NEWS IN FOCUS

DARK ENERGY SURVEY

The Dark Energy Survey mapped the shape of 26 million galaxies, including NGC 1398, which is about 20 million parsecs from Earth.

COSMOLOGY

Cosmic map reveals a not-so-lumpy Universe

Odd results could still be consistent with the 'standard model' of cosmology.

BY DAVIDE CASTELVECCHI

Cosmologists have produced the biggest map yet of the Universe's structure, and found that matter might be spread more evenly than previously thought.

The results, part of the ongoing Dark Energy Survey (DES), chart the distribution of matter in part by measuring how mass bends light, an effect known as weak gravitational lensing. It was the first time the technique had been fed enough data to measure some of the crucial features of cosmic evolution with a precision approaching that for the maps generated from cosmic microwave background (CMB) data, which measure the afterglow of the Big Bang and are the gold standard of cosmology. "We believe that, with these results, we're no longer the poor cousin" to other efforts, says DES leader Joshua Frieman, a cosmologist at the Fermi National Accelerator Laboratory (Fermilab) in Batavia, Illinois. "We now have results that have comparable power to constrain cosmology."

There are still some discrepancies with earlier surveys on measurements such as the lumpiness of mass, but they are within the experiments' margins of error. As the DES maps larger volumes of space, it should become clear whether the disagreements are real, says cosmologist Anthony Tyson, a pioneer of weak gravitational lensing at the University of California, Davis. So far, he says, "I believe they have been very careful and conservative in their interpretations".

The DES, a collaboration of more than 400 researchers, gathers its data using the ▶

4-metre Victor M. Blanco telescope, part of the Cerro Tololo Inter-American Observatory in Chile. Data collection began in 2013; the current map is based on the first year of measurements, which logged 26 million galaxies in the southern sky and their apparent shapes.

According to Albert Einstein's general theory of relativity, mass warps space, so a large amount of matter in the foreground of a galaxy can bend its light in a way that makes the galaxy look slightly squashed. This is true whether the foreground mass is made of ordinary matter or of invisible dark matter. Galaxies can appear squashed for other reasons, including their actual shapes and orientations. But if many galaxies in a certain region of the sky seem on average to be skewed along the same direction, gravitational lensing is the probable culprit.

The DES cosmologists were able to tease out the composition of the Universe in a similar way to how the CMB surveys have done in the past — most recently using the European Space Agency's Planck satellite. Their results confirm that ordinary matter constitutes only 4% the Universe's contents. But they show a slightly smaller amount of dark matter — about 26% — than the 29% estimated by Planck, with the rest being taken up by 'dark energy', the stuff thought to be pushing the cosmos apart at an accelerating speed.

More intriguingly, the DES seems to have found a deviation from Planck's prediction of the current lumpiness of matter. Whereas ordinary and dark matter were evenly distributed in the Universe's infancy 14 billion years ago, that is not the case in present galaxies. Gravity has been pulling the matters together into a web-like structure of clusters and filaments, with enormous voids in-between. The concentration measured by the DES is 7% lower than that predicted by the standard model of cosmology.

"My own view of all of these measurements is that they are stunning tests of the cosmological model."

INTRIGUING GAP

The gap is not statistically large, at about one standard deviation. But another weak lensing project, the Kilo Degree Survey (KiDS), found the same kind of deviation last year (H. Hildebrandt *et al. Mon. Not. R. Astron. Soc.* http://doi.org/cbmx; 2016).

If confirmed, the discrepancy could mean that, over cosmic history, mass has been clumping more slowly than expected. And that could potentially reveal new physics, such as unexpected interactions between dark matter and dark energy or new types of neutrino. The DES presented its results on 3 August at a meeting of the American Physical Society at Fermilab, and the authors posted a battery of ten papers online (see go.nature.com/2ubhr8l).

Although cosmological observations have been converging towards a consistent, detailed picture in recent decades, the weak-lensing observations are not the only ones still troubling researchers. Astronomers have, for instance, found that the cosmos is expanding faster than predicted on the basis of Planck data. George Efstathiou, director of the Kavli Institute for Cosmology in Cambridge, UK, and a member of both the Planck and DES collaborations, says that the clumping discrepancy is potentially more worrisome than the one relating to cosmic expansion.

Overall, researchers are excited to have another tool with which to probe the cosmos in ever-greater detail. "My own view of all of these measurements is that they are stunning tests of the cosmological model, and the precision and accuracy only keep getting better and better," says astronomer Wendy Freedman of the University of Chicago in Illinois.

The final survey, due to conclude in 2018, will cover one-eighth of the sky; the results might be available some time in 2020, Frieman says. Ultimately, the DES aims to map a large-enough region to see how the influence of dark energy has evolved over the Universe's recent history.

"This is exciting," Tyson says. "The future looks bright for weak gravitational lensing." ■

CONSERVATION

Africa's scientists step up to save primates

Network aims to train a generation of home-grown leaders in research on apes, monkeys and lemurs.

BY DECLAN BUTLER

Inza Koné, a primate conservationist at the Swiss Centre for Scientific Research in Abidjan, Côte d'Ivoire, is used to overcoming adversity. During the country's bloody civil war in the 2000s, he and his colleagues managed to keep research going in conflict zones, even after most international scientists had fled, because of long-standing ties with communities in these areas. In the country's Taï National Park — one of the last vestiges of primary rainforest in West Africa — such relationships allowed long-running studies of chimpanzees and monkeys to continue safely, and largely spared the park from poaching.

As the first president of the African Primatological Society (APS), launched at a congress near Abidjan on 24–26 July, Koné will lead another hard task: training a generation of home-grown primate researchers. The aim is for them to start and lead efforts such as the Taï Chimpanzee Project — established in 1979 by researchers from Germany's Max Planck Institute for Evolutionary Anthropology in Leipzig — and to gain the institutional buy-in needed to protect Africa's 200 or so species of apes, monkeys and lemurs.

Few primate-research and conservation efforts are currently led by Africans, and those run by scientists from elsewhere don't usually last long enough to make a difference, notes Inaoyom Imong, director of the Cross River Gorilla Landscape Project in Nigeria. "Greater involvement in and leadership of primate-conservation projects by Africans has the potential to ensure the necessary long-term commitment to sites, stronger local ownership and sustainability of such projects."

Continental Africa has an estimated 111 species of primate, with the greatest diversity in the Democratic Republic of the Congo, Tanzania, Cameroon, Nigeria and Equatorial Guinea. Another 103 species are found in Madagascar, an island nation and biodiversity hotspot.

But many African primate species are at risk of extinction: 37% of species on the mainland and 87% of species in Madagascar are listed as threatened. This is largely a result of habitat loss caused by human activities, such as large-scale farming and logging, as well as overhunting of bushmeat.

The APS's scientific congress will be an annual event. The first meeting brought together around 100 African primatologists and conservation biologists from across the continent, and some 30 non-Africans. "For African primatology to get its own society is tremendously important," says Roman Wittig, a primatologist at the Max Planck Institute for Evolutionary Anthropology. "It's a milestone."

Most primate research and conservation in Africa over the past half-century has been done by overseas researchers, says Russell Mittermeier, vice-president of the non-profit environmental organization Conservation International in Arlington, Virginia, who attended the launch. "But the job is too big to