

**EINSTEIN: IN A SEARCH OF QUANTUM MEANING – FROM
THE EPR PAPER (1935) TO THE ASPECT EXPERIMENT (1980).
DID LIFE UTILIZE STRANGE QUANTUM EFFECTS
REVEALED BY THIS EXPERIMENT IN ORDER TO PROMOTE ITS
OWN CAUSE?**

Tomislav Živković

Institut Ruđer Bošković, Zagreb, Hrvatska

Over the course of many years Einstein mounted a series of challenges aimed to reveal gaps in the structure of quantum theory (QT). Probably the most sophisticated challenge was raised by the EPR (Einstein, Podolsky, Rosen) paper published in 1935. In this paper EPR challenged the very foundation of QT. They attempted to show that QT provides only an incomplete description of reality. According to EPR, particles do have definite position and moment, but the quantum mechanics (QM) uncertainty principle shows that those features of reality are beyond the bounds of QT. This failure of QT to provide both, the position and momenta reveals fundamental limitation of this theory. QT is hence not complete.

Bohr did not agree. His argument was that physics addresses only things we can measure. From the standpoint of physics, that is reality. Trying to use physics to analyze "deeper" reality, one beyond we can know through measurement, is like counting angles on the top of the pin. For five decades this issue who was right, Einstein or the supporters of QT was left unresolved. It looked like a philosophical question that can not be settled by experiment.

However, in (what Henry Stapp in *nuovo Cimento* called "the most profound discovery of science"), Irish physicist John Bell in 1964 transformed the central idea of the EPR paper from philosophical speculation into question that could be answered by concrete experimental measurement. Bell proved that, even if you can not simultaneously determine position and momenta of a particle, still, if in fact the particle has those properties, then there are testable, observable consequences. At the time the adequate technology did not exist, but by the early 1970 it did. Beginning by Stuart Freedman and John Clauser at Berkeley and culminating in the early 1980s with the work of Aspect and collaborators in France, the EPR were proven by experiment to be wrong!

The amazing results of those experiments show that two things can be separated by an enormous amount of space and yet not have a fully independent existence. A quantum connection can unite them and space can not overcome this interconnection. Those connections (quantum entanglement) show us, fundamentally, that space is not what we once thought it was.

What is the possible impact of quantum entanglement on life, the most complex known structure in our universe? Nobody knows. However it is very likely that the evolution, in one way or another, did use those subtle quantum effects in order to enhance its own cause.