Re: Entropy question

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- *From*: Andy Resnick <andy.resnick@xxxxxxxxxxx>
- *Date*: Mon, 22 Aug 2005 16:11:59 −0400

Zigoteau wrote:

> I can see where you're coming from, but I'm sticking to my guns.
> Statistical mechanics reconciles classical thermodynamics with
> mechanics, either Newtonian or quantum. You are right that for a long
> time people believed, on the basis of analyses of systems with a small
> number of degrees of freedom, that time had no inherent direction in
> Newtonian mechanics. In thermodynamics it definitely does have one.
> Statistical mechanics explains why such analyses are misguided for
> systems where the number of degrees of freedom is very large.

I don't know if you read these 2 papers by Jaynes mentioned in another, similar, thread:

Phys. Rev. 106, 620−630 (1957)
Phys. Rev. 108, 171−190 (1957)

But there's an interesting section on the density matrix. Jaynes draws a distinction between a "complete" and a "sufficient" density matrix. It plays into how entropy increases regardless of the temporal ordering of measurement events.

His example is to consider a measurment on a stream of spin 1/2 particles passing through a magnetic field: the object is to measure if the particles are 'up' or 'down'.

A "sufficient" density matrix is the 2 x 2 matrix specified for a single particle, while the "complete" matrix for the entire experiment is a 2N x 2N matrix, where N is the number of particles measured.

In any case, we may consider the sufficient matrix, and interpret the measurement results in terms of a statistical distribution. This is what is usually done. Alternatively, we could use the complete matrix, but then we have only performed a single experiment, and cannot use probability arguments (in addition to the matrix being rather unwieldy) to interpret the result.

His point is that when the sufficient matrix is used, we are losing information: in this case, the possible correlations which occur between different particles (among other possibilities). And, it is this loss of information which makes the process irreversible. Now the interesting thing is that it can be shown that the entropy goes up as information is lost, regardless of the temporal ordering of events− he uses multiple experimenters to illustrate this point.

All I'm saying is that there's more to statistical mechanics than just statistics and mechanics. There seems to be a way to generate higher−level structure: emergence is the current buzzword, I think.

It's funny how the interesting stuff is learned after formal schooling is over.....

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