Spatially Separated EPR State

Masataka Ohta

Email: mohta@necom830.hpcl.titech.ac.jp

Department of Computer Science, School of Information Science and Engineering

Tokyo Institute of Technology

2-12-1-W8-54, O-okayama, Meguro, Tokyo 1528552, JAPAN

Apr. 24, 2018

Usual arguments on EPR state [EPR] assume that, after particles I and II interact somewhere, they are spatially separated, which is why EPR correlation was considered to be a paradox. That is, after the interaction, particle I exists only in a spatial region A, while particle II exists only in a spatial region B located at a distance from A.

However, though the separation imposes certain restriction on possible quantum state, its implication has not been properly considered. That is, though quantum state of A is a tensor product of quantum state of particle I and II in A, as quantum state of particle II in A is ground state only, the product is identical to quantum state of particle I in A. Similarly, quantum state of B is quantum state of particle II in B. Then, as entire quantum state is Cartesian, not tensor, product of quantum state of A and B, the entire quantum state is Cartesian product of quantum state of particle I and II, which means there is no tensor product term to represent quantum entanglement. For example, using binary state, (|0>, |0>) + (|1>, |1>) = (|0>, |1>) + (|1>, |0>) = (|0> + |1>, |0> + |1>). Separation process resolves entanglement.

If the entire quantum state is calculated differently, by first taking Cartesian product and, then, tensor product, a tensor product term appears. However, as the term represents action at a distance and, thus, unphysical, its coefficient must always be 0.

That is, quantum entanglement of EPR correlation assuming the spatial separation is a superficial mathematical artifact representing action at a distance.

REFERENCES

[EPR] A. Einstein, B. Podolsky, N. Rosen, “Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?”, Physical Review, May 1935.