Bells theorem

In theoretical physics, **Bell's theorem** (a.k.a. Bell's inequality) is a no-go theorem, loosely stating that:

'*no physical theory of local hidden variables can ever reproduce all of the predictions of quantum mechanics.*'

It is the most famous legacy of the late physicist John S. Bell.

Bell's theorem has important implications for physics and the philosophy of science, as it indicates that quantum theory must violate either the Principle of locality or counterfactual definiteness. In conjunction with the experiments verifying the quantum mechanical predictions of Bell-type systems, **Bell's theorem** maintains that certain quantum effects travel faster than light, and so limits the class of tenable 'hidden variable' theories to the nonlocal variety.

Bell's theorem is a term encompassing a number of closely related results in physics, all of which determine that quantum mechanics is incompatible with local hidden-variable theories, given some basic assumptions about the nature of measurement. The first such result was introduced by John Stewart Bell in 1964, building upon the Einstein–Podolsky–Rosen paradox, which had called attention to the phenomenon of quantum entanglement.

In the context of Bell's theorem, "local" refers to the principle of locality, the idea that a particle can only be influenced by its immediate surroundings, and that interactions mediated by physical fields cannot propagate faster than the speed of light. "Hidden variables" are supposed properties of quantum particles that are not included in quantum theory but nevertheless affect the outcome of experiments. In the words of Bell, "If [a hidden-variable theory] is local it will not agree with quantum mechanics, and if it agrees with quantum mechanics it will not be local."

In his original paper, Bell deduced that if measurements are performed independently on the two separated particles of an entangled pair, then the assumption that the outcomes depend upon hidden variables within each half implies a mathematical constraint on how the outcomes on the two measurements are correlated. Such a constraint would later be named a Bell inequality. Bell then showed that quantum physics predicts correlations that violate this inequality. Multiple variations on Bell's theorem were put forward in the years following his original paper, using different assumptions and obtaining different Bell (or "Bell-type") inequalities.

The first rudimentary experiment designed to test Bell's theorem was performed in 1972 by John Clauser and Stuart Freedman. More advanced experiments, known collectively as Bell tests, have been performed many times since. Often, these experiments have had the goal of "closing loopholes", that is, ameliorating problems of experimental design or set-up that could in principle affect the validity of the findings of earlier Bell tests. Bell tests have consistently found that physical systems obey quantum mechanics and violate Bell inequalities; which is to say that the results of these experiments are incompatible with local hidden-variable theories.

The exact nature of the assumptions required to prove a Bell-type constraint on correlations has been debated by physicists and by philosophers. While the significance of Bell's theorem is not in doubt, different interpretations of quantum mechanics disagree about what exactly it implies. [wikipedia]

Bell’s Theorem and Keely’s sympathetic vibration [3/23/25]:
https://grok.com/share/bGVnYWN5_da707167-9b9b-4ad1-89cd-236db241baf5

See Also

AI Interpretations of SVP
Action at a distance
Bells Inequality
Compound Interetheric

John S. Bell
Mind to Mind
Non-Locality
P.E.A.R. Proposition
Quantum Entanglement
Remote Viewing
Sympathetic Oscillation
Sympathetic Vibration
Sympathy