Group of galaxies found to bend the light of remote galaxies

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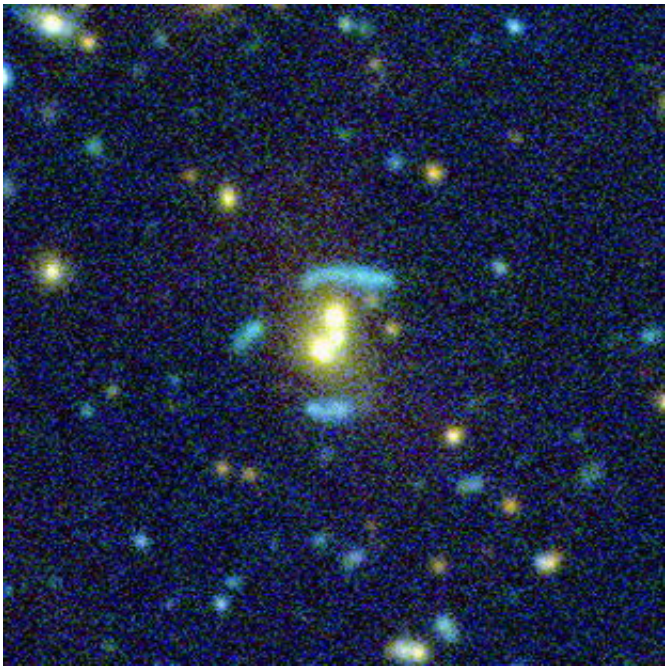

This example of a galaxy group lens in the CFHTLS-SL2S, called SL2SJ021408-053532, shows a very complex arc structure (in blue). Such complex arc geometries allow us to probe the details of the dark matter profiles associated with the group of yellow galaxies in the center of the image. © Canada-France-Hawaii Telescope Corporation 2006

The discovery of a new class of gravitational lenses, the groups of galaxies, by an international team of astronomers using the Canada-France-Hawaii Legacy Survey (CFHTLS), comes 20 years after the publication in January 1987 of the first image of a gravitational arc,

made also at CFHT with one of the first CCD cameras in operation at an observatory.

This discovery of gravitational arcs in the center of galaxy groups is an important step in our understanding of the large scale structures of the universe. These new results will allow a better understanding of the distribution of the dark matter and the formation mechanisms of the groups of galaxies, structures intermediate in mass between galaxies and clusters of galaxies.

Twenty years ago at CFHT, French astronomers observed for the first time galaxies distorted in giant arcs at the center of the most massive galaxy clusters. These observations brought to light one of the most spectacular effects of what is called "gravitational lensing".

According to Einstein's theory of General Relativity, spacetime is curved by the presence of matter. Therefore, the light passing close to an important concentration of mass will be bent. When an observer, a galaxy cluster and a remote galaxy are in nearly perfect alignment, the remote galaxy appears to the observer as one or more luminous arcs resulting from the fusion of images of the remote galaxy distorted and amplified by the galaxy cluster acting as a complex gravitational lens. The shape, brightness and distribution of these gravitational arcs bring invaluable information on the mass distribution of the lensing cluster.

Up to recently, only the most massive galaxy clusters and the massive galaxies were the object of gravitational lensing studies. Intermediate-scale structures like the galaxy groups should however be looked in order to better understand the evolution of the structures in the Universe.

Since the arrival of the MegaCam camera in 2003 on Megaprime, the new CFHT prime focus, astronomers have been able to observe at once a large area of the sky (1 square degree or 4 Full Moon) in 340 MegaPixel

digital images with an unprecedented resolution for such a field of view. The Canadian and French communities decided to pull their resources together and to devote 500 nights of telescope time over five years to a large project, the CFHT Legacy Survey, which will cover around 1% of the sky visible from Hawaii.

Thanks to a careful inspection aimed at detecting gravitational arcs in one fourth of the CFHTLS, the team has been able to detect for the first time numerous arcs around galaxy groups. This unexpected discovery provides for the first time direct information on the structure of galaxy groups which are key environments in the formation of structures in the Universe. Scientists will be able to understand the role of dark matter in the evolution of these groups and of the mass concentrations that make the large structures of the Universe.

Source: CFHT