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Collision of Galaxy Clusters Captured by Astronomers

Two UC Santa Barbara astronomers are part of a team that has made a stunning discovery using the Hubble Space Telescope and Chandra X-ray Observatory, it was announced today by the National Aeronautics and Space Administration.

The capture of a collision of galaxy clusters was made by a team led by Marusa Bradac, a postdoctoral researcher and Hubble fellow in UCSB's Department of Physics. The international team also included Tommaso Treu, assistant professor of physics at UCSB.

"It is in our view an important step forward to understanding the properties of the mysterious dark matter," Bradac said. "Dark matter makes up five times more matter in the universe than ordinary matter. This study confirms that we are dealing with a very different kind of matter, unlike anything that we are made of. And were able to study it in a very powerful collision of two clusters of galaxies."

Below is the complete text of the press release issued today by NASA.

(Cambridge, Mass.) – A powerful collision of galaxy clusters has been captured with NASA's Chandra X-ray Observatory and Hubble Space Telescope.

Like its famous cousin, the so-called Bullet Cluster, this clash of clusters provides striking evidence for dark matter and insight into its properties.

Like the Bullet Cluster, this newly studied cluster, officially known as MACSJ0025.4-1222, shows a clear separation between dark and ordinary matter. This helps answer a crucial question about whether dark matter interacts with itself in ways other than via gravitational forces.

This finding is important because it independently verifies the results found for the Bullet Cluster in 2006.

The new results show the Bullet Cluster is not an exception and that the earlier results were not the product of some unknown error.

Just like the original Bullet Cluster, MACSJ0025 formed after an incredibly energetic collision between two large clusters in almost the plane of the sky. In some ways, MACSJ0025 can be thought of as a prequel to the Bullet Cluster. At its much larger distance of 5.7 billion light years, astronomers are witnessing a collision that occurred long before the Bullet Cluster's.

Using optical images from Hubble, the team was able to infer the distribution of the total mass – dark and ordinary matter – using a technique known as gravitational lensing (colored in blue).

The Chandra data enabled the astronomers to accurately map the position of the ordinary matter, mostly in the form of hot gas, which glows brightly in X-rays (pink).

An important difference between the Bullet Cluster and the new system is that MACSJ0025 does not actually contain a "bullet."

This feature is a dense, X-ray bright core of gas that can be seen moving through the Bullet Cluster. Nonetheless, the amount of energy involved in this mammoth collision is nearly as extreme as that found in the Bullet Cluster.

As the two clusters that formed MACSJ0025 (each almost a whopping million billion times the mass of the Sun) merged at speeds of millions of miles per hour, the hot gas in each cluster collided and slowed down, but the dark matter did not. The separation between the material shown in pink and blue therefore provides direct evidence for dark matter and supports the view that dark matter particles interact with each other only very weakly or not at all, apart from the pull of gravity.

One of the great accomplishments of modern astronomy has been to establish a complete inventory of the matter and energy content of the Universe. The so-called

dark matter makes up approximately 23 percent of this content, five times more than the ordinary matter that can be detected by telescopes.

The latest results with MACSJ0025 once again confirm these findings.

The international team of astronomers in this study was led by Marusa Bradac of UCSB, and Steve Allen of the Kavli Institute for Particle Astrophysics and Cosmology at Stanford and Stanford Linear Accelerator Center (SLAC). Other collaborators included Tommaso Treu, UCSB; Harald Ebeling, University of Hawaii; Richard Massey, Royal Observatory Edinburgh; R. Glenn Morris, SLAC; and Anja von der Linden, and Douglas Applegate, both of Stanford.

Their results will appear in an upcoming issue of The Astrophysical Journal.

About UC Santa Barbara

The University of California, Santa Barbara is a leading research institution that also provides a comprehensive liberal arts learning experience. Our academic community of faculty, students, and staff is characterized by a culture of interdisciplinary collaboration that is responsive to the needs of our multicultural and global society. All of this takes place within a living and learning environment like no other, as we draw inspiration from the beauty and resources of our extraordinary location at the edge of the Pacific Ocean.