Causality
and
Quantum Theory

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Structure

- The Point of our Project
- Scientists before us
- Explanation of Quantum Theory and Causality
- Gedankenexperiment
- Math-Hacker John S. Bell
- Conclusion

Our Point

- „Does Quantum Theory violate Causality in terms of Relativistic physics?“

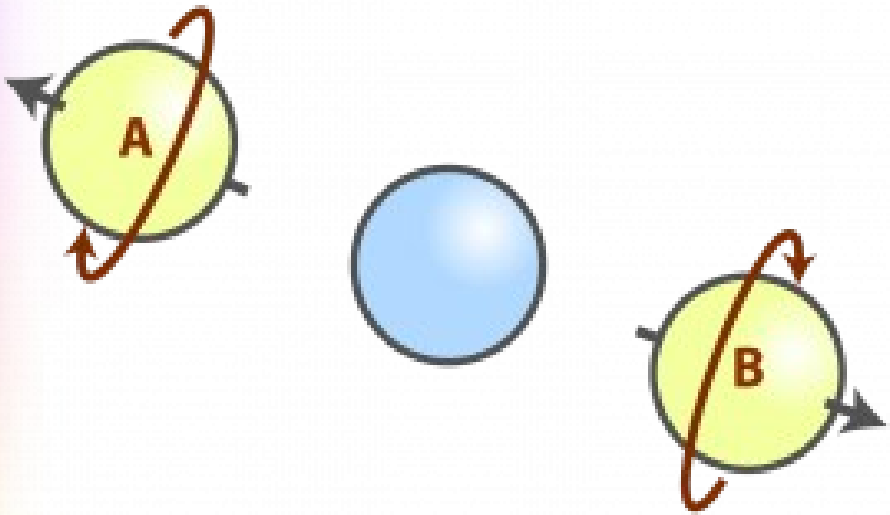
Our Forerunners

- Einstein: „God doesn't play dice!“
- Relativistic / Quantum Theories
- EPR-Paradox

Explanation of Quantum Mechanics and Causality

- Causality – relation between 2 events
  - cause/effect relation
  - we assumed it always works
- Quantum Mechanics – describes microworld
  - denies logical reasoning
  - is very cool

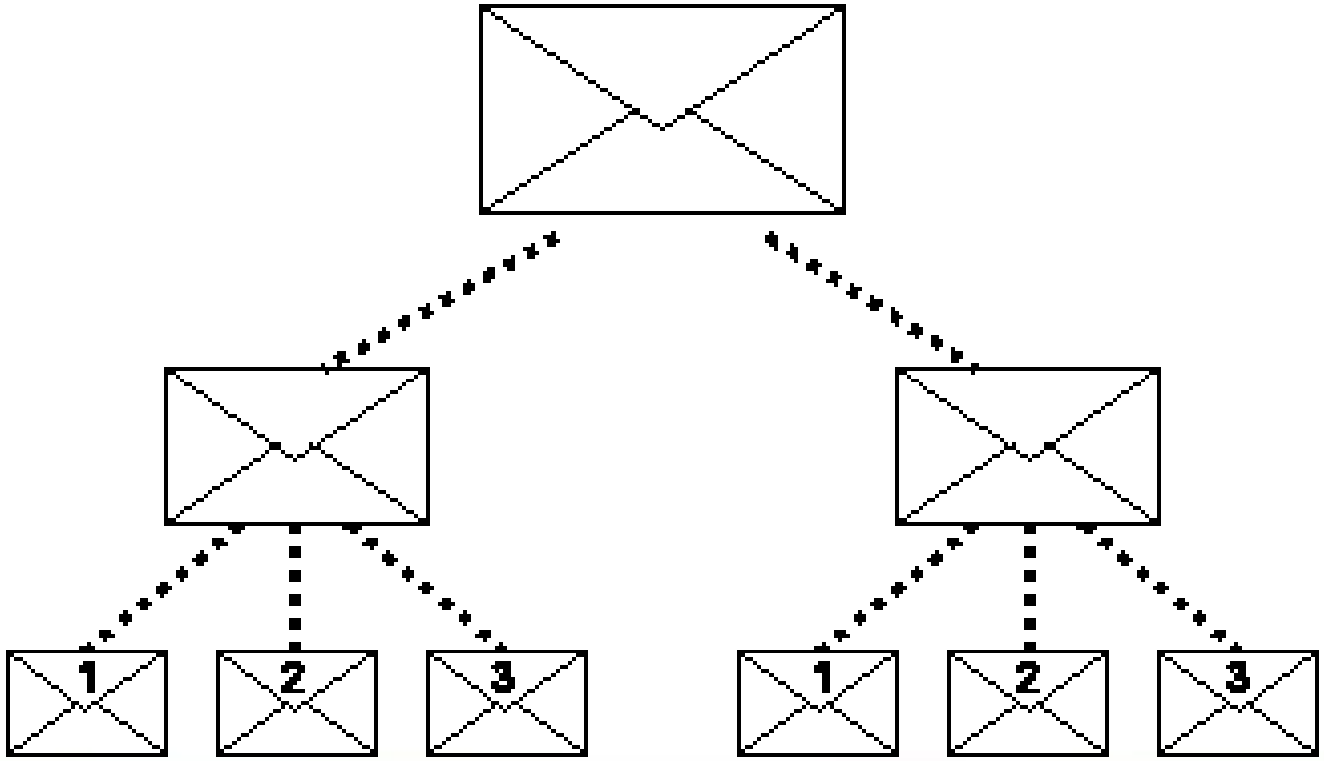
Gedankenexperiment



- 2 electrons entangled
  - Random spin
  - We measure the spin
  - 2nd electron: opposite spin

Explanation of Experiment

- ...in terms of classical physics:



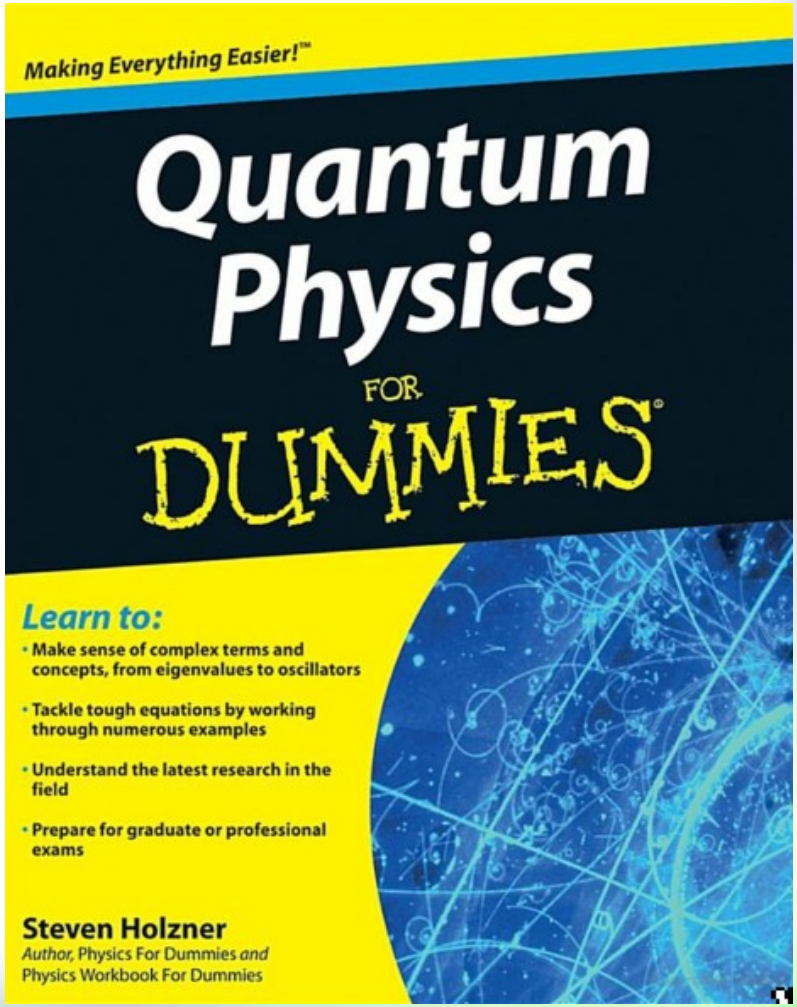
Bell's inequality

$$w_c + w_d + w_b + w_c \geq w_b + w_d$$

$$2w_c \geq 0$$

Conclusion

- Answer on our question:
  „YES, Quantum Mechanics can exceed the speed of light!“



References

- Einstein, A. – Podolsky, B. – Rosen, N.: *Can Quantum-Mechanical Desription of Physical Reality Be Considered Complete?* Physical Rev. 47, 1935, 777–780
- Bell, J. S.: *Speakable and Unspeakable in Quantum Mechanics* Cambridge University Press, 1988
- Clauser, J. F. – Shimony, A.: *Bell's theorem: Experimental tests and implications* Rep. Progr. Phys. 41, 1881 (1978)