

Generalized Hydrodynamics, Renormalization, Fractional Equations and the CTRW

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Over forty five years ago Zwanzig presented a wave-vector and frequency dependent Fickian type law for diffusion that in real space is a convolution. Some twenty five years later our group used his basic ideas to derive a nonlocal dispersion theory for flows in porous media with evolving heterogeneity. Under appropriate conditions this latter theory can be shown to reduce to the fractional Fokker-Planck equation for Levy dispersion, the master equation for most CTRW schemes, and it can be used to test for the transition to the classical Fickian limit. We will review this model and show its relation to recent renormalization schemes for microbial dynamics in fractal media and to models of turbulent diffusion.