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A FURTHER DISCUSSION ON THE FORCES THAT CAUSE THE UNIVERSE TO EXPAND

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Abstract:

This article makes more contribution on the discussion about the forces causing the universe to expand. It shows that the stars' radiation pressure force can not only push small matters such as interstellar dust away, but also can push big celestial bodies away. Gravitational lens effect can further help during the process of radiation pressure forces pushing away big celestial bodies. Then the interstellar dusts and big celestial bodies will exert continuous pulling forces to nearby bigger celestial bodies and cause the entire universe to expand. So after the total radiation of stars inside the universe decreases, the universe will start to contract. Another expansion may begin when the universe contract to a certain degree. Thus there can be a cycle of repeated expansion & contractions. When all the fusion materials are used up to a degree so that another expansion cannot happen, the universe will eventually contract together and form a hugest black hole. If this black hole becomes unstable, it will explode and form another universe.

Key Words: Universe Expansion; Space Expansion; Radiation Pressure Force; Light Pressure; Gravity; Gravitational Force; Cosmic Ray; Sunlight Pressure; Big Bang; Origin of Universe; Evolution of Universe

Main Text:

Inside the article <A Study on the Forces that Cause the Universe's Accelerating Expansion> and the article <A More Accurate Discussion on the Forces that Cause the Universe to Expand>, it was concluded that the total expanding force is bigger than the total contracting force inside our universe. But for huge celestial bodies, it is apparent that the pull of the gravitational force of our sun will be much bigger than the radiation pressure force push of the sun. So it is very much possible that much of the light pressure of the sun is imposed on the dusts of galaxies in the vast space inside the universe and pushes the dusts away from the sun. And then the dusts will help pull the celestial bodies near to the dusts away from the sun, just as a man can be pushed above ground by wind during paragliding.

It needs to be mentioned that the conclusion that the accelerating expansion of the universe is caused by forces but not by space expansion can probably be supported by the fact that even on very large intergalactic scale, galaxies still may not expand. A typical example is the famous "Great Attractor". Astronomical observations show that even galaxies are hundreds of millions of light years apart, they are still not influenced by the so-called space expansion and receding away from each other, but being attracted by the "Great Attractor" and all moving towards it.

Another important point is that: when radiation pressure forces cause the universe to expand,even for a big celestial bodies, it is possible that the pull of the gravitational force of our sun is smaller than the push of the radiation pressure force of the sun. This can be shown by the following calculation:

We already know that the power of the sun is $P_{sun}= 3.72\times10^{26}$W, so the energy per second is 3.72×10^{26}J.For every photon, $E=hc/\lambda$. And the average wavelength of the sun light is 5×10^{-7}meters.

So the number of photons the sun emits each second is:

$N=P_{sun}/E=P_{sun}\lambda/(hc)=3.72\times10^{26}\times5\times10^{-7}/(6.626\times10^{-34}\times 299792458)=9.36356\times10^{44}$

And the average force of the pressure of sunlight throughout its lifetime was calculated to be roughly (when sunlights are fully reflected):

$F_{total\ pressure}=1.33\times10^{21}$N.

Thus, for a photon, its pushing force is:

$F_{photon=}F_{total\ pressure}/N=1.33\times10^{21}N/9.36356\times10^{44}=1.42\times10^{-24}$N

And the total mass of the sun M_{sun} is 2×10^{30}kg, and the radius of the universe R is approximately 4.4×10^{26}m.

Thus, if the pushing force of one photon is in balance with the gravitational force of a celestial body which is located 4.4×10^{23}m(1/1000 of universe radius) away from the sun, the mass of this celestial body $M_{celestial\ body}$ will be:

(because $F_{sun\text{-}celestial\ body}=(GM_{sun}M_{celestial\ body})/R^2$)

$M_{celestial\ body}=R^2F_{sun\text{-}celestial\ body}/(GM_{sun})=R^2F_{photon}/(GM_{sun})$

$=(4.4\times10^{23})^2\times1.42\times10^{-24}N/(6.67\times10^{-11}$ N•m²/kg²$\times2\times10^{30}$kg$)=2.061\times10^{3}$kg

This means, at 46.5 million light years away, the radiation pressure force of one photon per second from the sun is bigger than the sun's gravitational force towards a celestial body whose mass is 2 tons. So one photon per second from the sun can keep this celestial body expanding away from the sun at accelerating speeds.

According to similar calculation, if the pushing force of one photon from the sun is in balance with the gravitational force of a celestial body which is located 4.4×10^{24}m(1/100 of universe radius) away from the sun, then the mass of this celestial body $M_{\text{celestial body}}$ will be:

(because $F_{\text{sun-celestial body}}=（GM_{\text{sun}}M_{\text{celestial body}}）/R^2$)

$M_{\text{celestial body}}=R^2F_{\text{sun-celestial body}}/(GM_{\text{sun}})=R^2F_{\text{photon}}/(GM_{\text{sun}})$

$=(4.4\times10^{24})^2\times1.42\times10^{-24}\text{N}/（6.67\times10^{-11}\ \text{N•m}^2/\text{kg}^2\times2\times10^{30}\text{kg}）=2.061\times10^5\text{kg}$

This means, at 465 million light years away, the radiation pressure force of one photon per second from the sun is bigger than the sun's gravitational force towards a celestial body whose mass is 200 tons. So one photon per second from the sun can keep this celestial body expanding away from the sun at accelerating speeds.

According to similar calculation, if the pushing force of one photon from the sun is in balance with the gravitational force of a celestial body which is located 4.4×10^{25}m(1/10 of universe radius) away from the sun, then the mass of this celestial body $M_{\text{celestial body}}$ will be:

(because $F_{\text{sun-celestial body}}=（GM_{\text{sun}}M_{\text{celestial body}}）/R^2$)

$M_{\text{celestial body}}=R^2F_{\text{sun-celestial body}}/(GM_{\text{sun}})=R^2F_{\text{photon}}/(GM_{\text{sun}})$

$=(4.4\times10^{25})^2\times1.42\times10^{-24}\text{N}/（6.67\times10^{-11}\ \text{N•m}^2/\text{kg}^2\times2\times10^{30}\text{kg}）=2.061\times10^7\text{kg}$

This means, at 4.65 billion light years away, the radiation pressure force of one photon per second from the sun is bigger than the sun's gravitational force towards a celestial body whose mass is 20000 tons. So one photon per second from the sun can keep this celestial body expanding away from the sun at accelerating speeds.

Therefore, the radiation pressure force of the sun can not only push small matters such as interstellar dusts away from the sun, it can also push distant big celestial bodies away from the sun.

Also, when we consider the detailed process when radiation pressure forces cause the universe to expand, there is another practical factor: gravitational lens. For example, if we use the gravitational source of the sun as the gravitational lens, the lens can increase the intensity of light by a factor of 100,000. This can also bring the result that radiation pressure force can not only push small matters such as interstellar dusts away from the sun, it can also push big celestial bodies away from the sun.

Now that we have known that our universe is expanding because the overall expanding forces is bigger than the overall contracting forces, we can predict:

With the accelerating expansion of the universe, galaxies will become more distant from each other. After many years, when the lives of many stars come to an end and the radiation of stars inside universe decreases, the total radiation pressure forces inside universe will be smaller than the total gravitational forces inside universe. Then, the expansion of the universe will first slow down, and then the universe will start to contract. When the universe contracts, matters become more close to each other so more stars will be created. The increase in the number of stars will increase the total radiation pressure inside the universe. Then, the contraction of the universe will first slow down, and then the universe will start to expand again. Hence, the universe development cycle:

1. accelerating expansion ->
2. decelerating expansion ->
3. accelerating contraction ->
4. decelerating contraction ->
5. accelerating expansion ->
6. decelerating expansion ->
7. accelerating contraction ->
8. decelerating contraction ->

.....

This repetitive process is a lot like the breathing process of human beings when the lung become bigger and then smaller and then bigger and then smaller.....

We can call it "breathing cycle" of the universe. Just to mention that when an expansion is followed by a contraction, it doesn't mean that a decelerating expansion must be followed with an accelerating contraction. It is possible that at the end of a decelerating expansion, there is another accelerating expansion (due to a sudden birth of many stars during a period), then there is another decelerating expansion, and then there is accelerating contraction.

Now a question will arise: is the universe at its first accelerating expansion stage ① since its birth? Or is the current accelerating expansion of the universe already its second accelerating expansion stage (5) after a decelerating contraction? Or the current accelerating expansion of the universe is already its 10th accelerating expansion stage after a decelerating contraction?.....

Suppose if the universe is really born with a big bang and it is at its first accelerating expansion stage, the age of the universe is about 13.9billion years old. But if the universe is at its second accelerating expansion

stage, then the age of the universe will be older than 13.9 billion years old. And if the universe is at its 10th accelerating expansion stage, then the age of the universe will be much older than 13.9 billion years old.

This can be used to explain why some stars are older than 13.9 billion years old. For example, HD 140283 - or Methuselah as it's commonly known - was estimated to be 16 billion years old in 2000. If this estimation is correct, it can be a support for above-mentioned theory of this article.

However, it can also be questioned: is the universe really born with a big bang? The current big bang theory is supported by the accelerating expansion of the universe. So if the current accelerating expansion of the universe is just a stage of a repetitive process of expansion and contraction, it is reasonable to assume that the universe may not be born with a big bang.

So the existence of the universe may just be an endless cycle of "breathing" (expansion->contraction->expansion->contraction.....), without beginning, without end? But this is not possible. Because, although we are not sure about the beginning of the universe, the "breathing" will eventually consume up all the hydrogen and other nuclear fusion materials in the universe so eventually the universe will all contract together. Thus the end of the universe can only be: the entire universe contract into one single black hole, the whole universe becomes one singularity. It is natural to deduce that this singularity will be unstable and will explode and form a new universe again. Or if this singularity is stable, the universe will stop forever.

Thus a possible version of the development of the universe can also be:

1. Big bang
2. accelerating expansion ->
3. decelerating expansion ->
4. accelerating contraction ->
5. decelerating contraction ->
6. accelerating expansion ->
7. decelerating expansion ->
8. accelerating contraction ->
9. decelerating contraction

..... (the nuclear fusion materials consumed to a degree so that another expansion cannot happen)

10. Final contraction(the whole universe contract into one hugest black hole)
11. Big bang
12. accelerating expansion ->
13. decelerating expansion ->
14. accelerating contraction ->
15. decelerating contraction ->
16. accelerating expansion ->
17. decelerating expansion ->
18. accelerating contraction ->
19. decelerating contraction

..... (the nuclear fusion materials consumed to a degree so that another expansion cannot happen)

20. Final contraction(the whole universe contract into one hugest black hole)
21. Big bang

.....

So if the universe is born with big bang, there may have been more than one big bangs before and there may probably be more big bangs in the future.

Conclusions:

- The radiation pressure force of the sun can not only push small matters such as interstellar dusts away from the sun, it can also push distant big celestial bodies away from the sun.
- Gravitational lens effect can further help radiation pressure force to push distant big celestial bodies away from stars.
- The development process of the universe will be "a breathing cycle":
    1. accelerating expansion ->
    2. decelerating expansion ->
    3. accelerating contraction ->
    4. decelerating contraction ->
    5. accelerating expansion ->
    6. decelerating expansion ->
    7. accelerating contraction ->
    8. decelerating contraction

    .....
- The age of the universe may be considerably older than 13.9 billion years old.

- Although it is not sure how the universe began, it can be sure that the universe will end in becoming one hugest black hole.
- It is natural to deduce that the one hugest black hole will explode into a new universe.
- The more complete description of the universe development can be:

1. Big bang
2. A universe is formed
3. Multiple expansions & contractions (the nuclear fusion materials consumed up)
4. Final contraction (the whole universe contract into one hugest black hole)
5. Hugest black hole
6. Big bang
7. A universe is formed
8. Multiple expansions & contractions(the nuclear fusion materials consumed up)
9. Final contraction (the whole universe contract into one hugest black hole)
10. Hugest black hole
11. Big bang

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