

## Re: Brownian motion.

**Source:** <http://sci.tech-archive.net/Archive/sci.physics/2004-12/2684.html>

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**From:** Andy Resnick (axr67\_at\_op.cwru.edu)

**Date:** 12/01/04

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LEJ Brouwer wrote:

>Suppose at time  $T=0$  we have a very large number  $N$  of tiny hard  
>spherical particles enclosed in a small sphere of radius  $\epsilon$ , each  
>with the same kinetic energy and travelling in random directions. If  
>we set them free and allow them to take part in elastic collisions,  
>they will presumably diffuse outwards with the distribution of the  
>particles being spherical Gaussian with spread  $\sim\sqrt{T}$  at time  $T$ .  
>  
>Can anyone point me towards a simple derivation of this?  
>

Your question, as stated, is too general. If you are simply asking how a (initially packed) cloud of hard spheres at some initial temperature  $T$  evolves over time, simply look at the thermodynamics of ideal gases. The gas will freely expand and cool. Pretty much any thermodynamics and statistical mechanics textbook will cover free expansion.

If, as another example, you are interested in the dynamics of an initially packed cloud of hard spheres immersed in a fluid, that is considerably more difficult— start by reading:

Mazur, P., *Physica* 110A, 128 (1982)

The origin of the difficulty is the hydrodynamic interactions between the particles as they move.

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transpose 'op' for mail