Philosophy of QM 24.111

Fourth lecture,

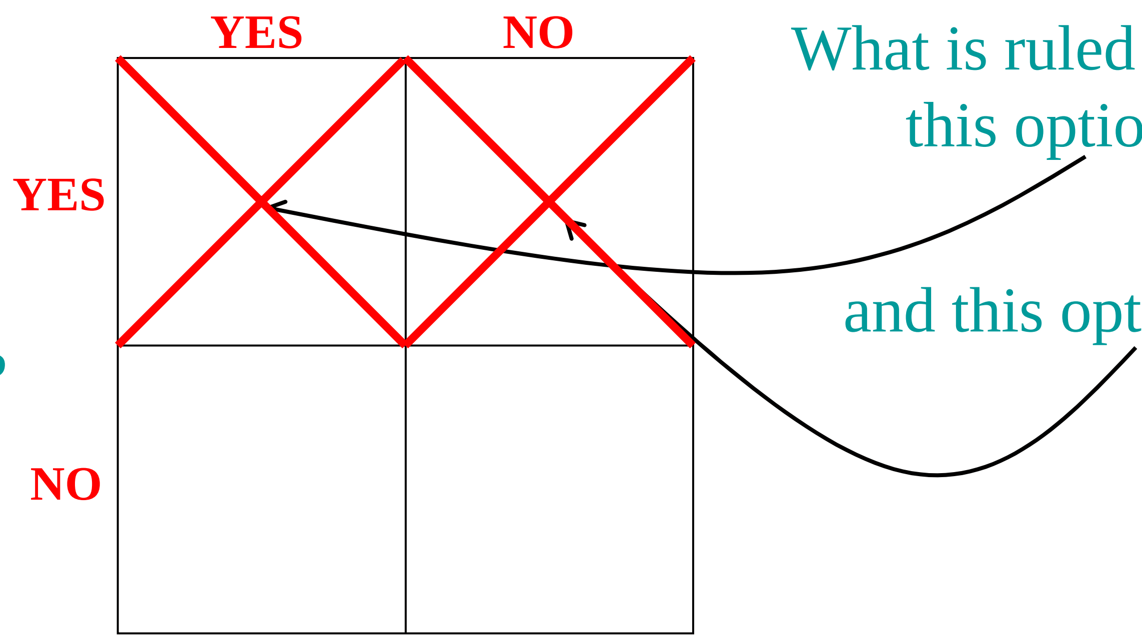
9 Feb. 2005

BELL'S INEQUALITIES—WHAT DO THEY SHOW?

Two questions we can ask about a theory (in particular, a theory of the phenomena exhibited in the experiments that violate Bell's Inequalities):

1. Is it local?

2. Is it deterministic?

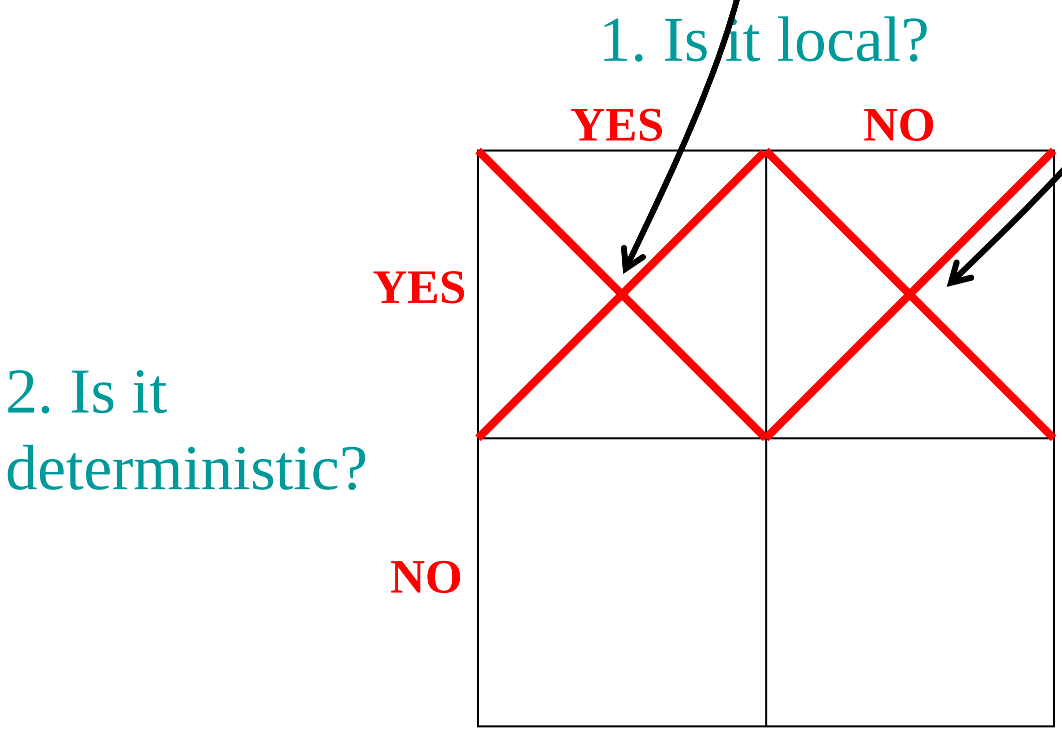


Common view: What is ruled out is this option

and this option.

This is a mistake. This option is ruled out by Bell’s Inequalities, plus the observed data:

But this option is not, since it denies locality:



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But this option is not, since it denies locality:

What's more, this option was ruled out from the beginning, since according to it, the perfect correlations are a massive coincidence:

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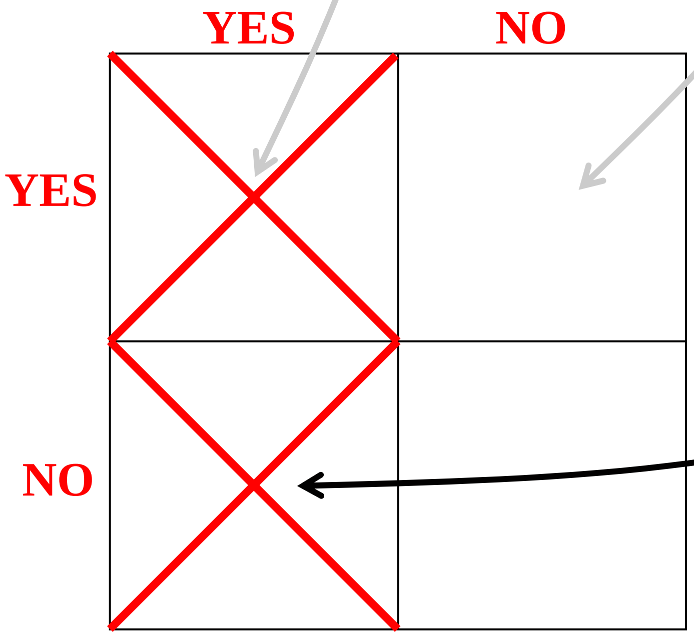
2. Is it deterministic?



A LOOPHOLE?

Consider the following objection:

The derivation of Bell's Inequalities assumes that when $\theta_1 = \theta_2$, the outcomes will *always* be opposite; that is, that we have *perfect* (anti-) correlation, in such a case. But life in the real world of the laboratory is never so simple: correlations are always at least a *little* less than perfect. So we do not yet have an experimental refutation of locality, after all.

How might we respond to this objection?

CLOSING THE LOOPHOLE

First step: Let us **abandon** the assumption of perfect correlation.

Second step: Let us try to devise as general a theory as possible (really, a framework for a theory) of the behavior of the particles in these experiments, making use only of locality and no-conspiracy assumptions.

Third step: Let us examine the theory to see if it has any testable predictions.

Fourth step: Let us check to see if the actual experiments conform to these predictions.

THEY DON'T.