

## Is There Any Spacetime Outside Our Universe

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### Abstract

In this essay, I discuss whether there is any spacetime outside our universe. If one claims that there is, then the question is: Which energy would justify the existence of that spacetime? This is because the universe as a whole does not have any energy. So this universe cannot justify the existence of any spacetime outside it, because without energy there cannot be any spacetime. As the total energy of the universe has always remained zero, so it is very much doubtful as to whether there was any spacetime outside our universe at any time.

**Keywords:** Spacetime, universe, existence, energy.

From special theory of relativity we come to know that matter and energy are equivalent. And from general theory of relativity we come to know that space, time and matter are interlinked and that there cannot be any space and time without matter. As matter and energy are equivalent, so we can also say here that there cannot be any space and time (or spacetime) without energy.

Sten Odenwald[1] has provided the following information on behalf of NASA Astronomy Cafe, part of the NASA Education and Public Outreach program:

*General relativity tells us that what we call space is just another feature of the gravitational field of the universe, so space and space-time can and do not exist apart from the matter and energy that creates the gravitational field. This is not speculation, but sound observation.*

Here we see what is stated in theory is also supported by sound observation.

Below are five links where it has been shown mathematically that the total energy of the universe is zero:

- 1) <http://iopscience.iop.org/article/10.1086/368258/pdf> (V. Faraoni and F. I. Cooperstock)
- 2) [http://www.scielo.br/scielo.php?pid=S0103-97332010000100001&script=sci\\_arttext](http://www.scielo.br/scielo.php?pid=S0103-97332010000100001&script=sci_arttext) (A. A. Sousa; J. S. Moura; R. B. Pereira)
- 3) <http://www.wall.org/~aron/blog/did-the-universe-begin-vii-more-about-zer...> (Aron Wall)
- 4) <http://arxiv.org/pdf/gr-qc/0605063.pdf> (Marcelo Samuel Berman)
- 5) [https://www.science20.com/hammock\\_physicist/all\\_zilch\\_much\\_ado\\_about\\_nothing\\_0](https://www.science20.com/hammock_physicist/all_zilch_much_ado_about_nothing_0) (Johannes Koelman)

Below are another six links where also it has been very clearly stated that the total energy of the universe is zero:

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- 1) <https://www.astrosociety.org/publications/a-universe-from-nothing/>  
(Alexei V. Filippenko and Jay M. Pasachoff)
- 2) <http://mxplx.com/meme/2098/> (Stephen Hawking)
- 3) <http://www.brainyquote.com/quotes/quotes/r/richardpf719034..html>

(Richard P Feynman)

- 4) <http://www.wsj.com/articles/SB10001424052748703946504575469653720549936> (Lawrence Krauss)
- 5) <https://www.independent.co.uk/arts-entertainment/is-the-universe-a-free-lunch-1340153.html>  
(Paul Davies)
- 6) <http://www.wall.org/~aron/blog/did-the-universe-begin-iv-quantum-eternity-theorem/> (Aron Wall)

So we can with some confidence say that the total energy of the universe is indeed zero.

So far we have come to know two things:

- 1) There cannot be any space and time without energy; and
- 2) The total energy of the universe is zero.

Now we want to know as to whether there is any spacetime outside our universe. If we claim that there is, then the question is: Which energy would justify the existence of that spacetime? This is because the universe as a whole does not have any energy. So this universe cannot justify the existence of any spacetime outside it, because without energy there cannot be any spacetime. So it is very much doubtful as to whether there is any spacetime at all outside our universe. As the total energy of the universe has always remained zero, so it is also very much doubtful as to whether there was any spacetime outside our universe at any time. This is as per the knowledge acquired from the present universe.

If it is still argued by anybody else that there could be other kinds of spacetime outside our known spacetime about which we do not know anything, then our question to that person will be this: From where has she acquired the knowledge that there can be spacetime without energy? Is it from the present universe? Or is it from some supernatural source? Or is it her own intuition?

If there cannot be any spacetime outside our universe, then can there be other universes beyond our universe?

## Reference

1. <https://einstein.stanford.edu/content/relativity/a11332.html>