Abstract Submitted
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Cascade of kinetic energy and scalar variance in DC electrokinetic turbulence[1] WEI ZHAO, Northwest University, GUIREN WANG, University of South Carolina — Turbulent flow can be generated by DC electrokinetic (EK) force based on the electric conductivity and permittivity variations in fluids, as have been demonstrated by Varshney et al (2016), where a -1.4 slope of velocity power spectrum is observed. Here, we theoretically found the scaling exponents of velocity and scalar structures in the electric-body-force (EBF) dominant subregion of DC EK turbulence were 2/5 (equivalent to the -7/5 slope of velocity power spectrum) and 4/5 respectively. The theory perfectly explains the experimental results of Varshney et al. (2016). Based on Kármán-Howarth equation with forcing terms, the energy cascade process of DC EK turbulence was also investigated. Depending on the electric Rayleigh number (Ra_e), two different energy cascade processes may happen. When Ra_e is small, the kinetic energy cascades along inertial subregion and EBF dominant subregion in sequence, before it is dissipated by fluid viscosity. When Ra_e is sufficiently large, the inertial subregion may be absent with EBF dominant subregion left. This investigation is very important on understand EK turbulence, which could be widely existed in nature and applied in engineerings.

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