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**Interaction Free Measurements or Interactions without Total Energy Loss?**

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Particle quantum interference several problems are discussed.

## 1. "Corpuscular paradoxes" in experiments with quantum particles

As it is well known, so-called "interaction-free measurements" can be performed in the quantum mechanics. For example (see **[DeWeerd, 2002]**), if several conditions are accomplished, then in the famous experiments with Mach-Zender's interferometer the passing photons come only to the first detector and never to the second one. However, if in the arm of the interferometer the mirror is replaced by an absolute absorber (for example, bomb), then a part of photons "rounding" this absorber comes still to the second detector. So, one can reveal an object without a visible interaction. In fact, the light could never come to the second detector if the absorber was absent. Thought the photon registration confirms immediately the absorber presence, however, the photon does not "meet" this absorber.

## 2. "Wave based" interpretation

The wave based interpretation of quantum experiments explains such the paradoxes. This interpretation allows us to predict truly the results of an experiment. However, I would like to precise the events physical meaning. The difficulties of wave-like features consciousness of quantum objects appear while one transits from large particle ensemble to a single particle **[Shulman, 2008]**. In order to keep wave features by a *single* particle one needs describe its behavior as a probabilistic one (not deterministic!). Note, the probability of the particle detection and non-detection must be inevitable equal to $\cos^2\alpha$ and $\sin^2\alpha$ respectively, where α is the angular parameter that determined the boundary states orthogonality (at α=0 the amount of detected particles is equal to the amount of emitted ones, i.e., is maximal).

Since $\cos^2\alpha+\sin^2\alpha=1$ the *total* particles amount (that are not still arrived at the output detector), is in fact *constant*. In the wave model such the total amount of particle must be interpreted as the sum of two components of the signal power: active and reactive ones (the first is presented by a real number, the second is presented by an imaginary one having the factor *i*). Finally, the active power is registered by the output detector, i.e., is irreversibly consumed by it. The reactive power *is not registered* by the output detector. Contrary, the source and the detector *exchange* it periodically between them. Meanwhile, it always exists in the information channel, and non-absorbing filters change only a wave function *phase* and redistribute the relative contributions of both the components. Formally this means that such a wave function evolution should be *unitary*.

## 3. Conclusion

The reactive component accounting allows us to understand what happens really while one performs an "interaction-free measurement". In classical mechanics one describes a particle interaction basing on the corpuscular model concept. Such the interaction truly takes into account the active energy change only (a real number) which is not conserved for each interacting particle separately. In this case we can neglect a reactive component because it is much less than an active one.

Contrary, in the above considered quantum experiments these components are comparable. Because of that the total output energy should be presented by *complex* value. Its active component (that corresponds to the *registered* particle amount) carries the energy and information containing in the output signal and due to that cannot propagate with a *superluminal* velocity, as Relativity states. However, the reactive component does not carry (in average) any energy, is not connected with any oriented signal and, in my opinion, its velocity is not limited at all. This is also true for experiments like EPR ones.

In other words, in the quantum domain the processes are possible when a phase (not magnitude) changes *only*. In such the processes a phase change must also be considered as a physical interaction though the separate particle total energy magnitude does not change. At the same time, since the *root-mean-square* of the reactive component is positive and differs from zero, such the component is able to support a *correlation* between wave bounds in the existence wave area (even if its size is a space-like one). Of course, this is due to the quantum non-locality that can be deduced from the quantum mechanics postulates.

Note, the wave-like quantum process description leading to its non-locality is formally connected with a *steady-state* (not transitional) oscillation. It is difficult to test such the hypothesis because a single experiment can provide a *probabilistic* issue only, and the experiment repetition may avoid the problem essence. It is possible reason to experimentally conclude that the particles are entangled in time (see **[Fedrizzi, 2010]**, **[Wiegner et al., 2011]**).

## References

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