$|00\rangle + |11\rangle = |01\rangle + |10\rangle$?

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Consider a four-dimensional Hilbert space H over $\mathbb{C}$ in which quantum states consisting of two binary quantum states are represented as $|00\rangle$ = (1, 0, 1, 0), $|01\rangle$ = (1, 0, 0, 1), $|10\rangle$ = (0, 1, 1, 0) and $|11\rangle$ = (0, 1, 0, 1). Then, $|00\rangle + |11\rangle = |01\rangle + |10\rangle$ = (1, 1, 1, 1), which is a quantum mechanical proof that there is no such thing as quantum entanglement. As H is a direct product of two two-dimensional subspaces of H, each in which a binary state is represented, a point in H represents points in the subspaces independent from each other, which means there is no room in H to represent correlation of entanglement between two binary states. Moreover, considering three (or more) binary quantum states, existence of similar linear dependency is obvious, because there are eight combinations of 0 and 1 in a six-dimensional Hilbert space.

(1, 1, -1, -1) is a state orthogonal to $|00\rangle$, $|01\rangle$, $|10\rangle$ and $|11\rangle$. The natural normalized orthogonal basis set of H is {(1, 0, 0, 0), (0, 1, 0, 0), (0, 0, 1, 0), (0, 0, 0, 1)}. Consider states of H are implemented by practical communication with two binary quantum channels where $|0\rangle$ and $|1\rangle$ are implemented by horizontal and vertical polarization modes, respectively. Then, implementation of (1, 0, 0, 0), which is a traditionally valid quantum state, should be that horizontally polarized photons are sent over the first channel and no photon, thus, no information, is sent over the second channel, that is, the second channel is vacuum. (0, 0, 0, 0) should also represent a valid quantum state that no photons are sent in either channel, that is, total vacuum. Implication of vacuum is further discussed in a separate paper [PHASE]. (1, 1, 1, 1) and (1, 1, -1, -1) are implemented by diagonally polarized photons in both channels with relative phase between the channels 0 and π, respectively.

If observation of the first binary state on (1, 1, 1, 1) results in $|0\rangle$, it denies possibility that the first binary state could be $|1\rangle$ without any information on the second binary state, which means new state will be projection to a subspace of H orthogonal to (0, 1, 0, 0), which is (1, 0, 1, 1).

Unless formalization of quantum mechanics in Hilbert space is fundamentally flawed, all the experiments resulting in violation of Bell's inequality [BELL] should be erroneous. In any case, all the theoretical results relying on linear independence of $|00\rangle$, $|01\rangle$, $|10\rangle$ and $|11\rangle$ are invalid.

REFERENCES

[BELL] J. S. Bell, "ON THE EINSTEIN PODOLSKY ROSEN PARADOX", Physics Vol. 1, No. 3, pp. 195-290, 1964.

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