

gustav / May 06, 2010 01:50PM

[\[International Cooperation\]\[Astronomy\] Astrophysicists Illuminate Shape of Dark Matter's Distribution](#)[\[International Cooperation\]\[Astronomy\] Astrophysicists Illuminate Shape of Dark Matter's Distribution \(Chinese Version\)](#)

Academia Sinica Newsletter (2010/04/29) Dark matter is an enigma of the cosmos that has fascinated astrophysicists for many years. The existence of dark matter was originally hypothesized to account for discrepancies found between measurements of the mass of galaxies, clusters of galaxies and the entire Universe; however, as dark matter is invisible and no “dark matter particle” has yet been discovered, the existence of dark matter can currently only be inferred from gravitational effects on other visible celestial matter, or theoretical models. Recently an international team of astrophysicists including Postdoctoral Fellow Dr. Nobuhiro OKABE from the Institute of Astronomy and Astrophysics at Academia Sinica (ASIAA) have collected direct, clear evidence that dark matter is distributed in an elliptic shape in massive clusters of galaxies, a finding that confirms a major prediction of the prevailing theory about dark matter. Their research was published online in Monthly Notices of the Royal Astronomical Society, a leading astrophysics journal, on April 23, 2010.

The scientists conducted their research using a powerful technique called gravitational lensing and made detailed measurements of the spatial distributions of dark matter in 25 massive clusters of galaxies. Clusters of galaxies are ideal sites for studying the distribution of dark matter because they contain thousands of galaxies and are known to be accompanied by a large amount of dark matter. The team observed the clusters of galaxies using the Subaru Telescope's Prime Focus Camera (Suprime-Cam). Observations with Suprime-Cam yielded wide-field images of massive clusters of galaxies (typically located at 3 billion light years from the Earth), which the team then used to measure and analyze dark matter distributions.

From their detailed analysis of the images, the team obtained clear evidence that the distribution of dark matter in the clusters has, on average, an extremely flattened shape rather than a simple spherical shape. The degree of the flattening was quite large, corresponding to ratio of 2:1 in terms of the ratio of the major to minor axes of the ellipse. This finding represents the first direct and clear evidence of flattening in dark matter distribution and agrees with prevailing theory for dark matter distributions in clusters of galaxies which predicts that dark matter distribution in clusters of galaxies is non-spherical, reflecting a large-scale structure of dark matter filaments.

In addition to Dr. OKABE, the research team consisted of Dr. Masamune OGURI from the National Astronomical Observatory of Japan and Stanford University, Dr. Masahiro TANAKA from the University of Tokyo, and Dr. Graham SMITH from the School of Physics and Astronomy at the University of Birmingham in the U.K.

The study was a part of the Local Cluster Substructure Survey (LoCuSS), an international project carrying out a systematic study of galaxy clusters by combining data from the Subaru telescope with a wide range of data sets from radio, infrared, optical and X-ray telescopes. The goal of the project is to reveal new aspects of cluster physics and cosmology.

The full article entitled “Direct measurement of dark matter halo ellipticity from two-dimensional lensing shear maps of 25 massive clusters” is available at the in “Monthly Notices of the Royal Astronomical Society” website at: <http://www3.interscience.wiley.com/journal/123375492/abstract>.

Media contacts:

Dr. Yao-Huan TSENG, Institute of Astronomy and Astrophysics, Academia Sinica Email:

yhtseng@asiaa.sinica.edu.tw (Tel) +886-2-23665458

Fang-Hsun YEH, Public Relations Office, Central Office of Administration, Academia Sinica (Tel)

+886-2-2789-8820, (Fax) +886-2-2782-1551, (M) 0922-036-691

Email: hongsum@gate.sinica.edu.tw

Mei-Hui LIN, Public Relations Office, Central Office of Administration, Academia Sinica (Tel) +886-2-2789-8821,

(Fax) +886-2-2782-1551, (M) 0921-845-234

Email: mhlin313@gate.sinica.edu.tw

Further Information:

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Edited 1 time(s). Last edit at 05/06/2010 01:56PM by gustav.
