16 November 2016

International team discovers major supercluster of galaxies hidden by Milky Way

An international team of astronomers has discovered a previously unknown major concentration of galaxies in the constellation Vela, which they have dubbed the Vela supercluster.

Superclusters of galaxies are the largest and most massive known structures in the Universe. They consist of clusters, embedded in wall-like structures of galaxies that span up to 200 million light-years across the sky. The most famous supercluster is the Shapley Supercluster, some 650 million light-years away. It is believed to be the largest of its kind in our cosmic neighbourhood.

Now a team from South Africa, the Netherlands, Germany, and Australia, led by Professor Renée C Kraan-Korteweg from the University of Cape Town, has discovered another major supercluster, slightly further away in distance (800 million light-years), which covers even more sky than Shapley. The Vela supercluster had gone unnoticed due to its location behind the plane of the Milky Way, where dust and stars obscure background galaxies, resulting in a broad band void of extragalactic sources. The team's results suggest the Vela supercluster might be as massive as Shapley – and, given the relative proximity in space of these major structures, this might actually pose a cosmological conundrum.

The discovery was based on multi-object spectroscopic observations of thousands of partly obscured galaxies. Observations in 2012, with the refurbished spectrograph of the Southern African Large Telescope confirmed that eight new clusters reside within the Vela area. Subsequent spectroscopic observations with the Anglo-Australian Telescope in Australia provided thousands of galaxy redshifts and revealed the vast extent of this new structure.

Despite her decade-long quest of charting the galaxy distribution hidden by the Milky Way, Prof Renée Kraan-Korteweg said: "I could not believe such a major structure would pop up so prominently" when she and colleague Dr Michelle Cluver (of the University of the Western Cape) analysed the spectra almost as soon as the photons hit the spectrograph.

Cluver said: "As I looked at each new spectrum, it became obvious we were uncovering a massive network of galaxies, extending much further than we had ever expected."

Following the discovery of this substantial structure, the team assessed its cosmological impact. Such huge galaxy concentrations attract matter through their immense gravity, and shape the pattern of cosmic flows on enormous scales. As co-author Dr Maciej Bilicki stated: "Despite its large distance from us, the Vela supercluster might have a significant influence on the motion of our Local Group of galaxies (which includes the Milky Way) and could help resolve some puzzles in the observed flows of galaxies around us."

The Future

But there is still much to do – further follow-up observations are needed to determine the full extent, mass, and influence of the Vela supercluster. So far this region of the sky is sparsely sampled, while the part closest to the Milky Way has not been probed at all because dense star and dust layers block our view.

The central core of the supercluster can only be mapped with dedicated radio surveys that can penetrate this "Zone of Avoidance" (ZOA). It is here that the South African Square Kilometre Array Pathfinder, MeerKAT, can pave the way. Kraan-Korteweg said: "We have proposed to use this powerful radio telescope in early-science mode (when 32 of its total of 64 dishes are in place) during 2017 for a systematic search of the fully hidden core of the supercluster." Meanwhile, the supercluster's outer edges will be mapped with the innovative new instrument Taipan, which will start science operations in 2017. Taipan includes an innovative starbugs optical fibre positioner and a purpose-built spectrograph.

The future is promising. As co-author Professor Matthew Colless, from the Australian National University, said: "This intriguing evidence for a previously unsuspected supercluster will be tested in the next year or so. The upcoming Taipan optical survey, and the WALLABY and MeerKAT radio surveys, will map the region thoroughly and reveal any shy giants hiding behind the Milky Way."

Further information. The new article entitled *"Discovery of a prospective supercluster in the ZOA in Vela"* will be published in Monthly Notices of the Royal Astronomical Society: Letters 2016; doi: 10.1093/mnrasl/slw229 Authors: Renée C. Kraan-Korteweg, Michelle E. Cluver, Maciej Bilicki, Thomas H. Jarrett, Matthew Colless, Hans Böhringer and Gayoung Chon.

Additional graphics:

The Vela Supercluster in its wider surroundings – including Shapley

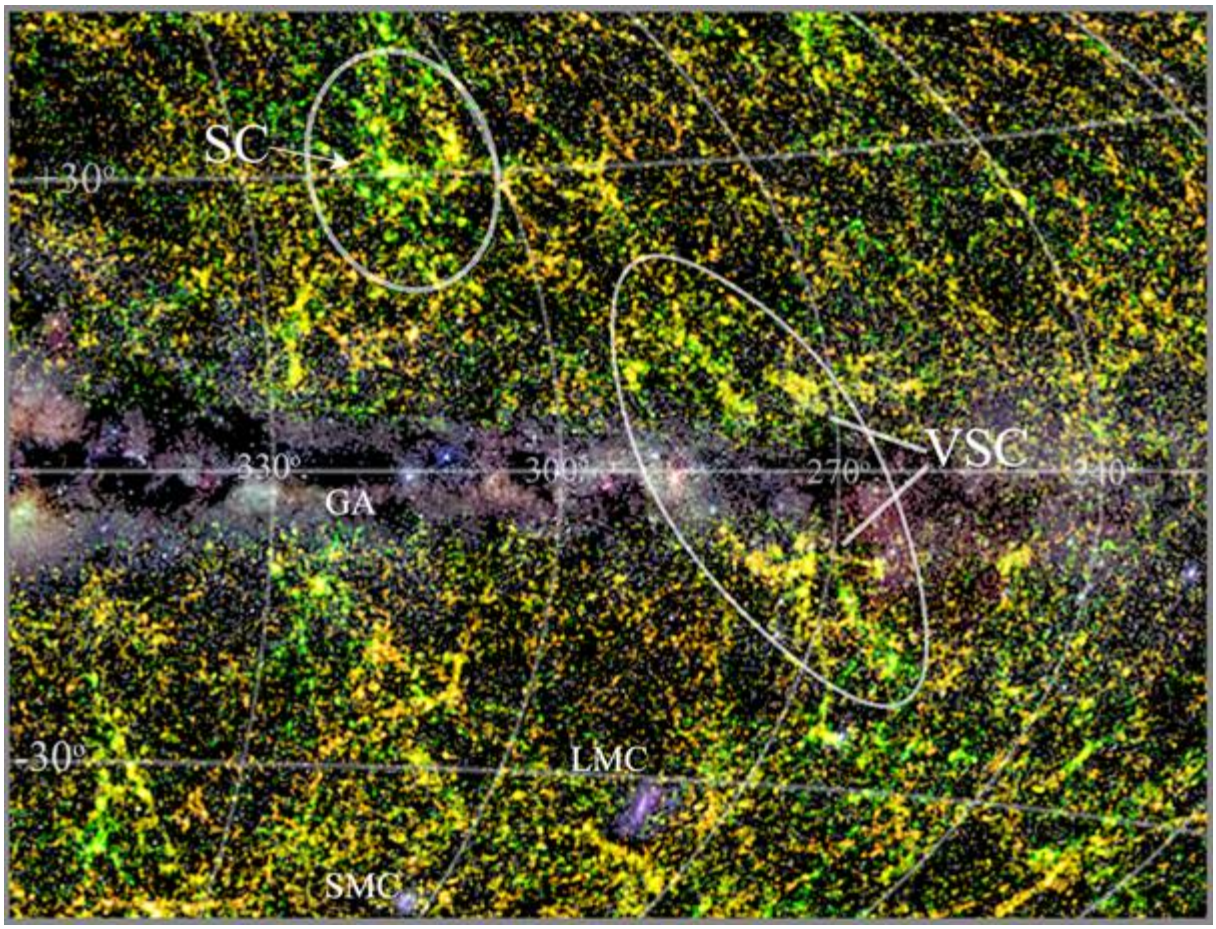

Image credit: Thomas Jarrett (UCT), based on data from the 2MASS Photometric Redshift catalogue (Bilicki et al. 2014) and the All-Sky Milky Way Panorama (Mellinger 2009).

The image displays the smoothed distribution of galaxies in and around the Vela supercluster (big ellipse; VSC). Colour indicates the distance ranges of all galaxies within 500 - 1000 million light years (yellow is close to the distance of the Vela supercluster, green is nearer and orange further away). The large ellipse marks the approximate extent of the Vela supercluster, crossing the Galactic Plane, where an optical image of the Milky Way reveals where dust obscuration and sheer density of foreground stars defines the Zone of Avoidance. LMC and SMC are the Large and Small Magellanic Clouds, satellites of the Milky Way.

The VSC structure was revealed thanks to the new low latitude spectroscopic redshifts. Note its prominence on either side of the plane of the Milky Way. It would be highly unlikely for these cosmic large-scale structures not to be connected across the Galactic Plane, where data is currently missing. The structure may be similar in aggregate mass to the Shapley Concentration (SC), although much more extended, and hence less concentrated. The so-called “Great Attractor” (GA), located much closer to the Milky Way, is an example of a large structure that crosses the Galactic Plane, although much smaller in extent than VSC. The central, dust-shrouded part of the VSC remains unmapped in the current Vela survey. To chart this obscure (d) part of the sky the team plans to use radio telescopes like MeerKAT.

The full paper is available here. A preprint of the paper is available on the arXiv

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