

Taylor dispersion

Mentor: Udi Yariv

The prototypical problem of Taylor dispersion involves a Brownian particle which is suspended within a liquid that flows within a channel. It is straightforward to formulate the boundary-value problem governing the conditional probability density for locating the particle at time t at a specified position given its introduction at time 0 . Solving this problem, however, is a completely different story. Fortunately, practical interest lies not in the detailed probability density, but rather in the long-time behavior of its moments. It turns out that the long-time behavior is diffusive, with both the first and second central moments varying linearly with time. The Taylor-Aris scheme allows to compute these moments, and in particular the associated diffusivity. This diffusivity differs from the Brownian diffusivity due to the stochastic sampling of different liquid velocities.

The Taylor-Aris scheme has been extended over the years so as to handle a large class of convective-diffusive problems that exhibit macroscopic diffusive behavior at large times. The goal of this project is to study this scheme and then apply it to a simple problem where the system exhibits effective diffusion properties in the absence of any Brownian diffusion.