# Scientists sense breakthroughs in dark-matter mystery

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Image released on June 22, 2011 combines visible light exposures of galaxy cluster Abell 2744 taken by the NASA/European Southern Observatory (ESO) Hubble Space Telescope and the ESO's Very Large Telescope, with X-ray data from NASA's Chandra X-ray Observatory and a mathematical reconstruction of the location of dark matter.

For decades, the strange substance called dark matter has teased

physicists, challenging conventional notions of the cosmos.

Today, though, scientists believe that with the help of multi-billion-dollar tools, they are closer than ever to piercing the mystery—and the first clues may be unveiled just weeks from now.

"We are so excited because we believe we are on the threshold of a major discovery," said Michael Turner, director of the Kavli Institute for Cosmological Physics at the University of Chicago, at an annual conference of the American Association for the Advancement of Science (AAAS).

Dark matter throws down the gauntlet to the so-called Standard Model of physics.

Elegant and useful for identifying the stable of particles and forces that regulate our daily life, the Standard Model only tells part of the cosmic story.

For one thing, it does not explain gravity, although we know how to measure gravity and exploit it for our needs.

And the Standard Model has been found to account for only around four or five percent of the stuff in the Universe.

The rest is dark matter, making up 23 percent, and dark energy, an enigmatic force that appears to drive the expansion of the Universe, which accounts for around 72 or 73 percent.

"On the cosmology side we now understand that this mysterious dark matter holds together our galaxy and the rest of the Universe," said Turner.

"And the tantalizing thing on the cosmology side is that we have an airtight case that the dark matter is made of something new... there is no particle in the Standard Model that can account for dark matter."

The dark matter theory was born 80 years ago when Swiss astrophysicist Fritz Zwicky discovered that there was not enough mass in observable stars or galaxies to allow the force of gravity to hold them together.

According to some theorists, dark matter is fleetingly formed by exotic particles called WIMPs (Weakly Interacting Massive Particles) that, as their name implies, have only weak interactions with the visible matter identified under the Standard Model.

But, again, this could only be part of the picture.

"The real question is why dark matter has six times the energy that is in ordinary matter," said Lisa Randall of Harvard University.

"It could be 10 trillions times bigger... This is an intriguing sign that there is maybe some other interaction we can detect."

High-powered instruments track cosmic particles

To track these phantom particles, physicists rely on several methods and tools.

One is the Alpha Magnetic Spectrometer (AMS) aboard the International Space Station (ISS), which captures gamma rays coming from collisions of dark matter particles.

The first results will be published in two to three weeks, according to Samuel Ting, a Nobel laureate and professor at the Massachusetts Institute of Technology (MIT) who is the mastermind of the two-billion-

dollar project.

Ting declined to give details, only suggesting that these highly anticipated results would give humans a better idea about the nature of dark matter.

Another tool used by the scientists is the South Pole Neutrino Observatory, which tracks subatomic particles known as neutrinos, which, according to physicists, are created when dark matter passes through the Sun and interacts with protons.

Another big weapon is the Large Hadron Collider (LHC) near Geneva, the biggest particle smasher in the world.

Its power, they insist, could allow them to break-up electrons, quarks or neutrinos to uncover dark matter.

Last July, LHC physicists announced they had discovered a particle believed to be the Higgs boson, which confers mass. The Higgs was the key missing piece in the Standard Model.

"The dark matter particles are very heavy. It is one of the reasons we have made the LHC, not only to look for the Higgs boson," said Maria Spiropulu, professor of physics at the California Institute of Technology (Caltech).