Review of: "Why Backward Time Travel Is Not Possible"

David Escors-Murugarren[1]

1 Universidad Pública de Navarra

Potential competing interests: No potential competing interests to declare.

The preprint by Krechmer is not really a scientific paper, but an opinion paper without formulae at any time. Nevertheless, I have an idea what the author means with his essay, which I summarize as follows, indicating all the drawbacks to the author.

As a starting point, we have the following statement from General Relativity, which is invariant and true in any coordinate system:

$$u^{\mu}u_{\mu} = -c^2$$

This is the magnitude-“squared” of the 4-velocity vector, but represented as it should be. Not with squaring the vector, but with tensor contraction of the vector with itself which gives a negative number. No problems with that. But in this case I am using the -+++ Lorentzian signature, which does not mean that the magnitude of the 4-velocity vector as a whole is an irrational number. If we use the other alternative Lorentzian signature (+---), then we have:

$$u^{\mu}u_{\mu} = c^2$$

The sign of this statement, which it is precisely what Krechmer is reflecting upon, does not imply going forwards or backwards in time, but the type of Lorentzian signature that we are using in the pseudoRiemannian manifold.

It is true that:

$$u^{t}u_{t} = c^2 - u^{\alpha}u_{\alpha}$$

In this case, the magnitude of the time component of the 4-velocity vector will change sign if the magnitude (squared) of the space-component of the 4-velocity vector is above c-squared. This take place in the interior of a black hole, or associated to tachyonic particles. However, most physicists interpret this change of sign after crossing the event horizon as a change in “quality”, whereby time behaves as space, and space as time. These are mathematical coordinates, and should be interpreted as such. This avoids clashing with the causality principle. But it can indeed happen (from a mathematical point of view, at least). For tachyons, well, they are theoretical particles that would be “travelling back in time”. But whether they exist or not, is currently a matter of speculation. But in principle you can have them from a

theoretical point of view.