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A novel model for the chaotic dynamics of superdiffusion

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Previously we've shown that by modeling the convective velocity in a turbulent flow field as Brownian, one obtains Richardson super diffusion where the expected distance between pairs of particles scales with time cubed. By proving generalized central limit type theorems it's possible to show that modeling the velocity or the acceleration as -stable Levy gives rise to more general scaling laws that can easily explain other super diffusive regimes. The problem with this latter approach is that the mean square displacement of a particle is infinite. Here we provide an alternate approach that gives a power law mean square displacement of any desired order. We do so by constructing compressed and stretched extensions to Brownian motion. The finite size Lyapunov exponent, the underlying stochastic differential equation and its corresponding Fokker-Planck equations are derived. The fractal dimension of these processes turns out to be the same as that of classical Brownian motion.