Qeios

Peer Review

Review of: "Is the Observational Dark Energy Universe Completely a Coincidence?"

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The work proposes an idea where a "cosmological constant" term arises in the Einstein field equation due to relative acceleration between different patches of the observable universe. Such accelerations naturally exist, as the author points out, like galaxies and clusters of galaxies colliding with each other. Another important aspect of the work is the introduction of the notion of "4D spacetime volume conservation." Overall, I find the idea quite novel. My queries, some of which stem from my curiosity, are as below:

1. As the author also points out, her introduced notion of 4D volume conservation is parallel to the thermodynamic explanation of Einstein's equation by Jacobson, in which the Einstein field equation results from the thermodynamic energy conservation equation. Conservation of energy can be related to time translation symmetry via Noether's theorem. Can the author say what kind of symmetry her introduced notion of 4D volume conservation can correspond to?
2. The author arrives at Eq. 14 by dropping the 2nd order terms in the Raychaudhuri equation. I wonder what the motivation is behind ignoring the 2nd order terms. Even if the author says that she assumes the universe to be almost FLRW, that justifies ignoring only the \sigma^2 term. What about the \theta^2 and \xi^2 terms?
3. Below Eq. (15), the author assumes the relation g^{ab}\xi_a\xi_b=-1. I think this relation holds only if \xi_a is geodesic (\alpha=0). Just do the \xi^c\nabla_c of both sides.
4. The author assumes \alpha=\alpha(\tau). However, if \alpha=\alpha(\tau) for all the patches, then according to textbook GR, a reparametrization \tau\to\tau^* is always possible such that with respect to \tau^*, the geodesic equation takes the usual form with the r.h.s. zero. Such a reparametrization would not be possible if different patches have different \alpha(\tau). In other words, I believe there should be an inhomogeneity in \alpha.
5. In section III, there is a paragraph above Eq. 21 which starts as "The argument is that....." In that paragraph, the author deduces \sigma^(\alpha)\sim\rho_m. I did not quite understand how the author arrived at this conclusion. Could the author provide more explanation?

I am happy to recommend this preprint for publication given these queries are satisfactorily addressed.

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Declarations

Potential competing interests: No potential competing interests to declare.