

## TEXAS TELESCOPE TO EXPLORE DARK ENERGY

A mysterious and largely unknown dark energy is thought to pervade our universe. A telescope at McDonald Observatory in West Texas is poised to survey a million galaxies, to explore it. The Hobby-Eberly Telescope has recently undergone a \$25 million upgrade and has just re-achieved first light. The telescope is being geared up for a new project, called the Dark Energy Experiment, or HETDEX. The project – due to begin in early 2016 – will survey a million galaxies in the next three to four years, with the aim of exploring the mysterious and largely unknown dark energy thought to pervade our universe.

**Astronomers use the term ‘dark energy’ to describe a theoretical repulsive force causing this fast expansion.**

The fate of the universe used to seem so simple. In the last century, astronomers found universe was expanding: the galaxies are moving away from each other. That observation gave rise to Big Bang theory and the idea that the universe would either expand forever or, if its own self-gravity were strong enough, ultimately collapse back on itself.

**By the early 1990s, astronomers thought they had the answer. They’d calculated how much mass was in the universe and determined it was destined for perpetual expansion, leading to a vast, dark, and cold state sometimes called the Big Freeze or Big Chill.**

But then, in the 1990s, astronomers noticed something strange. They discovered that the expansion of the universe is moving faster today than it was a billion years ago. The fast expansion of the universe has since been confirmed. Within our current cosmology – our Big Bang universe, described by Einstein’s theory of General Relativity – this fast expansion in recent times is hard to explain. One possibility is that a mysterious force is pushing the universe apart. Astronomers don’t understand the force yet, but they’ve begun to explore it. They call it dark energy.

To explain cosmic acceleration, cosmologists are faced with two possibilities: Either 73% of the universe exists in an exotic form, now called dark energy, that exhibits a gravitational force opposite to the attractive gravity of ordinary matter, or General Relativity must be replaced by a new theory of gravity on cosmic scales. If our modern cosmology holds true, then 73% of our universe exists as dark energy. Another major chunk of the universe (21-26% or so) is thought to exist as dark matter. The variation in the numbers reflects uncertainties in the measurements. Either way, it appears that only 4 percent of the universe is composed of regular matter, such as stars, planets and people.

It could spring from the vacuum of space itself, becoming a more dominant force as the universe expands and gets more spacious. Dark energy could be exotic new particles or new physics.

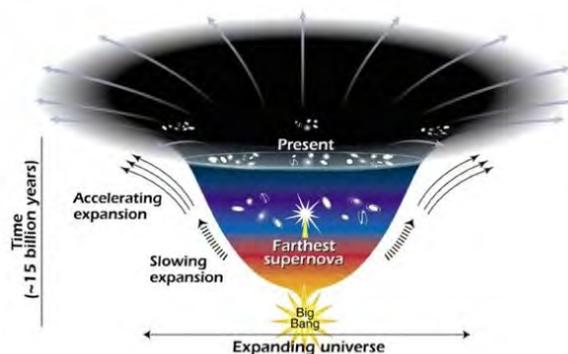
**Dark energy could mean that our understanding of gravity needs an overhaul.**

It’s this dark energy that this large telescope in Texas is now poised to explore. The project will cost \$42 million. It will begin in 2016 and take three to four years to complete. A suite of 150 spectrographs is being mounted on the Hobby-Eberly Telescope. 34,000 optical fibres will be wired into the focal plane of the telescope. These spectrographs – used to split light into its individual wavelengths – will enable astronomers to map the three-dimensional positions of one million galaxies. The telescope will search an area of northern sky overlapping the Big Dipper asterism. Astronomers have said they expect to have a pretty good idea about their findings within the first year.

Dark Energy is today’s biggest problem in astronomy. It may represent a fundamental misunderstanding of the basic properties of the universe. AK, with EarthSky Notes



Stars wheel around Polaris, above the Hobby-Eberly Telescope – home of the Dark Energy Experiment – at McDonald Observatory in West Texas



This diagram reveals changes in the rate of expansion since the Big Bang. The curve changes noticeably about 7.5 billion years ago, when objects in the universe began flying apart at a faster rate.



The mirror's effective size has increased from 9.2 meters to 10 meters