Fractional diffusion: A new paradigm

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Abstract

The relation between the classical diffusion equation and Brownian motion was established by Einstein in 1905. Subsequent experiments indicate that anomalous diffusion, where spreading is faster or slower than the implied square root of time, is relatively common. The fractional diffusion equation for anomalous diffusion replaces the integer order derivatives by their fractional analogues. Fractional derivatives were invented by Leibnitz, but have only recently found practical applications. An extension of Einstein's result connects anomalous diffusion to Lévy motion, a stochastic process with heavy power-law tails.