-modal parameter spaces. Fully-marginalized Bayesian estimates are obtained with free knot locations and nuisance parameters that reduce reliance on uncertain experimental details. We compare EDA H-mode and I-mode high-performance scenarios with an L-mode discharge in Alcator C-Mod. In these experiments, trace amounts of calcium (Z=20) were introduced with laser blow-off injections and diagnosed via measurements of Ca17+/18+ emission. To interpret data, the STRAHL impurity transport code [Dux PPCF 2003] was optimized for iterative operation, resulting in fundamental advantages in parallel execution and additional physics fidelity in sawtoothing discharges. Bayesian model selection and uncertainty quantification enable improved comparison of experimentally-inferred transport with neoclassical NEO [Belli PPCF 2008], as well as turbulent TGLF [Staebler PoP 2007] and CGYRO [Candy JCP 2016] simulations.

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