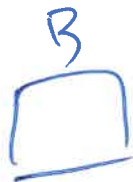


Alice - Caltech
Bob - Chicago
Charlie - AP. Princeton
grad student who did all the work.

15
need an exp. for 3
to help Charlie.
~~know~~ go to p. 49.

technical
reports



WOW: always odd # of black balls:
always one of these: $0_A 0_B 1_C$ $0_A 1_B 0_C$ $1_0 0_B 1_C$ $1_1 1_B 1_C$

never one of those: 110 101 011 000

so, after opening 2 boxes, can predict third one perfectly it always works.

↓

So, here: you get curious about both X & Y,
just do this: We'll ^{B&C} open the Y doors,
then you'll know what's behind the X
door for sure. So just open Y and you
find out both

Charlie: let's open all three in X!

* Greenberger, Horne, Zeilinger, Mermin

suppose we know

$$Y_A Y_B Y_C = 000 \quad \text{then: for some } Y_A = Y_B = 0$$

$$\Rightarrow X_B = 1$$

similarly $X_B = 1, X_C = 1$

$$\text{So } Y_A Y_B Y_C = 000 \Rightarrow X_A X_B X_C = 111$$

only 8 possibilities

$Y_A Y_B Y_C$	$X_A X_B X_C$
000	111
001	001
010	010
100	100
011	100
101	010
110	001
111	111

$Y Y Y$	$X X X$
000	111
001	001
010	010
100	100
011	100
101	010
110	001
111	111

note all odd!

A & B & C do the experiment.
what do they see?

3 white balls. every time. ???
even # of Black balls every time.

every time - opposite prediction of Einstein locality.

A quantum description:

$$\frac{1}{\sqrt{2}}(|000\rangle_{ABC} + |111\rangle_{ABC})$$

Simultaneous eigenstate of:

$$Z_A \otimes Z_B \otimes I_C,$$

$$I_A \otimes Z_B \otimes Z_C,$$

$$X_A \otimes X_B \otimes X_C$$

← show +1 eigenstates.

deterministic
violation of
Einstein Locality.

irreconcilable
incompatibility
of complementary observables

$$\begin{aligned} |X_+\rangle &= \frac{1}{\sqrt{2}}(|0\rangle + |1\rangle) & |X_-\rangle &= \frac{1}{\sqrt{2}}(|0\rangle - |1\rangle) \\ |Y_+\rangle &= \frac{1}{\sqrt{2}}(|0\rangle + i|1\rangle) & |Y_-\rangle &= \frac{1}{\sqrt{2}}(i|0\rangle + |1\rangle) \\ |Z_+\rangle &= |0\rangle & |Z_-\rangle &= |1\rangle \end{aligned}$$