Derivation of a fractional-diffusion-advection equation as a macroscopic limit of a kinetic transport model

One of the most popular equations in biology is the so-called Patlak-Keller-Segel model, which is used to describe the movement of the bacteria *E. coli*, as well as many other microorganisms. One of the key features of this model is its simplicity, and capability to reproduce experimentally observed phenomena, such as pattern formation and aggregation. However, recent experimental results have shown that E. coli do not exhibit the typical normal diffusion in certain circumstances. Instead, they spread following an anomalous diffusion behavior.

A brief introduction to the concept of anomalous diffusion will be presented, and several examples appearing in nature will be discussed. We shall derive, as a macroscopic limit from a kinetic equation, a fractional diffusion-advection equation in a rigorous manner. This equation has some similarities with the Patlak-Keller-Segel model.