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Simulating anomalous transport and multiphase segregation in porous media with the Lattice Boltzmann Method

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Many hydrodynamic phenomena ranging from flows at micron scale in porous media, large Reynolds numbers flows, non-Newtonian and multiphase flows have been simulated on computers using the lattice Boltzmann (LB) method. By solving the Lattice Boltzmann Equation on unstructured meshes in three dimensions, we have developed methods to efficiently model the fluid flow in real rock samples. We use this model to study the spatio-temporal statistics of the velocity field inside three-dimensional real geometries and investigate its relation to the, in general, anomalous transport of passive tracers for a wide range of Peclet and Reynolds numbers. We extend this model by free-energy based method, which allows us to simulate binary systems with large-density ratios in a thermodynamically consistent way and track the interface explicitly. In this presentation we will present our recent results on both anomalous transport and multiphase segregation.