Further Evidence that Dark Energy is Cosmic Gravity

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Abstract

I have proposed that Dark Energy is the gravitational pull of the cosmos. This second paper summaries some of the additional evidence which supports my speculation. Follow the data, not the crowd.

Two predictions -

1. The rate of expansion of the universe will increase with time as the gravitational pull of the cosmos increases as we move out into the cosmos.
2. The expansion of our universe will not be isotropic. There will be dipole in the direction of the biggest and/or closest mass out there.

The debate on the correct value of Ho continues. I don't want to spoil a good argument but they could both be right.
An anisotropic universe will be strongly resisted but there is now even more evidence of a dipole in the sky.

While the prospect of 'new physics' has much appeal there could be a much simpler explanation. Change the assumptions about the size of the universe and some of the biggest problems in cosmology can be explained.

The universe has always been much bigger than we thought.

Introduction

In this paper I return to my theory that Dark Energy is the gravitational pull of the cosmos. Many papers have now been published supporting the idea that the acceleration rate of the universe is increasing with time. Now it is accepted as a consensus but nobody can explain why.
Recently, even the assumption that the universe is isotropic has been questioned.

My theory makes 2 predictions which are both testable and falsifiable.

1. The rate of expansion of the universe will increase with time as the gravitational pull increases as we move out into the cosmos.
2. The local cosmos is unlikely to be homogeneous so the expansion will not be isotropic. There will be dipole in the direction of the biggest and/or closest mass out there.

If they are both correct then the possibility of a 'Megaverse' must at least be investigated. Megaverse is an assumption that our universe, created from the Big Bang, is only a part of a much bigger, more massive and older cosmos.

Some of the biggest problems in cosmology may be explained by just changing the 'priors'. Assume that the cosmos is bigger and older and it all becomes much simpler.

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Dark Energy

1998, two teams of researchers discover Dark Energy. Unexpectedly the expansion of the universe is not slowing down but is accelerating.

20 years later, another shock. Even this acceleration is not constant, but is increasing with time.
2020 another potential shock. The expansion, whatever it is, is not isotropic. It is stronger in the direction of the dipole in the CMB.
Prediction:- This one will be fiercely contested. An isotropic universe is necessary for the standard model.

In my paper, "What Is Dark energy?" published in viXra 1901.0451 on 29th January 2019, I proposed that Dark Energy was the gravitational pull of the cosmos.

The assumption that our observable universe is not alone in the cosmos may be seen as the stuff of science fiction, but we should remember that the universe has always been much bigger and older than we thought. Changing the initial assumptions about the size and age of the cosmos may help to explain some of the biggest challenges facing cosmology and, without introducing new physics.

Dark Energy is increasing with time

In "What is Dark Energy?" I quoted Risaliti and Luss, Nature Astronomy 3,272-277(2019) "Cosmological constraints from the Hubble diagram of quasars at high redshifts." (1)
"a deviation from the ΛCDM model emerges at higher redshift, with a statistical significance of ~4σ. If an evolution of the dark energy equation of state is allowed, *the data suggest dark energy density increasing with time*."

Back then there were few papers supporting the idea that Dark Energy was increasing with time.

Since then many more papers have been published on the tension in Ho and concluding that Dark Energy is increasing with time. The KITP Conference in July

2019: “Tension between the Early and Late Universe” in Santa Barbara has been well reported, mainly along the lines of “Tension or Crisis in Cosmology” Most commentators now conclude that the Hubble discrepancy is a real problem, we are missing some important physics somewhere.
Now I do not want to spoil a good argument, but if our universe is under the gravitational pull of the cosmos then both the Planck value and the SHoES result could be correct.

July 2019, another paper from Chen et al. (2). Using adaptive optics technology on the W.M. Keck telescopes in Hawaii, they arrived at an Ho of 76.8. Speaking to Science Daily - "More and more scientists believe there's a real tension here," Chen said. "If we try to come up with a theory, it has to explain everything at once."

October 2019, Risaliti et al again.Investigating Dark Energy Equation of State With High Redshift Hubble Diagram (3)
Here they state,
"This result not only confirms the tension previously detected, but shows that it is not an artifact of cosmographic expansions."

I think it is now fair to say that there is a consensus that the **rate of expansion of the universe is increasing with time. Dark Energy is increasing with time.**

But why?

As Barnes and Lewis say in their great little book, “The Cosmic Revolutionary’s Handbook”, you have to explain all the data. LCDM cannot explain why Dark Energy is increasing with time. In truth the standard model can’t explain what Dark Energy is at all.

We have no idea what Dark Energy is. Vacuum energy, always a vacuous explanation, cannot explain an increasing rate of expansion. If Dark Energy is a constant then the rate of expansion should be slowing down.

Avi Loeb and Lisa Randall have both come up with alternative theories. Both admit that they are not satisfied with the results.

Loeb (4) is not happy with his Late Universe Decaying Dark Matter, “you add two free parameters in order to resolve one discrepancy — and I’m uneasy about that”. Randall (5) devised a “rock ’n’ roll” solution to the Hubble tension. The density of dark energy oscillates, or rocks, while in others it rolls down from a high value to zero. But in all cases, the early dark energy must disappear after a few hundred thousand years. “The tricky part is that [early dark energy] can’t really stick around; it has to go away quickly,”.

No need for new physics. It’s just gravity.

Is the Universe really Isotropic?

A prediction of cosmic gravity is that the expansion of our universe will not be isotropic. There will be a dipole aligned towards the most significant mass of the cosmos.

Our galaxy is subject to the gravitational forces of our local universe producing so-called ‘peculiar’ velocities within our local cluster. Similarly, our universe will be subject to the gravitational pull of the local cosmos. This will result in expansion rates differing in different directions.

Now the new data on an anisotropic universe is far from substantial. There is certainly no consensus on a real dipole in the expansion of the universe. But do remember, it is only a couple of years ago that Dark Energy was definitely constant.

Professor Subir Sarkar of Oxford University has written much on the subject of the measurements of Dark Energy. Here I refer to an interview given with Dr Sabine Hossenfelder published on YouTube on 2nd March 2020. (6)

His team finds no evidence for acceleration, but a cosmic flow of spacetime in the same direction as the CMB dipole. Our galaxy is moving in the same direction as the dipole but 4x faster. (He gives credit to Singer who found this prior but was discounted). Bottom line he says *"Evidence for isotropic acceleration is non-existent, and it is this that has had a major impact not just on cosmology but also fundamental physics."*

" The universe is accelerating in one direction and decelerating in the opposite direction. This direction is pretty close to the CMB dipole, it's within 23 degrees."

" The evidence for an isometric acceleration is non existent."

"Interpreting this as due to vacuum energy is not what is written in the sky."

"We found that the velocity was in the same direction as the CMB dipole but it was 4 times larger."

Prof Sargar is of course careful to say;

"I want to emphasise that this does not mean that the universe has an axis. It means that the sample of supernovae that have been so far observed show this dipole. What one makes of this is another matter. I'm not commenting here. It's hard to imagine how the universe could have an axis and how one could have a directionality in the metric."

But there's more.

In April 2020 a paper by Kostas Migkas et al (7) was published which is consistent with Prof Sargar's conclusions. It raised quite a storm.

Astronomers have assumed for decades that the Universe is expanding at the same rate in all directions. The study based on data from ESA's XMM-Newton, NASA's Chandra and the German-led ROSAT X-ray observatories suggests this key premise of cosmology might be wrong. I quote extensively from the blog of **Kostas Migkas**, a doctoral researcher in the Argelander Institute of Astronomy of the University of Bonn, Germany.

"However, in about the last 4 billion years the so-called dark energy became the dominant element that drives the evolution of the Universe, constituting 70% of the latter's total content. Its baffling nature has not yet allowed astrophysicists to understand it properly. Therefore, assuming it to be isotropic is almost a leap of faith for now. This highlights the urgent need to investigate if today's Universe is isotropic or not.

In our first study in 2018, we came upon some intriguing results! That's why we decided to look into this more carefully and with more data. To do so, we analyzed 313 galaxy clusters using the Chandra and XMM-Newton telescopes and we combined them with 529 available clusters from previous studies. What we found was even more impressive than our 2018 results. We managed to pinpoint a region that seems to expand slower than the rest of the Universe, and one that seems to expand faster! Interestingly, our results agree with several previous studies that used other methods, with the difference that we identified this "anisotropy" in the sky with a much higher confidence and using objects covering the whole sky more uniformly.

So did we tear down one of the most crucial pillars of cosmology? Not so fast, it is not that simple. At least two scenarios may have led us to wrong conclusions.

Firstly, cosmic material might interfere with the light that travels from the clusters to the Earth. For example, previously unknown gas and dust clouds beyond the Milky Way could obscure a fraction of photons emitted from the clusters. Since we ignore the possible existence of such clouds, we do not account for their interference, and *hence we would falsely underestimate the true luminosity of the clusters. Eventually, we could mistake this for a cosmological effect. We performed several tests that led us to believe that this scenario seems unlikely, but not impossible. However, considering that the direction of the anisotropy we find agrees with other studies that used observations in light at different wavelengths, where such obscuring effects are not expected, one could argue against the possibility of such biases in our analysis.*

The second case is what we call "bulk flows". In a nutshell, some "superclusters" (groups of galaxy clusters!) exist that attract other clusters towards them through gravity. This can generate a coherent motion of some clusters (lying in the same sky region) towards a supercluster. But why is this important? Well, in our default analysis we assume that these "local" speeds of clusters, on top of the Universe's expansion speeds, are small and random and that they do not matter in general. If this condition is not met, then our assumption does not hold. This might result in wrong distance (hence luminosity) estimations, producing "fake" cosmological anomalies. This scenario is not far-fetched and more tests are required to deliver a definite conclusion, although such large correlated speeds are not easily expected.

If none of the above is true, then ***the hypothesis of an isotropic Universe may be under question and a cosmological paradigm shift is possibly required.*** (bold case is mine)

Of course for such a big change to occur, the astronomical community must perform other scrutinized tests obtaining consistent results every time.

The take-home message is this: the implications of this study could be profound either if a non-isotropic expansion of the Universe exists or if dominant bulk flow motion affects astronomers' measurements. Many studies in cosmology, including X-ray studies of galaxy clusters, assume that the Universe is isotropic and that correlated motions are not significant enough to consider them. Even if the mysterious gas and dust clouds are the origin of our results, the X-ray community *might need to revisit their results, if their data were coming from that mysterious sky region."*

More evidence for anisotropy from Migkas et al (8) in March 2021

"Through rigorous tests, we ensure that our analysis is not prone to generally known systematic biases and X-ray absorption issues. By combining all available information, we detect an apparent 9% spatial variation in the local H0 between (l,b)~(280◦+35◦−35◦,−15◦+20◦−20◦) and the rest of the sky. The observed anisotropy has a nearly dipole form. Using Monte Carlo simulations, we assess the statistical significance of the anisotropy to be >5σ. This result could also be attributed to a ~900 km/s bulk flow which seems to extend out to at least ~500 Mpc. These two effects are indistinguishable until more high−z clusters are observed by future all-sky surveys, such as eROSITA."

The eROSITA data should be available and analysed in the next 2 to 3 years.

Migkas argues that new physics that interfere with the directionality of the expansion rate would be needed to explain his results.
No new physics required, just change the assumptions about the size of the universe.

Fine Structure Constant

Yet another paper out suggesting a directionality in the universe. Professor John Webb of New South Wales university spoke on Spacetime with Stuart Gary, series 23, episode 47 about his new paper. (9)

From the Spacetime interview:-

"These new measurements (of the Fine Structure Constant, FSC) do not conflict with a directionality to the universe. In fact, a directionality is preferred over a non directionality when you take the data set as a whole.
What's new is that we have measurements which go back earlier, closer to the Big Bang time. They support the idea that there could be a directionality in the laws of physics."
"There is a bunch of other data which is entirely independent of my work on FSC which also suggests a directionality. Perhaps each is not especially compelling but they all seem to line up in the sky within the errors."
"We are above 3 sigma with our measurements alone. Whether we are up to 5 sigma with this collection, I don't know. I haven't looked into that."
" Several papers out there suggest directionality in the supernovae data and this lines up with the directionality in our FSC data."

Conclusion

There is now a consensus that the rate of expansion of the universe is increasing with time.
The universe may not be isotropic. More and more data is coming in to support this unwelcome idea.

Cosmic gravity can explain both of these. LCDM cannot. It explains a great deal about the structure of the universe. But how much does it tell us about the big questions of cosmology?

Cosmology:
"the scientific study of the origin, evolution, and eventual fate of the universe"
Wikipedia.
1. Origin - It tells us nothing about where all the stuff of the universe came from.

2. Evolution - It leaves 95% of our universe unexplained.

3. Fate - It tells us little about how the universe will end.

One change to the initial assumptions about our universe *may* explain Dark Energy, one of the biggest problems in cosmology.
Not only Dark Energy, but if the cosmos is bigger and older then the questions about how the universe started and how it will finish may also become much simpler.

The universe has always been much bigger and older than we thought.

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