Review of: "Dark Energy as an intrinsic property of Matter"

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Potential competing interests: No potential competing interests to declare.

This paper postulates a dark energy/dark matter unification scheme, in which the basic model is a mixture of 1 part “stiff” matter to 2 parts “vacuum energy”. This results in a “coasting” (d^2a/dt^2=0) cosmology, and the total density evolves in a C/a^2 kind of behavior. It then shows an energy momentum tensor of this type can arise from a scalar field, and that the 1 to 2 ration can be interpreted as analagous to virial equilibrium. This basic idea could be further refined in future papers to see how well observations can be fit, which may lead to interesting models. There are however a few points which could be addressed to improve the current paper.

Section IIIC : there is an argument featuring moving all of the density of a sphere onto its surface (it is not clear whether the “pressure” is allowed to stay put or if it is also confined to the surface, although confining the pressure to the surface would cause its own set of problems that I will get into later). A claim is made that this results in a surface tension, when it would result in a surface density. Also, there are subtleties with treating singular shells in general relativity (the so called “junction conditions”) which are not present in the Newtonian framework and don't seem to be dealt with here. It is incidentally a consequence of the junction conditions a spherical surface may have a surface tension and surface density, but cannot have the third component of the pressure projected onto it. There is also a claim that the trace of the energy momentum tensor is the gravitational mass term, which appears to be interpreted in this paper as the trace of the mixed index tensor. However, in the Komar mass formula we have -T^0_0 rather than T^0_0 and the post Newtonian approximation (see equation 5) we have epsilon rather than -epsilon. Note these can be written as a trace, but over the components of T with matching (not mixed) indices in a Local Lorentz frame.

In section IIID it shows how the stiff matter/ vacuum energy mixture can be interpreted as a scalar field. It might be helpful to give the action for the scalar field, as there seems to be differing conventions on the sign of the “kinetic term” (specifically in the GR textbooks I was looking at there was a - sign which would transfer through to - signs on the “m” terms, but in some other sources I saw the kinetic terms were positive). Also, while I found a way to derive equation 28 from dividing the conservation equation by the total density, I did not see how to get it from the Klein Gordon equation 27, maybe some additional words are needed here.

In section IVA, it is used that the inhomogeneous cosmology is stationary, it is not obvious to me that this should be the case as inhomogeneities may in principle grow, shrink, or migrate. It also may be helpful to remind the readers of the form Euler's equation takes in this situation.