Title: **Multilevel Monte Carlo for Bayesian Inference**

Abstract: For half a century computational scientists have been numerically simulating complex systems. Uncertainty is recentbecoming a requisite consideration in complex applications applications across science and engineering which have been classically treated deterministically. This has led to an increasing interest in recent years in uncertainty quantification (UQ). Another recent trend is the explosion of available data. Bayesian inference provides a principled and well-defined approach to the integration of data into an a priori known distribution. The posterior distribution, however, is known only point-wise (possibly with an intractable likelihood) and up to a normalizing constant. Monte Carlo methods have been designed to sample such distributions, such as Markov chain Monte Carlo (MCMC) and sequential Monte Carlo (SMC) samplers. Recently, the multilevel Monte Carlo (MLMC) framework has been extended to some of these cases, so that numerical approximation error can be optimally balanced with statistical sampling error, and ultimately the Bayesian inverse problem can be solved for the same asymptotic cost as solving the deterministic forward problem. This talk will concern the recent development of various MLMC algorithms for Bayesian inference problems, which arise from one of three primary strategies. This class of algorithms are expected to become prevalent in the age of increasingly parallel emerging computer architectures, where resilience and reduced data movement will be crucial algorithmic considerations. These methods are prototypical of a general trend of convergence between statistics and mathematics in computational science. Some thoughts on the future work in these subject areas in connection to the new paradigm of data-intensive science will also be discussed.

Bio: Kody J.H. Law is a professor of Applied Mathematics at the School of Mathematics at the University of Manchester and fellow of The Alan Turing Institute, specializing in computational applied mathematics. He received his PhD in Mathematics in 2010 from the University of Massachusetts, Amherst, and subsequently held positions as a postdoc at the University of Warwick, and senior mathematician at King Abdullah University of Science and Technology and Oak Ridge National Laboratory. He has published in the areas of computational applied mathematics, physics, and dynamical systems. His current research interests are focused on the fertile intersection of mathematics and statistics; in particular, inverse uncertainty quantification: data assimilation, filtering, and Bayesian inverse problems.