QM as theory of classical signals with noisy background

Andrei Khrennikov

Linnaeus University, P.G. Vägen, Växjö, Sweden

Bunching and anti-bunching are considered as fundamentally quantum phenomena which could not be described in the classical field framework. In this paper we show that, opposite to this very common opinion, bosonic and fermionic (as well as anyonic) correlations can be described with the aid of classical random fields. We present a model of bunching and anti-bunching of classical random (Gaussian) bi-signals. Thus quantum and classical signal theories (and, in particular, classical and quantum optics) are much closer than it is typically assumed. By our model [1], prequantum classical statistical field theory (PCSFT), quantum mechanics can be considered as a formalism for calculation of averages with respect to classical signals combined with a rather strong random background field, so to say vacuum fluctuations. The presence of such a background random field is the cornerstone of PCSFT; quantum correlations can be represented as classical field correlations only by taking into account the background field, cf. SED. In PCSFT quantum entanglement is reduced to classical correlations ("renormalized" by subtraction of the contribution of the correlations with respect to the background field). Thus quantum randomness was finally reduced to classical randomness, but in a tricky way. Quantum correlations can be so strong (that they violate Bell's inequality) only due to the presence of the additional correlations inside the common background field. By PCSFT composite systems are not independent even for factorizable quantum states. Thus "nonlocality" induced by the background field is even stronger than "quantum nonlocality". However, there is nothing mystical in such "nonlocality" of classical signals coupled through the common random background.

[1] A. Khrennikov, Physica E: Low-dimensional Systems and Nanostructures 42 (2010) 287-292.