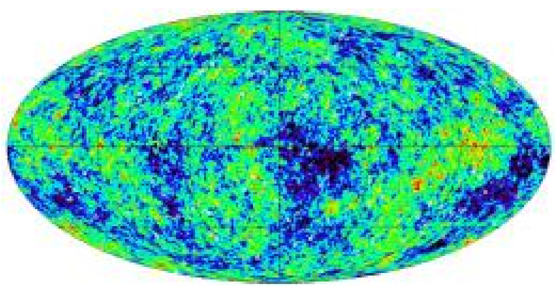
Durham astronomers' doubts about the 'dark side'

June 14 2010, by Robert Massey



The unresolved radio sources used by Sawangwit & Shanks to measure the effect of telescope smoothing are marked on the WMAP CMB map (open circles). Sawangwit and Shanks found that the radio sources implied stronger telescope smoothing than previously found, suggesting that the CMB ripple size may be smaller. Click the image for larger version (Credit: NASA/WMAP plus Durham University).

(PhysOrg.com) -- New research by astronomers in the Physics Department at Durham University suggests that the conventional wisdom about the content of the Universe may be wrong. Graduate student Utane Sawangwit and Professor Tom Shanks looked at observations from the Wilkinson Microwave Anisotropy Probe (WMAP) satellite to study the remnant heat from the Big Bang. The two scientists find evidence that the errors in its data may be much larger than previously thought, which in turn makes the standard model of the Universe open to question.

The team publish their results in a letter to the journal Monthly Notices of the Royal Astronomical Society.

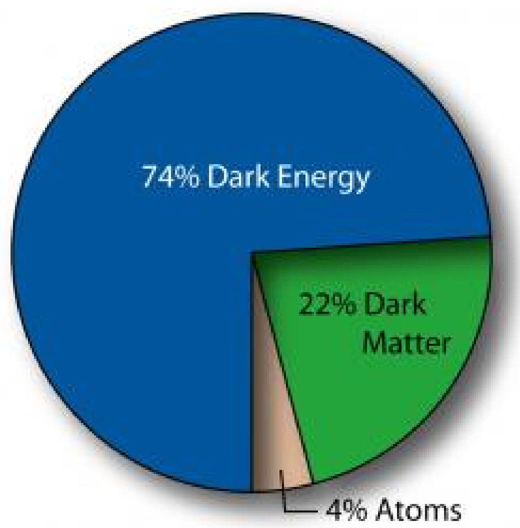
Launched in 2001, WMAP measures differences in the Cosmic Microwave Background (CMB) radiation, the residual heat of the Big Bang that fills the Universe and appears over the whole of the sky. The angular size of the ripples in the CMB is thought to be connected to the composition of the Universe. The observations of WMAP showed that the ripples were about twice the size of the full Moon, or around a degree across.

With these results, scientists concluded that the cosmos is made up of 4% ‘normal’ matter, 22% ‘dark’ or invisible matter and 74% ‘dark energy ’. Debate about the exact nature of the ‘dark side’ of the Universe - the dark matter and dark energy - continues to this day.

Sawangwit and Shanks used astronomical objects that appear as unresolved points in radio telescopes to test the way the WMAP telescope smoothes out its maps. They find that the smoothing is much larger than previously believed, suggesting that its measurement of the size of the CMBR ripples is not as accurate as was thought. If true this could mean that the ripples are significantly smaller, which could imply that dark matter and dark energy are not present after all.

Prof. Shanks comments “CMB observations are a powerful tool for cosmology and it is vital to check for systematic effects. If our results prove correct then it will become less likely that dark energy and exotic dark matter particles dominate the Universe. So the evidence that the Universe has a ‘Dark Side’ will weaken!”

In addition, Durham astronomers recently collaborated in an international team whose research suggested that the structure of the CMB may not provide the robust independent check on the presence of dark energy that it was thought to.



The standard cosmological model which predicts that the Universe is dominated by 74% dark energy and 22% dark matter. The remaining 4% are the atoms of ordinary matter that we see around us. Thus in this model 96% of the Universe is dark. (Credit: NASA/WMAP Science Team)

If dark energy does exist, then it ultimately causes the expansion of the Universe to accelerate. On their journey from the CMB to the telescopes like WMAP, photons (the basic particles of electromagnetic radiation including light and radio waves) travel through giant superclusters of galaxies. Normally a CMB photon is first blueshifted (its peak shifts towards the blue end of the spectrum) when it enters the supercluster and then redshifted as it leaves, so that the two effects cancel. However, if the supercluster galaxies are accelerating away from each other because of dark energy, the cancellation is not exact, so photons stay slightly blueshifted after their passage. Slightly higher temperatures should appear in the CMB where the photons have passed through superclusters.

However, the new results, based on the Sloan Digital Sky Survey which surveyed 1 million luminous red galaxies, suggest that no such effect is seen, again threatening the standard model of the Universe.

Utane Sawangwit says, “If our result is repeated in new surveys of galaxies in the Southern Hemisphere then this could mean real problems for the existence of dark energy.”

If the Universe really has no ‘dark side’, it will come as a relief to some theoretical physicists. Having a model dependent on as yet undetected exotic particles that make up dark matter and the completely mysterious dark energy leaves many scientists feeling uncomfortable. It also throws up problems for the birth of stars in galaxies, with as much ‘feedback’ energy needed to prevent their creation as gravity provides to help them form.

Prof. Shanks concludes “Odds are that the standard model with its enigmatic dark energy and dark matter will survive - but more tests are needed. The European PLANCK satellite, currently out there collecting more CMB data will provide vital new information and help us answer these fundamental questions about the nature of the Universe we live in.”

More information: The research on the WMAP “ripples” will appear as a letter in the journal Monthly Notices of the Royal Astronomical Society. A preprint of the paper can be seen at: arxiv.org/abs/0912.0524
The research on the test for dark energy has also appeared in the journal Monthly Notices of the Royal Astronomical Society. The paper can be found either at ukads.nottingham.ac.uk/abs/2010MNRAS.402.2228S or arxiv.org/abs/0911.1352

Provided by Royal Astronomical Society