Title: Thoughts on vacuum growth

Date: Sep 06, 2006 05:00 PM

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Abstract:

- Vacuum effects may violate energy conservation
    - mode creation (Danielsson, ...)
    - causet fluctuations (Sorkin, ...)

- Bianchi identity $G_{ab} = 8\pi G T_{ab}$

$$\nabla^a G_{ab} \equiv 0 \quad \Rightarrow \quad \nabla^a T_{ab} = 0$$

must relax Einstein eq'n.

- In FRW symmetry

$$G_{tt} = 8\pi G T_{tt} \to H^2 = \frac{8\pi G}{3}\rho.$$

$$G_{rr} = 8\pi G T_{rr} \longrightarrow \ddot{a} = \dots$$

$$\nabla^a T_{at} = 0 \to \dot{\rho} + 3\frac{\dot{a}}{a}(\rho + p) = 0$$

So G_{rr} can be replaced by $\nabla^a T_{at} = 0$.

If $\nabla^a T_{at} = q \neq 0$ can use this instead...

- Covariant formulation of this: drop trace (Danielsson) of Einstein eq'n, i.e. impose only

$$G_{ab} = 8\pi G T_{ab} + \Phi g_{ab}, \qquad \Phi \text{ arbitrary function}$$

Follows from "unimodular gravity" (det g = fixed)

or from derivation of Einstein eq'n as eq'n of state.

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- But violation of energy conservation cannot be arbitrary:

$$8\pi G \, \nabla^a T_{ab} + \nabla_b \Phi = 0 .$$

i.e. $\nabla^a T_{ab}$ is <u>gradient of a scalar</u> $(\ast)$

→ Automatic for RW symmetry

→ fails already for Bianchi models (anisotropic) let alone generally.

- Is there a way to guarantee $(\ast)$?

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