

# Earth's new address: 'Solar System, Milky Way, Laniakea'

Analysis of galaxies shows local supercluster to be 100 times larger than previously thought.

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The supercluster of galaxies that includes the Milky Way is 100 times bigger in volume and mass than previously thought, a team of astronomers says. They have mapped the enormous region and given it the name Laniakea — Hawaiian for 'immeasurable heaven'.

Galaxies tend to huddle in groups called clusters; regions where these clusters are densely packed are known as superclusters. But the definition of these massive cosmic structures is vague.

The new study, published in *Nature*<sup>1</sup>, describes a novel way to define where one supercluster ends and another begins. A team led by Brent Tully, an astronomer at the University of Hawaii in Honolulu, charted the motions of galaxies to infer the gravitational landscape of the local Universe, and redraw its map.

## Cosmic speed

The team used a database<sup>2</sup> that compiles the velocities of 8,000 galaxies, calculated after subtracting the average rate of cosmic expansion. "All these deviations are due to the gravitational pull galaxies feel around them, which comes from mass," says Tully. The researchers used an algorithm to translate these velocities into a three-dimensional field of galaxy flow and density. "We really can't claim to have a good understanding of cosmology if we cannot explain this motion," says Tully.

This method is superior to merely mapping the location of matter, because it enables scientists to build a map of uncharted regions of the Universe, says Paulo Lopes, an astrophysicist at the Valongo Observatory, part of the Federal University of Rio de Janeiro. It relies on detecting the galaxies' influence, rather than seeing them directly.

Moreover, the galaxies' motions reflect the distribution of all matter, not just that which is visible in our telescopes — including dark matter.

Discounting cosmic expansion, their map shows flow lines down which galaxies creep under the effect of gravity in their local region (see video). Based on this, the team defines the edge of a supercluster as the boundary at which these flow lines diverge. On one side

of the line, galaxies flow towards one gravitational centre; beyond it, they flow towards another. “It’s like water dividing at a watershed, where it flows either to the left or right of a height of land,” says Tully.

### Frontiers in space

This is a completely new definition of a supercluster. Scientists previously placed the Milky Way in the Virgo Supercluster, but under Tully and colleagues’ definition, this region becomes just an appendage of the much larger Laniakea, which is 160 million parsecs (520 million light years) across and contains the mass of 100 million billion Suns.

However, this work is unlikely to be the final word on what a supercluster is, says Gayoung Chon, an astronomer at the Max Planck Institute for Extraterrestrial Physics in Garching, Germany. Her team works on a different definition, based on superclusters being structures that will one day collapse into a single object. This will not happen to Laniakea, she estimates, because some of the galaxies within it will recede from one another forever. “The definition you use really depends on the questions you want to ask. This latest method is a very good way to chart the large-scale structures of the Universe, but it doesn’t ask what will happen to these superclusters eventually,” she says.

Although the map is comprehensive over the Universe around the Milky Way, its distance measurements become less accurate, and less numerous, the farther out you go, says Lopes. This is currently the technique’s biggest potential source of error, he says, but adding more galaxy measurements will improve the map and could eventually help scientists to fully trace what is behind the motion of our local group of galaxies.

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### References

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1. Tully, R. B., Courtois, H., Hoffman, Y & Pomarède, D. *Nature* **513**, 71–73 (2014).
2. Tully, R. B. *et al. Astron. J.* **146** 86 (2013).