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Is it possible to travel in Time?

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Introduction

As Wikipedia writes (see Section "Time Travel"), Time travelling idea started in science fiction since 19th century. The writers, philosophers, and scientists innumerable times discussed this idea. Particularly, one debates the question: is there a natural fundamental law which is violated while one travels in Time?

I would like propose two objections against such the type of travel. The first one is based on the common modern representations; I will call it "the Wheeler-Feynman's argument". The second objection ("the geometrical argument") is based on cosmological representations. Additionally, we will consider a Time travelling using "wormholes" in spacetime.

The Wheeler-Feynman's argument

The great American physicist R. Feynman paid many attention to the Time problem in the radiation theory. He and his scientific adviser – the patriarch of the American physics J. Wheeler – proposed (**[Wheeler and Feynman, 1945]**) the idea to use the *advanced* (i.e., that propagate *backwards in Time*) potentials in order to describe the distant interaction between particles and explain the radiative friction force. Then, in the next work **[Wheeler and Feynman, 1949]**, they studied "the advanced action paradox" that hypothetically could violate the causality principle (for example, when a boy kill in the Past his grandfather and excludes by this the own birth possibility). Solving the paradox they proposed to forbid the *closed timelike curves* (looped world lines) of particles.

Later, in his Nobel Prize Lecture **[Feynman, 1965]** Feynman described as Wheeler called him and said that one could interpret a collision between an electron and positron like world line turn backwards into the Past: the charge sign changing is equal to the electrical charge and proper time one (it is known as CPT symmetry theorem). And Feynman supported this idea: one can think of positrons simply as electrons travelling from the Future to the Past.

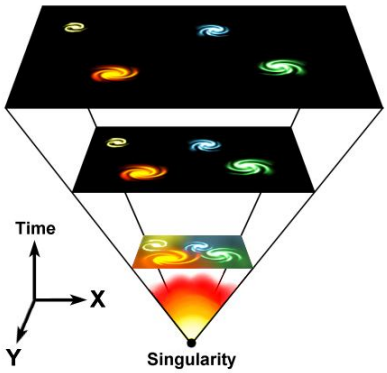
But this means that any Time Machine starting into the *Past* that contained particularly electrons and protons will immediately transformed to an object containing *positrons* and *anti-protons*. As result, such the object will instantly annihilate with its environment. By the way, this annihilation resolves the important problem of the matter/energy conservation while the Time Machine moves: the nontrivial travel in Time leads to the very power energy liberation and the Machine physical destroying. What about a hypothetical travelling *towards the Time* it should lead to the *energy absorption*.

Thus, the ban on a *closed timelike curves* deduced initially from causality becomes to be grounded by the reasonable "energetic" base: the points of turn in Time are special ones because a nontrivial liberation or absorption happen there perhaps accompanied by the objects destroying. And if a travelling backwards in Time were possible the traveler could not return in his Present.

Geometrical argument

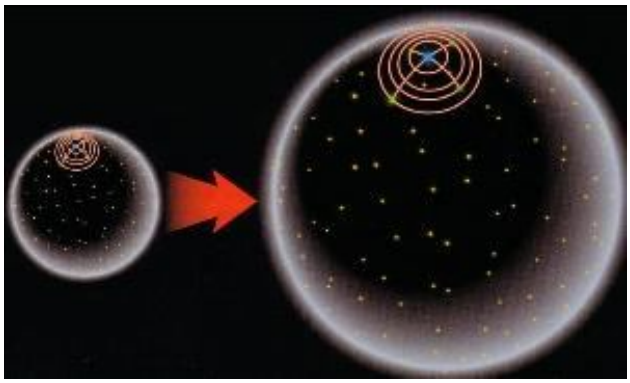
It useful to note that in fact any travelling (and even rest state) turns out to be the travel in *Time*, since the stream of Time is the more general process in the Universe. Because of that we have to precise what namely travels seem to be *paradoxical*.

There exists different geometrical models of the Universe. The most of astrophysicists believe now that the real Universe geometry is near to the “flat” one (at left), and its expansion is specified by so-called “scale factor”. However, it is possible that our Universe has the closed geometry, i.e., represents 3D hypersurface of a 4D sphere (at right), in this case the scale factor is identified with the sphere radius.



The Universe open model

[Image from http://ru.wikipedia.org/wiki/%D0%A4%D0%B0%D0%B9%D0%BB:Universe_expansion.png]



The Universe closed model

[Image from http://galspace.spb.ru/index60.file/ras.jpg]

In any case a scale factor value corresponds to a time point like correspondence between the age of a tree and its annual rings. Such the parameterization allows us to talk about some kind of the time “layers”. This layer is a general cosmic time for the whole Universe and is not linked with the local time interval of the Special Relativity.

As it is well known, the Special Relativity suggests the following way “to travel into the Future”: a voyager starts to travel using superfast rocket and then returns to the initial space point where he discovers that 100 years passed on Earth while he-self spent only one year in his rocket. In this case we mean a different rate of the *local* time in the rocket and on the Earth. However, the rocket and the Earth are included in the same layer (having increasing scalar factor) of the global (comoving) cosmic time and never leave this layer. It is impossible to “jump” from one layer into another one (if a set of layers exists), the world line of a body can appertain to the single Universe realization.

Outside of our Universe?

At the end of the 20th century the astrophysisists started to theoretically study very exotic objects (some kind of BH’s one-half fraction) that are called “wormholes” (hypothetical timespace tunnels). One of such the fractions (as they believe) can take out a matter from our Universe. Moreover, they suggest that another half fraction exists and may lead the matter into another universe or in our Universe at infinity distant time point (in future or in past). Note, this other half fraction should be similar to a “white” hole (not a black one), however, such the objects existence is very problematic.

There exist many investigations of these phenomena which are as well interesting as fashionable. Many works contain serious and intriguing results about the wormhole's properties. However, a possibility to displace between the time layers requires, before all, to have a model of a medium (outside of our Universe) where such the displacement was possible. No similar model exists now in the science. Moreover, one cannot describe any navigation during such the displacement.

Thus, I believe, the time machine is a beautiful dream that has not any real base.

References:

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