#### Bell's Theorem:

No local theory can reproduce the statistical predictions of quantum mechanics.

### Bell's Theorem: step 1

 Step 1: The only kind of local theory that can make the "fact 1" prediction is a DETERMINISTIC HIDDEN VARIABLES THEORY.

## Bell's Theorem: step 2

- Fact 2: According to the statistical predictions of QM, the probability that the electrons in the singlet state are deflected in opposite directions when any of the experiments
- (0, 120), (120,0), (120,240), (240,120), (0, 240), (240,0)
- is performed is 1/4.

### Bell's Theorem: step 2

• Step 2: No deterministic local hidden variables theory can make this same prediction.

Possible instruction sets.

- A DLHVT makes the "fact 2" prediction only if:
  - The proportion of pairs that will go in opposite directions when the experiment (0, 120) is conducted is 1/4.
  - The proportion of pairs that will go in opposite directions when the experiment (0, 240) is conducted is 1/4.
  - The proportion of pairs that will go in opposite directions when the experiment (120, 240) is conducted is 1/4.

- Intermediate conclusion: A DLHVT makes the "fact 2" prediction only if:
  - The proportion of pairs with this property (call it "property X"): EITHER they will go in opposite directions in (0, 120), or in (0,240), or in (120,240)—-is less than or equal to 3/4.

- The proportion of pairs with this property (call it "property X"): EITHER they will go in opposite directions in (0,120), or in (0,240), or in (120,240)—-is less than or equal to 3/4.
  - Which instruction sets give a pair that carries it property X?

#### Bell's Theorem

- Step 1: The only kind of local theory that can make the fact 1 prediction is a DETERMINISTIC HIDDEN VARIABLES THEORY.
- Step 2: No deterministic local hidden variables theory can make the fact 2 prediction.
- QM makes both the fact 1 and fact 2 predictions.
- Therefore, no local theory can make the statistical predictions of QM.

# Aspect's experiment(s)