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Statistical Mechanics of Porous Media Flow

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Message from the Guest Editors

Flow in porous media is driven process, and therefore a non-equilibrium one in the statistical mechanical sense. Yet, in many cases it has common features with equilibrium systems: For instance, the steady states in immiscible fluid flows continuously explore a large configuration space and gives rise to well-defined averages. This makes it possible to formulate a statistical mechanics starting from the pore-scale, rather than the molecular or atomic scale, at which the microstates in traditional statistical mechanics are described. Recently, this has been done using concepts from Shannons information theory.<false,>Also, processes that gives rise to entropy production in the classical sense include mixing, viscous dissipation and the evolution of active matter populations. Characterizing such entropy producing systems may yield Onsager reciprocity relations for the viscous cross-coupling between two immiscible fluids, or the symmetry of dispersion tensors. Transport processes within porous media, such as the growth of bacterial cultures may yield analytical solutions based on the link between Langevin and Fokker-Planck equations.

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Message from the Editor-in-Chief

The concept of entropy is traditionally a quantity in physics that has to do with temperature. However, it is now clear that entropy is deeply related to information theory and the process of inference. As such, entropic techniques have found broad application in the sciences.

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