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

need an exp. ~~for~~ 3
to help Charlie.
~~[illegible]~~ go to p. 49.

techniques
prefers

A

B

C

WOW: always odd # of black balls:

always one of these → $0_A 0_B 1_C$ $0_A 1_B 0_C$ $1_A 0_B 0_C$ $1_A 1_B 1_C$

never one of those: 110   101   011   000

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

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So, Alice: if 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

$Y_A Y_B Y_C = 000$ then: for sure $Y_A = Y_B = 0$

$\Rightarrow X_{\cancel{B}C} = 1$

similarly $X_B = 1$, $X_C = 1$

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
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1

X_A	X_B	X_C
1	1	1
0	0	1
0	1	0

$\cancel{Y}$	Y	Y
0	0	0
0	0	1
0	1	0
1	0	0
0	1	1
1	0	1
1	1	0
1	1	1

$\Rightarrow$

X	X	X
1	1	1
0	0	1
0	1	0
1	0	0
1	0	0
0	1	0
0	0	1
1	1	1

$\leftarrow$ 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.

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A quantum description:

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

Simultaneous eigenstate of: $Z_A \otimes Z_B \otimes \mathbb{I}_C$, $\mathbb{I}_A \otimes Z_B \otimes Z_C$, $X_A \otimes X_B \otimes X_C$ ← show +1 eigenstate.

~~State~~

deterministic violation of Einstein Locality.

irreconcilable incompatability of complementary observables

$$|X_+\rangle = \frac{1}{\sqrt{2}}(|0\rangle + |1\rangle) \qquad |X_-\rangle = \frac{1}{\sqrt{2}}(|0\rangle - |1\rangle)$$

$$|Y_+\rangle = \frac{1}{\sqrt{2}}(|0\rangle + i|1\rangle), \qquad |Y_-\rangle = \frac{1}{\sqrt{2}}(i|0\rangle + |1\rangle)$$

$$|Z_+\rangle = |0\rangle, \qquad |Z_-\rangle = |1\rangle$$