

Indeterminism in quantum and classical physics: the future is open

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Quantum physics is usually presented as non-deterministic. This can be proven assuming no instantaneous influences at a distance and the existence of independent systems. However, quantum theory can be supplemented by additional variables (e.g. Bohmian particles) that turn the extended theory deterministic, though these additional variables are necessarily inaccessible. Classical physics is usually presented as deterministic. This is the consequence of deterministic evolution equations and the use of real numbers to describe initial conditions. The use of real numbers is very convenient, but is an assumption. Typical real numbers contain an infinite amount of (Shannon) information. An alternative classical mechanics based on finite information quantities is empirically equivalent to classical mechanics. However, for chaotic classical dynamical systems, this alternative classical mechanics is intrinsically indeterministic. Hence, the huge empirical successes and enormous explanatory power of classical mechanics does not imply determinism. Actually, if one likes to avoid infinities, then indeterminism is the more natural view also for classical physics. Though, here also, one may supplement the theory by adding inaccessible variables, e.g. the usual real numbers.

Indeterminism implies that the future is open. A view much closer to the way we experience the world. It implies, among others, that when time passes, new information is created, instead of information coded in inaccessible initial conditions gaining relevance. In both cases, knowledge about the future is intrinsically limited.

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