# Counterportation and TGD

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### Abstract

Hatim Salih has introduced the concept of counterportation. It is communication that does not involve classical or quantum signals (photons). Counterfactuality is a basic concept: the first web source that one finds tells "Counterfactuals are things that might have happened, although they did not in fact happen. In interaction-free measurements, an object is found because it might have absorbed a photon, although actually it did not." In the case considered, the blocking or opening of a channel involved in the arrangement corresponds to a communication of bit by teleportation and involves no photon transfer between Alice and Bob. This looks rather paradoxical and Salih suggests that the description of the situation requires new notions at the space-time level. The blocking and opening of the channel is nanoscopic or even macroscopic operation and has non first principle description in the standard quantum theory. The proposal of Salih is that wormholes, proposed to serve as correlates for quantum entanglement, are involved.

In the TGD framework, the generalization of point-like particles to 3-surfaces implies that space-times identified as 4-surfaces in $M^4 \times CP_2$ satisfy holography, being therefore analogous to Bohr orbits. This forces a new ontology that I call zero energy ontology (ZEO). ZEO solves the basic paradox of the quantum measurement theory. Also quantum coherence is made possible in arbitrarily long scales due to the predicted hierarchy of effective Planck constants predicted by the number theoretical view of TGD. The new topological and geometric degrees of freedom would naturally correspond to new quantum coherent degrees of freedom in long scales.

This suggests a description of the blocking and opening operations as space-time engineering changing the connectedness properties of the space-time surfaces associated with the counterportation. The identification of the blocking operation and its reversal as a reconnection for a pair of monopole flux tubes connecting two systems is natural. Reconnections appear in the TGD framework in all scales, in particular in living matter where they define a basic mechanism of biocatalysis and serve as a control tool of the magnetic body serving as a "boss".

## Contents

# 1 Introduction

Tuomas Sorakivi sent links to interesting articles related to the work of Hatim Salih [B1] (see this) summarized in a popular article.

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The example considered by Salih is as follows.

1. Consider a mirror system consisting of a) fully reflective mirrors and b) mirrors that let through the horizontal polarization H and reflect the vertical polarization V. The system consists of two paths: A and B. In the first mirror, which is type b) mirror, the signal splits into two parts, H and V and which propagate along A and B. At the end the signals meet in a type b) mirror and H goes through to detector D1 and V is reflected and ends up to detector D2.

2. The horizontal polarization component H going through type b) mirror at the first mirror travels along the path A. It contains only one fully reflective mirror and the beam reflected from it ends up in the downstream mirror of type b) as H type polarization and goes to the detector D1.

3. The vertical polarization component V reflected at the first mirror travels along the path B. The path B contains many steps and with each step the polarization is slightly rotated so that the incoming polarization V transforms so that its horizontal component H at the end has same magnitude but a phase opposite to that of H coming along A. H components interfere to zero and only V from B remains so that the detector D2 registering only V clicks.

   In the B-path mirrors, the varying polarization directions H and V are chosen so that to guarantee the destructive interference. Hence "counterfactuality". There is no interaction with photons: only the possibility of it and this seems to be enough. This looks paradoxical and suggests that something is not understood.

4. Bob can control path B and can block it so that nothing can get through. The result is that only the signal coming from path A gets through and travels to detector D1. Bob can therefore communicate information to Alice. For instance, at moments of time $t_n = nt_0$ Bob can block or open path B. The result is a string of bits that Alice observes. This is communication without photons or classical signals.

5. The roles of Bob and Alice can be changed. Alice can block or open the channel and Bob can look at the detectors registering the outcome. Therefore Bob and Alice can have "conversations".

The following remarks can be made.

1. The controlled qubit (channel B open or closed) is macro- or at least nanoscopic and cannot be represented by the spin states of an elementary particle.

2. The experimental arrangement under consideration corresponds logically to cnot operation. If channel B is closed, nothing happens to the incoming signal and it ends up in D1. If B is open, then the signal ends up at detector D2. cnot would be realized by bringing in Bob as the controller that affects the space-time topology.

3. Quantum coherence is needed in meso- or even macroscopic scales. Number-theoretic TGD predicts a hierarchy of effective Planck's constants $h_{eff}$, which label to the phases of ordinary matter, which can be quantum-coherent on an arbitrarily long length and time scales. These phases behave like dark matter and explain the missing baryonic matter whereas dark energy in the TGD sense explains galactic dark matter. They enable quantum coherence at the nano- and macro levels.

The basic question is what does the blocking of channel B mean in the language of theoretical physics. It is a mesoscopic or even macroscopic operation. That's where Bob comes in as a conscious, intentional entity. Here recent theoretical physics cannot help.

Salih emphasizes that this is something new that standard quantum physics cannot describe. Such a situation leads to a paradox. Salih considers many options, starting from different interpretations of quantum measurement theory.

1. "Weak measurement", as introduced by Aharonov and his colleagues (see this), is one option presented. In the name of honesty, it is necessary to be politically incorrect and say that this model is already mathematically inconsistent. Weak measurement has another meaning and would be a generalization of the Zeno effect, which usually means that repeated measurements of the same observables have no effect on the measured system. Weak measurements would have a small effect on the system and would be much like classical measurements.

   In the TGD inspired theory of consciousness reducing to a theory of quantum measurement in what I call zero energy ontology (ZEO) weak measurements correspond to "small" state function reductions (SSFRs): the conscious experience of conscious entities corresponds to a sequence of SSFRs. In ordinary, "big" SFRs (BSFRs) the arrow of geometric time changes and this has dramatic implications.

2. "Consistent histories approach" (see this) is another option that was hoped to solve the measurement problem. It gives up the concept of unitary time evolution. Also this model is mathematically and conceptually hopelessly ugly. A mathematician could never consider such an option, but emergency does not read the law.

3. Wormholes as a cause or correlate of quantum entanglement is the third attempt to describe the situation. The problem is that they are unstable and the ER-EPR correspondence (see this) has not led to anything concrete even though there are scary big names behind it. Salih also suggests a connection with quantum computation but this connection is extremely obscure and requires something like AdS/CFT.

   Here, however, I think Salih is on the right track in that he has realized that the solution to the problem is at the space-time level. The ordinary trivial topology of Minkowski space is not enough. The question is how to describe geometric objects like this experimental setup on a fundamental level. In the standard model, they are described phenomenologically by means of matter densities, and this is of course not enough at the quantum level.

## 2 TGD view of counterportation

What does TGD say? TGD (the appendix of [L6] gives a brief summmary of basic ideas and notions of TGD) brings a new ontology both at the space-time level and in quantum measurement theory.

1. In addition to elementary particles, TGD brings to quantum physics the geometric and topological degrees of freedom related to the space-time surfaces. A description of the observed physical objects of different scales is obtained: typically they correspond to a non-trivial space-time topology. Spacetime is not a flat $M^4$, not even its slightly curved GRT variant, but a topologically extremely complex 4-surface with a fractal structure: space-time sheets glued to larger space-time sheets by wormhole contacts, monopole flux tubes, etc...

   (a) The system just considered corresponds to two different space-time topologies. Photons can travel a) along path A (blocking) or b) along both paths A and B simultaneously (no blocking).

   (b) Bob has a spacetime the competence of a topology engineer and can decide which option is realized by blocking or opening channel B by changing the spacetime topology.

   (c) Describing this operation as a quantum jump means that Bob is quantum-entangled with the geometric and topological degrees of freedom of channel B. The initial state is a superposition of open B and closed B. Bob measures whether the channel is open

or closed and gets the result "open" or "closed". The outcome determines what Alice observes. Monopole flux tubes replacing wormholes of GRT serve as correlates and prerequisites for this entanglement.

The controlled qubit (channel B open or closed) is macro- or at least nanoscopic and cannot be represented by the spin states of an elementary particle.

Note that the experimental arrangement under consideration corresponds logically to cnot operation. If channel B is closed, nothing happens to the incoming signal and it ends up in D1. If B is open, then the signal ends up at detector D2. cnot would be realized by bringing in Bob as the controller that affects the space-time topology.

2. The second requirement is quantum coherence in meso- or even macroscopic scales. Number-theoretic TGD predicts a hierarchy of effective Planck's constants $h_{eff}$, which label to the phases of ordinary matter, which can be quantum-coherent on an arbitrarily long length and time scales. These phases behave like dark matter and explain the missing baryonic matter whereas dark energy in the TGD sense explains galactic dark matter. They enable quantum coherence at the nano- and macro levels.

These two new elements of TGD make possible quantum entanglement in mesoscopic, macroscopic and even astrophysical scales and bring to quantum computation the hierarchy of Planck constants. This has dramatic implications: consider only the stability of the qubits against thermal perturbations implied by the fact that the cyclotron energy scale increases by the factor $h_{eff}/h_0$.

1. Braided monopole flux tubes making possible topological quantum computation in turn stabilize the computations at the space-time level. In ordinary topological quantum computations the braiding is fixed. Now the braiding could become dynamical since reconnection of flux tubes would change the topology of the topological quantum computer as a braid.

2. U-shaped monopole flux tubes emanating from two systems can reconnect to form a pair of monopole flux tubes connecting two systems. This makes possible quantum entanglement between them. The reconnection could provide a fundamental realization of the blocking and its reverse operation. In quantum biology biocatalysis would be based on this process controlled by magnetic bodies carrying dark matter and acting in the role of "boss". Entire control hierarchies of magnetic bodies could be involved and realize controlled operations cX and also higher level controlled operations c..cX.

There are also deep implications for the classical computation [L4, L5, L3].

1. Classical computers could become conscious, intelligent entities in the TGD Universe if a quantum coherence time assignable to the computer exceeds the clock period [L4, L5, L7]. The TGD view of the role of classical gravitational and electric fields [L2, L1, L3] makes this possible. Also the entanglement of living entities with computers could make it a part of the living entity.

2. The control of computers by living entities using a cnot-coupling making possible counterportation could make possible human-quantum computer interaction if ordinary computers can have quantum coherence in time scales longer than clock period (in principle possible in the TGD Universe!).

As a matter of fact, there is evidence for the interaction between computers and living matter [J2]. A chicken gets marked to a robot and the behavior of the robot begins to correlate with that of the chicken! Maybe a cnot-coupling with the random number generator of the robot is involved! Here the TGD view of classical fields and long length scale quantum coherence associated with the classical electric and magnetic fields and gravitational fields might allow us to understand what is involved [L2, L1, L3].

1. The gravitational field of the Sun corresponds to gravitational Compton time of 50 Hz, average EEG frequency? Does this mean that we have already become entangled with our computers without realizing what has happened: who uses whom? The Earth's gravitational field corresponds to Compton frequency 67 GHz, a typical frequency for biomolecules. D The clock frequencies for the computers are approaching this limit.

2. The analogous Compton frequencies for the electric fields of Sun and Earth [L3] are also highly interesting besides the cyclotron frequencies for monopole flux tubes, in particular for those carrying "endogenous" magnetic field of $2/5B_E = .2$ Gauss postulated by Blackman [J1] to explain his strange findings about the strange effects of ELF radiation at EEG frequencies on the vertebrate brain.

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