Quantum Correlations and Separate Common Causes

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Probabilistic causation

Correlation:



Probabilistic causation

Direct causal relation:



Probabilistic causation

Common cause:



Reichenbach's Common Cause Principle (RCCP): If there is a correlation between two events and a direct causal (or logical) connection between the correlated events can be excluded, then there exists a common cause of the correlation.



Correlation:

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Causal explanation of correlations



Direct causal relation?

Excluded by the theory of relativity!

Causal explanation of correlations



Joint common cause



Separate common cause



Motivation by Markov condition



 Markov condition => screening-off, locality and no-conspiracy

Bell inequality and joint common cause

Bell inequality and joint common cause

 The Bell inequality is violated for the specific measurement directions, therefore EPR correlations cannot have a joint common cause.

Motivation by Markov condition



 Markov condition => screening-off, locality and no-conspiracy

Bell inequality and separate common cause



Bell inequality and separate common cause



Still, EPR correlations *cannot* even have a separate common cause.

Correlation:



No direct causal relation:



No common cause:



Open question

Joint common cause:

Separate common cause:



Does there exist a connection between the following two facts?

- 1. From a set of assumptions one can derive a *Bell inequality*.
- 2. This set of assumptions result from the *Markov condition* applied to a causal graph.

The answer is not known.

References

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