Re: Determinacy in classical physics (naive question)

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mmeron@cars3.uchicago.edu wrote:
(order changed, for continuity)
>
> *Determinism (in physics), means that given the knowledge of a*
> *sufficient set of physical parameters of a system at time t_0, the*
> *values of all physical parameters of said system at any subsequent*
> *time t > t_) are uniquely determined. In more physical terms this*
> *means that given two systems, identically prepared, at time t_0, the*
> *result of any physical measurement performed on both systems at any*
> *subsequent time t are the same.*
>
(/order)

Yeah, that's what I thought. I just thought I would illustrate it with measurable quantities. :)

(snip)
> *To begin with, there is nothing magical about either positions and*
> *momenta or the uncertainty principle (and, no, the uncertainty*
> *principle is *not* an axiom, it is a derived result withing quantum*
> *mechanics). You've an uncertainty principle in *classical* wave*
> *theory as well, nevertheless classical wave theory is fully*
> *deterministic.*
> *As you may notice, there is not a word in the above about position*
and
> *momenta. These happen to be a convenient "sufficient set of physical*

> *parameters" for a classical system of particles, but other than this*
> *there is nothing special about them. For other systems, other sets*
of
> *parameters may be used.*
(snip)

There are a few things here that I had always been wondering about... and actually asked my physics GSI more than once, without a satisfactory answer.

First, _where_ do we get uncertainty principle? The answer I got was the one I posted here: he said that it comes from cannonical commutator, [x,p] = ihbar (at least for the case of position and momentum. I know, from general uncertainty theorem, that operators that commute have simultaneous eigenstates, thus can have exact values at the same time). But then, my next question was, where does [x,p] = ihbar come from? Now, that's something just assumed, he said (as can be seen in "cannonical" commutator). I was told that I could start at either end−−either by assuming that cannonical commutator, [x,p] = ihbar, or by assuming the position−momentum uncertainty principle, reach the other end (and as you know, all the other operators...(er... with the exception of quantum spin... I'm not quite sure about that...) can be defined in terms of momentum and position, and we can get their commutator... and so on.

Second, about the difference between classical wave and QM... my GSI (the same one) told me that if you study enough of classical wave theory, it looks much like QM, that mathematically, there is not much difference. So, what makes classical wave deterministic and QM nondeterministic? Is it because in QM, the wave is not the kind of wave you see on surface of water, but a representation of probability distribution?

Best wishes,

Andrew

PS. Oh, so... you are saying that uncertainty principle is not the basis on which QM is indeterministic? I'm just curious−−then why is QM (what is the principle, postulate, or axiom behind QM that makes it) indeterministic?