Philosophy of QM 24.111

Fifth lecture,
14 Feb. 2005
A PUZZLE ABOUT LOCALITY

How does the Bell’s Theorem definition of locality

\[ \text{Prob}(x,y \mid \theta_L, \theta_R, \lambda) = \text{Prob}(x \mid \theta_L, \lambda)\text{Prob}(y \mid \theta_R, \lambda) \]

match up to

- our intuitive understanding of this notion;
- the kind of “locality” that features in special relativity?
SOME HYPOTHETICAL PHYSICS

Unstable particle; when it “explodes”, it sends out a spherical shock wave:
When the shock wave reaches a certain critical distance, two localized “flashes” appear on its surface, at opposite positions, with their axis randomly determined:
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When the shock wave reaches a certain critical distance, two localized “flashes” appear on its surface, at opposite positions, with their axis randomly determined:
Bell-locality is violated in this example. Why?

Is our intuitive notion of locality (no “action at a distance”) violated?

Is special relativity violated?
WHAT SPECIAL RELATIVITY FORBIDS:

Five options:

- Faster-than-light mass/energy transport
- Faster-than-light information transfer
- Faster-than-light signalling
- Faster-than-light causation
- Dynamical laws that are not Lorentz-invariant