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Richardson Dispersion in Brownian Motion EMMANUEL VILLERMAUX, Aix Marseille University, JEROME DUPLAT, Universite Joseph Fourier — Since Langevin, the Brownian motion of a microscopic particle explicitly accounts for a short-time correlated "thermal" force. The motion is ballistic, $\langle x^2 \rangle \sim t^2$ at short time scales, and diffusive $\langle x^2 \rangle \sim t$ at long time scales, where x is the displacement of the particle during time t, and the average is taken over the thermal distribution of initial conditions. High Reynolds number turbulence is known to exhibit a régime called Richardson dispersion, in which the *relative* separation δx of material particles grows super-diffusively. Namely, $\langle \delta x^2 \rangle \sim t^3$, with the average taken over many particles released from the same initial conditions. We show that Richardson dispersion is indeed property of Brownian motion, under the condition that the initial velocity is fixed rather than distributed thermally. We analyze the motion of an optically trapped particle in air, and indeed find t^3 dispersion. This super-diffusive régime, unveiled here, is the direct proof of the existence of the random, rapidly varying force imagined by Langevin, and reveals a profound similarity between molecular diffusion at microscopic scales and turbulent diffusion at much larger scales.

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