PHYS 486 Problem Set #4

1 Constructing a Local Model

In class, we examined in detail the construction of a local model, and Bell's Inequality. We showed that, given two qubits are in the state $|\Psi\rangle = \frac{1}{\sqrt{2}}(|01\rangle - |10\rangle)$, it is possible to construct a hidden-variable local model that will reproduce the results of quantum mechanics. However, we showed that for the case when the optional unitary transformation was the Hadamard operator.

Try to construct a similar model in the case where the operator used is Q rather than H. You must start by constructing the quantum-mechanical probability table, then construct the local hidden-variable model, and show that it is possible to match the results of quantum mechanics by adjusting the populations of each kind of particle pair. Give the population of each pair if such a model can be constructed, or prove that the model can not be constructed.

Warning: We are considering the two-kinds-of-measurements case! Do not mess with the three-kinds-of-measurements case!

2 The Special Thing about the State...

The two-qubit state $|\Psi\rangle$ is given by:

$$|\Psi\rangle = \frac{1}{\sqrt{2}}(|01\rangle - |10\rangle)$$

Show that, when a one-qubit unitary operator U is applied to *both* qubits, the result differs from the original state by at most a phase factor. In more mathematical notation show that:

$$(U \otimes U)|\Psi\rangle = e^{i\theta}|\Psi\rangle$$

where θ is a real number.