National Aeronautics and Space Administration

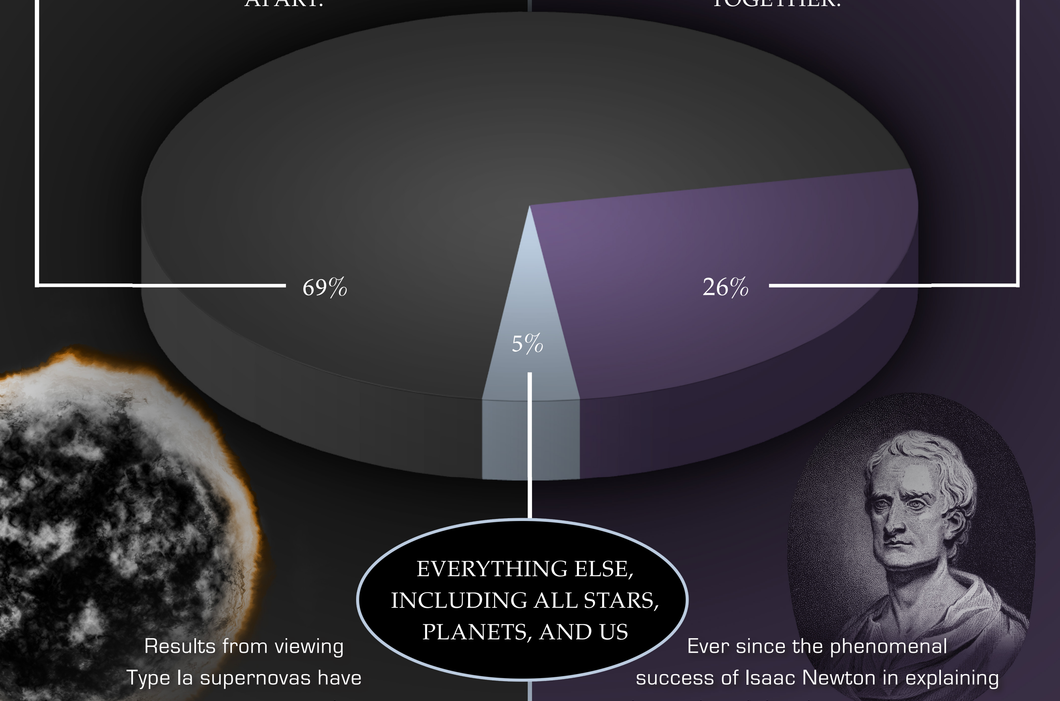
The two largest pieces of the Universe, dark matter and dark energy, are the two that we know the least about, yet nothing less than the ultimate fate of the Universe will be determined by them.

DARK ENERGY

TENDS TO DRIVE THE UNIVERSE APART.

DARK MATTER

TENDS TO DRIVE THE UNIVERSE TOGETHER.

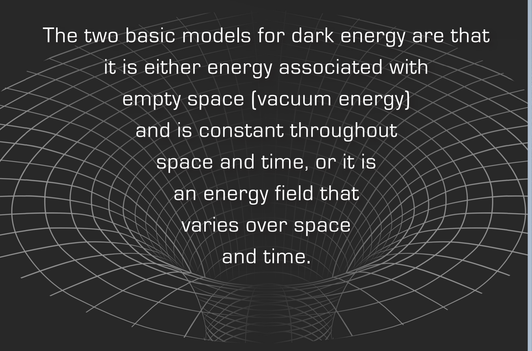


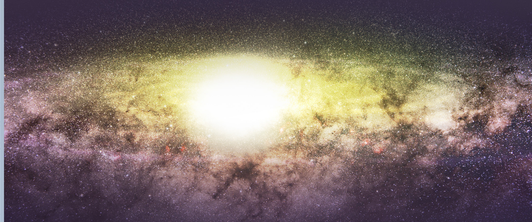
EVERYTHING ELSE, INCLUDING ALL STARS, PLANETS, AND US

Results from viewing Type Ia supernovas have shown astronomers that the expansion of the Universe is accelerating and dark energy is the reason for the acceleration.

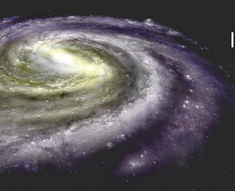
Ever since the phenomenal success of Isaac Newton in explaining the motion of the planets with his theory of gravity and laws of motion in 1687, unseen matter has been invoked to explain puzzling observations of cosmic bodies.

The two basic models for dark energy are that it is either energy associated with empty space (vacuum energy) and is constant throughout space and time, or it is an energy field that varies over space and time.



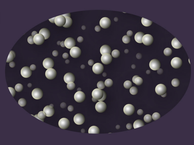


Evidence suggest that the mass of dark matter in galaxies, clusters of galaxies, and the Universe as a whole is about 5 or 6 times greater than the mass of ordinary baryonic matter such as protons and neutrons.

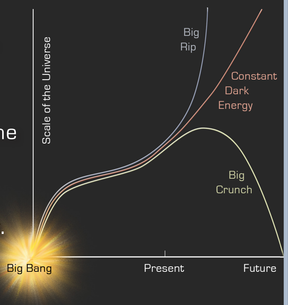


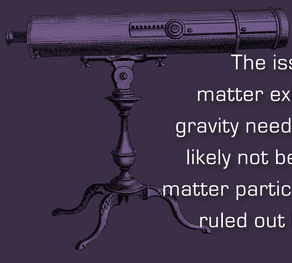
If vacuum energy is correct, in about 100 billion years, no galaxy outside our own will be visible.

Dark matter is thought to be mostly composed of exotic particles formed when the Universe was a fraction of a second old.

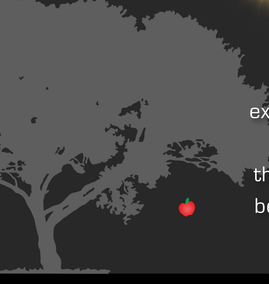


If it is an energy field, depending on the nature, expansion could stop and become a collapse, or the acceleration could increase without limit.





The issue of whether dark matter exists or the theory of gravity needs to be modified will likely not be resolved until dark matter particles are detected, or ruled out by lack of detection.



If dark energy does not exist, cosmic acceleration could be a sign that the theory of gravity needs to be modified for extremely large distance scales.

Some physicists propose actually making dark matter.

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