# Dark energy fills the Universe

- **Dark energy makes the universe fly apart like a runaway freight train and keeps space-time flat as a pancake, but what is it?**

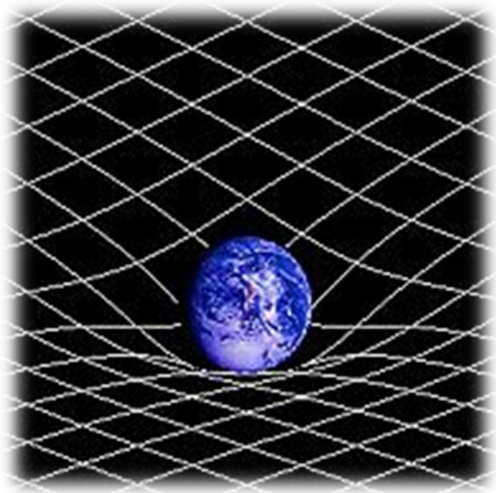
Hypothetical 'dark energy' is the most popular way of explaining why the universe is expanding at an ever increasing rate. Dark energy plays a massive part in shaping our reality however nobody seems certain of what the dang stuff actually is. Future space missions hope to solve this mystery and shake up our current understanding of the universe.

- **The discovery of 'Dark Energy'**

In 1998 two rival groups of scientists embarked on research projects to measure the effects of gravity on the expansion of the universe. Since the Big Bang 13.7 billion years ago, the universe had been expanding. What was unknown was would this expansion go on forever. Was there too little mass in the universe to slow down the expansion - and it would continue forever? Or was the amount of mass in the universe sufficient to not only slow down the growth of the universe, but to eventually pull it all back together to one point?

Both teams got startling results. Instead of slowing or continuing at a steady rate, the universe was expanding faster and faster. A mysterious energy was causing the universe to fly apart.

We have since established that the acceleration of the expansion of the universe begun about 9 billion years ago when dark energy dominated the force of gravity and begun to push the universe apart at an ever increasing rate. These findings were understandably shocking to scientists who thought it most likely we lived in a universe which was gently slowing down due to gravitational attraction.



## How do scientists determine how fast the universe is expanding?

Scientists use 'standard candles' to measure the rate of expansion of the universe. These are objects which we know always have the same total brightness. The most reliable standard candles are type 1a supernovae. These are created when a white dwarf star consumes matter from a neighbouring star until it reaches a certain critical mass and it suddenly explodes into a supernova. Because the mass of a star which becomes a Type 1a supernova is always the same, we know how bright the explosion which follows will be - and as well, the characteristic pattern of the dimming of this light.

By measuring how much fainter the light from a Type 1a supernova appears to us on earth we know how far away it must be. However, we still need a way to measure the rate at which these standard candles are moving away from us. To do this, scientists look at the redshift of the light they emitted from the parent galaxy in which the Type 1a supernova appeared. Redshift is the effect of the 'stretching' of light which has travelled a long distance to reach us.

We know that light always travels at the same speed through a vacuum - and that this speed doesn't change over time. However, the amount of energy in the light does change. If the object which emits the light is moving away from us, the wavelength of the light will be 'stretched' which means the energy of the light is decreased. An analogy for this is the change in sound you hear when an ambulance passes. When it begins to move away from you the sound waves are 'stretched' which makes the pitch of the siren lower. The faster the ambulance moves away from you, the more the pitch will change. Distant galaxies are moving away from us as the universe expands, so the light they emit is 'stretched' so it's energy is reduced. The further away the object is from us here on earth, the faster it is moving away from us so the lower the energy of the light we receive.

The scientists who were researching the expansion of the universe in 1998 found that when they compared the light from distant Type 1a supernovae to the redshift of the light in the galaxy in which it was located that it was dimmer than expected. Something was causing the expansion of the universe to accelerate! A 'dark' unknown energy was at work.