1154-70-2645 **Jiequn Han***, Fine Hall 1007, Washington Road, Princeton, NJ 08544, and **Chao Ma**, **Zheng Ma** and **Weinan E**. *Uniformly Accurate Machine Learning Based Hydrodynamic Models for Kinetic Equations.*

A new framework is introduced for constructing interpretable and truly reliable reduced models for multi-scale problems in situations without scale separation. Hydrodynamic approximation to the kinetic equation is used as an example to illustrate the main steps and issues involved. To this end, a set of generalized moments are constructed first to optimally represent the underlying velocity distribution. The well-known closure problem is then solved with the aim of best capturing the associated dynamics of the kinetic equation. The issue of physical constraints such as Galilean invariance is addressed and an active learning procedure is introduced to help ensuring that the data set used is representative enough. The reduced system takes the form of a conventional moment system and works regardless of the numerical discretization used. Numerical results are presented for the BGK (Bhatnagar–Gross–Krook) model and binary collision of Maxwell molecules. We demonstrate that the reduced model achieves a uniform accuracy in a wide range of Knudsen numbers spanning from the hydrodynamic limit to free molecular flow. (Received September 17, 2019)