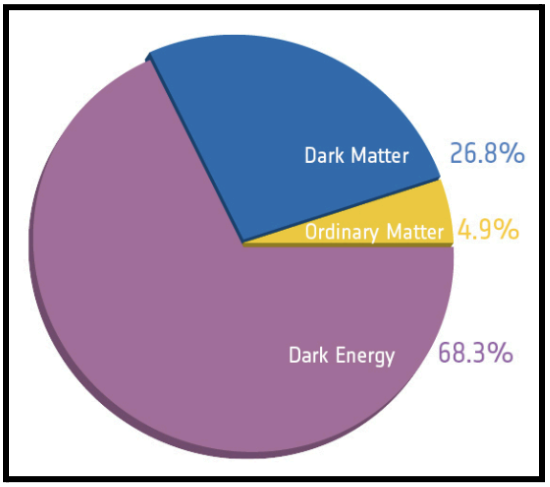
The Enigmatic Cosmos: Diving into the Mysteries of Dark Matter and Dark Energy

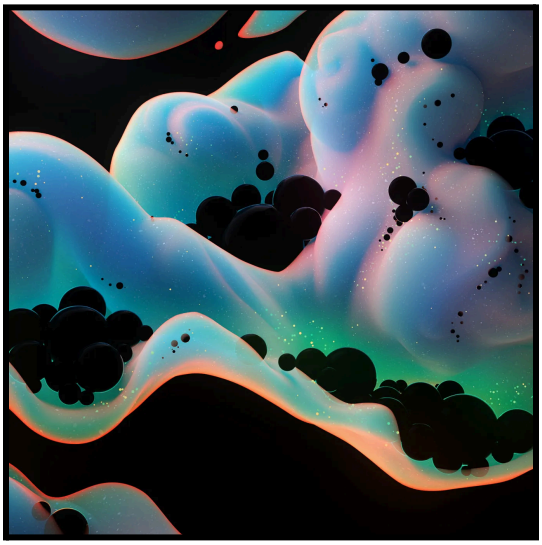
What is Dark Matter and Dark Energy

All visible matter, which makes up stars, planets, and galaxies, only accounts for 5% of the universe's total mass-energy content. Cosmology's most pressing issue is discovering what the other 95% is. First coined by Lord Kelvin in 1884, 'hidden matter,' now known as dark matter, is completely undetectable as it does not interact with light or the electromagnetic field. Similarly, dark energy is invisible to modern space instruments, yet it makes up the majority of the universe. While different theories have attempted to explain dark matter and energy, scientists have been unsuccessful in providing a definite answer for what it is.



How We Know Dark Matter Exists

While we cannot directly see dark matter, we know it's there through its gravitational effects on visible matter and light. The observable mass of all the stars and planets in our galaxy is far too little to hold the galaxy cluster together. This indicates the presence of a hidden matter, which prevents the contents of the Milky Way from scattering.



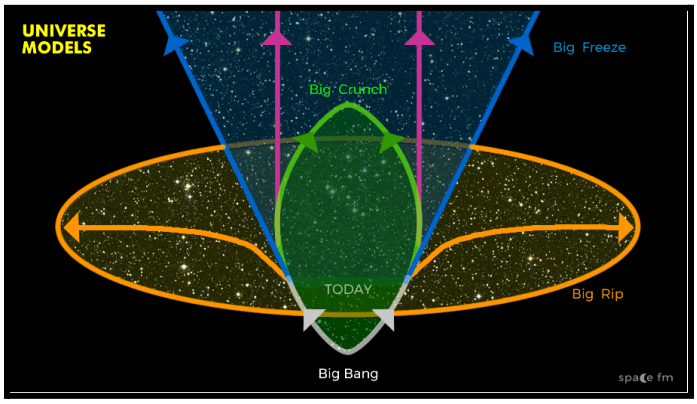
Theories Regarding Dark Matter's Composition

The idea that dark matter consists of millions of microscopic black holes explains its undetectable nature. Atom-sized black holes that formed during the Big Bang could be the reason for dark matter's massive gravitational influence on nearby objects. However, because all black holes emit Hawking Radiation and no such energy fluxes have been detected from areas containing dark matter, this theory, while fun, is most likely incorrect. A second, more tame explanation for dark matter relies on Einstein's Theory of General Relativity being partially incorrect. If Einstein's formulas are wrong, this would eliminate the need for dark matter entirely.

Importance of Dark Energy

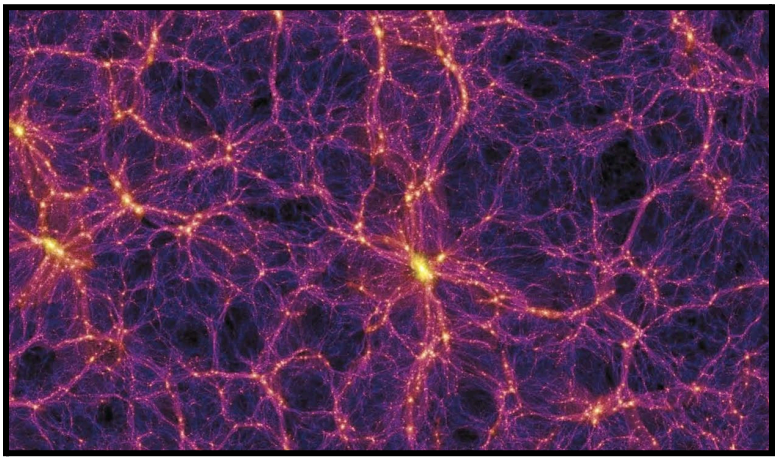
Dark energy, also known as 'the Great Repulsor', is single-handedly responsible for the expansion of our universe. Initially, it was believed that the expansion of the universe, caused by the Big Bang, was slowing down. However, after experimental observation, scientists discovered that the universe's rate of expansion is increasing. This is due to dark energy, often called 'anti-gravity' because of

its tendency to push objects away from each other. Importantly, the fate of our universe depends on the properties of dark energy. If dark energy's force increases exponentially, it will rip the fabric of space, overpower gravity, and pull atoms apart. On the other hand, if its force decreases over time, the universe will begin to detract and collapse, resulting in the Big Crunch.



The Cosmological Constant

Similarly, to dark matter, scientists have yet to uncover where dark energy comes from. The prevailing theory is that dark energy is an intrinsic property of the fabric of space. If we think of space as a grid, each sector contains a certain amount of 'negative pressure' that causes it to expand outward. It is believed dark energy is spread uniformly throughout the universe, however, 'quintessence,' another model for dark energy, is dynamic, meaning that dark energy's force changes over time.



Conclusion

Dark matter and dark energy constitute the majority of our universe's mass-energy total. While undetectable, they interact with baryonic (visible) matter through their gravitational force. Importantly, the two shape the universe: because of dark matter, stars, and galaxies tend to cluster together, and due to dark energy, these clusters are separated from each other, giving the universe its branch-like appearance.

Works Cited

Bertone, Gianfranco. "A History of Dark Matter." NASA/IPAC Extragalactic Database, California Institute of Technology, 2016, https://ned.ipac.caltech.edu/level5/Sept16/Bertone/Bertone2.html.

HubbleSite. "Dark Energy." Space Telescope Science Institute, https://hubblesite.org/contents/articles/dark-energy.

Imperial College London. "Scientists Find First Evidence That Black Holes May Be Source of Dark Energy." Imperial College London, https://www.imperial.ac.uk/news/243114/scientists-find-first-evidence-that-black/.

NASA. "Dark Matter and Dark Energy." Science, NASA, https://science.nasa.gov/universe/dark-matter-dark-energy/.

Robert, Lea. "If Dark Matter Is Invisible, How Do We Know It Exists?" Space.com, Space, https://www.space.com/if-dark-matter-invisible-how-do-we-know-it-exists