67d Non-Isothermal Brownian Motion in Gases

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Einstein's theory of Brownian motion, which addresses only isothermal fluids, is here extended to situations in which the fluid is subject to an externally-imposed temperature gradient. This extension involves adding a temperature-gradient animated "drift velocity" **U** to the usual diffusive Brownian contribution appearing in the Fokker-Planck equation governing the particle's conditional probability density. Remarkably, this drift velocity, tending to cause the particle to move towards colder regions of the fluid, is an innate molecular property solely of the solvent in which the Brownian particle is dispersed. Explicitly, **U** is independent of the Brownian particle's size and shape, as well as of its physicochemical properties. As such, the drift velocity is exactly the same for a macroscopic particle as it is for a molecule of the solvent itself. The underlying theory is supported by experimental thermophoresis data. The ansatz underlying our theory is derived by elementary sedimentation-equilibrium-type arguments of the type invoked by Einstein in his 1905 paper.