

Homework Problem 3.3

GHZ-Mermin violation of local realism. Consider the three-qubit state

$$|\Psi\rangle = \frac{1}{\sqrt{2}}(|000\rangle - |111\rangle),$$

which is called the *Greenberger-Horne-Zeilinger* (GHZ) state.

(a) Show that the GHZ state is a +1 eigenstate of $X \otimes Y \otimes Y$, $Y \otimes X \otimes Y$, and $Y \otimes Y \otimes X$.

(b) Use the results of part (a) to argue that each qubit has well-defined values of X and Y . For qubit j , denote these values by x_j and y_j . We say that these values are *elements of reality*. What does local realism, i.e., the assumption of realistic values that are undisturbed by measurements on other qubits, predict for the product of the outcomes of measurements of X on each qubit?

(c) What does quantum mechanics predict for the product of the outcomes of measurements of X on each qubit?