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Hypothesis

The Way To Solve ‘Dark Energy’ Problem Use Black Hole Property Without Ad Hoc Dark Energy Solution

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Abstract: Dark energy is hypothesized to explain both the curvature of the universe and its accelerated expansion, yet its true nature remains elusive. In this paper, we propose a novel approach to explain dark energy using the properties of black holes. By considering the contribution of the energy-momentum tensor of black holes, often neglected in cosmological models, we demonstrate that ignoring this component can lead to the observed effects attributed to dark energy. Furthermore, we explore a logical paradox involving observability and causality, arguing that this paradox supports the isotropic and instantaneous nature of dark energy effects. Finally, we connect our theoretical framework to observational data, particularly the growth of supermassive black holes (SMBHs) and their relationship to cosmic expansion, providing an empirical foundation for our hypothesis.

Keywords: General relativity; black holes; dark energy

We propose that the cosmological “dark energy” may be an emergent artifact of neglecting the energy–momentum tensor of black holes, $T_{\mu\nu_BH}$, in standard cosmological models. Retaining this term ensures total conservation $\nabla_\mu T_{\mu\nu_obs} + \nabla_\mu T_{\mu\nu_BH} = 0$, so that observers who omit $T_{\mu\nu_BH}$ perceive an extra source term that mimics a positive curvature, negative-pressure fluid. We identify a causality/observability paradox that enforces isotropy and apparent instantaneous action, matching the uniformity of dark energy. Finally, we connect our framework to observational evidence for cosmological coupling of supermassive black holes—whose mass growth $\propto t^3$ reproduces the time-evolution of dark energy inferred from DESI, supernovae, and the CMB—thus providing an empirical foundation for our hypothesis.

2.1. Mathematical Explanation

At the cosmological scale, the total energy-momentum tensor $T_{\mu\nu}$ should be conserved. This is expressed mathematically as:

$$\nabla_\mu T_{\mu\nu} = 0$$

Here,

∇_μ represents the covariant derivative, which is fundamental in the framework of general relativity. Even though different detectors might define energy differently based on their positions, local energy conservation holds.

However, in actual observations, we can only measure the observable part of the energy-momentum tensor $T_{\mu\nu_obs}$, while ignoring the contribution from inside black holes, there are $T_{\mu\nu_BH}$,

Thus, the total energy-momentum tensor can be written as:

$$T_{\mu\nu} = T_{\mu\nu_obs} + T_{\mu\nu_BH}$$

Substituting this into the conservation equation, we can get:

$$\nabla_\mu T_{\mu\nu_obs} + \nabla_\mu T_{\mu\nu_BH} = 0$$

The first term represents the conservation of the observable energy-momentum tensor, while the second term represents the conservation of the ignored black hole energy-momentum tensor.

Since we neglect $\nabla_{\mu}T_{\mu\nu_BH}$ in actual observations, the conservation equation for the observable energy-momentum tensor becomes:

$$\nabla_{\mu}T_{\mu\nu_obs} = - \nabla_{\mu}T_{\mu\nu_BH}$$

This equation shows that the conservation of the observable energy-momentum tensor deviates from true global conservation, with the difference depending on the ignored black hole energy-momentum tensor $\nabla_{\mu}T_{\mu\nu_BH}$.

In simpler terms, by ignoring the contribution of the black hole energy-momentum tensor, the observed average energy-momentum tensor is less than the true total value. This discrepancy could explain the effects attributed to dark energy.

3. Paradox

A paradox arises when we consider something beyond our worldline that cannot be detected. In this case, what exists beyond the worldline itself becomes a cause. For example, when we consider the energy tensor inside a black hole (which is, of course, beyond our light cone and worldline)

4. Exploring the Logic Paradox in Observability and Existence

lets set region U (shaded), hidden region H that $\notin U$ (including BH interiors).that $\nabla \cdot T_BH$ in H acts as an effective source term in U, despite H being spacelike or time like disconnected."

The variable that

$$\nabla_{\mu}T_{\mu\nu_obs} \equiv N$$

where $N \equiv -\nabla_{\mu}T_{\mu\nu_BH}$.

N is nonzero, but its origin lies behind our horizon—how can it influence T_obs locally without violating c?

here is the paradox, if they have this kind of casulaity, that mean they will not in same lightcone, thats the point, even you reverse it (remember they are not just definitional ,but with energy tensor exchange)

5.....

$ds^2=-g_{00}(x)dt^2+g_{ij}(x)dx^i dx^j$,that's the equation we usually used to know can they have causality because another point a is defined by us than when and only when $\nabla_{\mu}T_{\mu\nu}/ds^2 =0$,point b cant defined(because we cant Distinguish everypoint with b,so cant be defined)

remember it it is isotropic that mean it will have dark energy property because negative energy tensor at total and have no momentum and have same negative pressure in every space dimension (because of isotropic)

because this effect is isotropic so we cant get any useful information inside because it have the biggest amount of enotropy

6. Data Support

Ducan Farrah et al. (2023) found that within the cosmological time range of $0 < z \leq 2.5$, the mass of supermassive black holes (SMBHs) in elliptical galaxies grew 8-20 times compared to the stellar mass, with a median growth factor of 15.7 ± 2.5 . The authors further analyzed and found that the SMBH mass exhibits a power-law dependence on the cosmological redshift z , which can be expressed as $M_{SMBH} \propto (1+z)^{3.1 \pm 0.3}$. This redshift dependence is consistent with a model with a cosmological coupling strength of $k \approx 3$,an in contrast to the traditional Kerr black hole solution ($k = 0$), which was excluded with a probability as high as 99.98% [Observational Evidence for Cosmological Coupling of Black Holes and its Implications for an Astrophysical Source of Dark Energy.][paper name] From The Astrophysical Journal Letters,

The formula this paper give is

$$M(a) = M(a_i) \left(\frac{a}{a_i} \right)^k \quad a \geq a_i,$$

where a_i is the scale factor at which the object becomes cosmologically coupled and k bigger or equal to zero is the cosmological coupling strength(when it is 3 it will offset the -3 square in freedman formula and become zero just like comsmo constant(?)

Kevin S. Croker et al.[2024]’s Observations of supermassive black holes (SMBHs) in elliptical galaxies suggest their masses grow cosmologically in proportion to $m \propto a^3$, consistent with the predictions of this model. This growth cannot be fully explained by accretion or mergers alone. Recent results from the DESI (Dark Energy Spectroscopic Instrument) collaboration show that dark energy evolves with time, deviating from a pure cosmological constant (Λ). The time-evolution of dark energy density predicted by cosmologically coupled black holes closely follows DESI’s results for redshifts $z \lesssim 3$

It also give Statistical Evidence that The model fits observational data from DESI, supernovae, and the cosmic microwave background (CMB) with fewer parameters than alternative dark energy models like the w_0w_a parameterization.For example, the model predicts a Hubble constant of $H_0 = 69.94 \pm 0.81 \text{ km s}^{-1} \text{ Mpc}^{-1}$, which reduces the tension between early-universe (Planck) and late-universe (SH0ES) measurements.

Those papers support black hole growth has a relation between dark energy density so they give strong evidence we can prove black hole and dark energy ,universe expand is related

7. Another Explanation

In other paper’,Can black holes be a source of dark energy?’by Serge Parnovsky ,they once use black hole still conservation that the dark energy is not ,but they not consider all our data base in observable and part 2 appearly reject this.And the point it have no negative pressure make a mistake at first that dark energy is happen in outside the black hole but not inside ,that is actually a misunderstanding confusion.[by part 4,negative pressure property actually because of the paradox.

9. Conclusion

In this work, we have proposed a novel explanation for the nature of dark energy by considering the often-overlooked contributions of black hole energy-momentum tensors to the total energy-momentum tensor of the universe. Through mathematical analysis, we demonstrated that neglecting these contributions can result in observable effects that mimic the properties of dark energy, such as negative pressure, isotropy, and instantaneous influence.

Furthermore, we explored a logical paradox involving observability and causality, showing that the exclusion of black hole tensors introduces self-referential inconsistencies. These inconsistencies align with the isotropic and universal nature of dark energy, providing a potential theoretical basis for its effects beyond the framework of the cosmological constant.

Finally, we grounded our hypothesis in observational evidence, such as the cosmological coupling of supermassive black holes (SMBHs), their growth rates, and their relationship to cosmic expansion. These findings suggest that black holes may play a critical role in the evolution of the universe and the effects attributed to dark energy.

While this work is an early exploration, it opens new possibilities for understanding dark energy without relying on ad hoc solutions. Further research is needed to refine the mathematical framework, test predictions, and explore the broader implications of this hypothesis. If validated, this approach could bridge the gap between black hole physics and cosmology, addressing one of the greatest mysteries of modern science.

References

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2. Kevin S. Croker *et al* JCAP10(2024)094 DESI dark energy time evolution is recovered by cosmologically coupled black holes
3. Serge Parnovsky Can black holes be a source of dark energy? arXiv:2302.13333

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