Using predictions from gyrokinetic simulations to guide design of experiments in tokamaks and stellarators

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Linear and nonlinear gyrokinetic simulations are often used after an experiment to compare qualitatively and quantitatively with measured turbulence and transport. All extensive validation efforts, e.g. Holland PoP 2009, Told PoP 2012, Goerler PoP 2014, and Howard NF 2016, have been carried out via this interpretive process, with simulations being run after the experiments. This presentation seeks to gather and summarize several efforts by authors who have run linear and nonlinear gyrokinetic simulations before the experiments, in a predictive manner, to guide the selection of experimental conditions or to constrain the design and construction of new diagnostic systems. In addition, it has been possible to run linear gyrokinetic simulations or reduced models in-between-shots to help determine the experimental session leader's next steps, based on the real frequency/growth rate analysis. This predictive work has been carried out to different degrees at AUG, C-Mod, DIII-D, NSTX-U, W7X, and other machines. These predictive efforts can be extremely valuable as they have the potential to provide stringent tests of transport models, and also help session leaders conduct detailed turbulence experiments more efficiently and successfully. Research supported by the US DOE under grants DE-SC0006419 and DEFC02-99ER54512-CMOD.