On the physical origin of the dark energy component: a revival of the vacuum contribution.

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Historical aspects

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\[ p = -\rho \] (1)
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So is this the origin of the acceleration?
Historical aspects

No!
The Vacuum catastroph (Weinberg, 1989):

\[ \rho_v = \langle 0 | T^{00} | 0 \rangle = \frac{1}{2(2\pi)^3} \int_{0}^{+\infty} k \, d^3k \]

highly divergent.
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highly divergent:

\[
\rho_v(k_c) \propto \frac{k_c^4}{16\pi^2}
\]
Equation of state

The pressure:

$$p_v = \frac{1}{3} \sum_i \langle 0 | T^{ii} | 0 \rangle = \frac{1}{3} \frac{1}{2(2\pi)^3} \int_0^{+\infty} k \, d^3k$$
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→ usual conclusion on zero-point energy contribution.
Casimir effect

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Brown & Maclay (1968)
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Casimir effect from from higher dimension

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Now let’s assume that physics of cancellation of the vacuum contribution occured at high energy when the radius $R = R_i$ then (after integration over 5th dim):
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Now let's assume that physics of cancellation of the vacuum contribution occurred at high energy when the radius $R = R_i$ then (after integration over 5th dim):

$$\rho_v = \int_0^{2\pi R} \rho_v^{5D} \, dx^5 = \frac{15\hbar c\zeta(5)}{64\pi^6 R^4} \left[ \left( \frac{R}{R_i} \right)^5 - 1 \right]$$
That’s it!

Choose $R_i$ and $R(< 50\mu m)$ to match $\Omega_\Lambda$. 
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corresponding to energy of $\sim 1$ TeV
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Conclusion

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Acceleration could be the direct manifestation of the quantum gravitational vacuum.