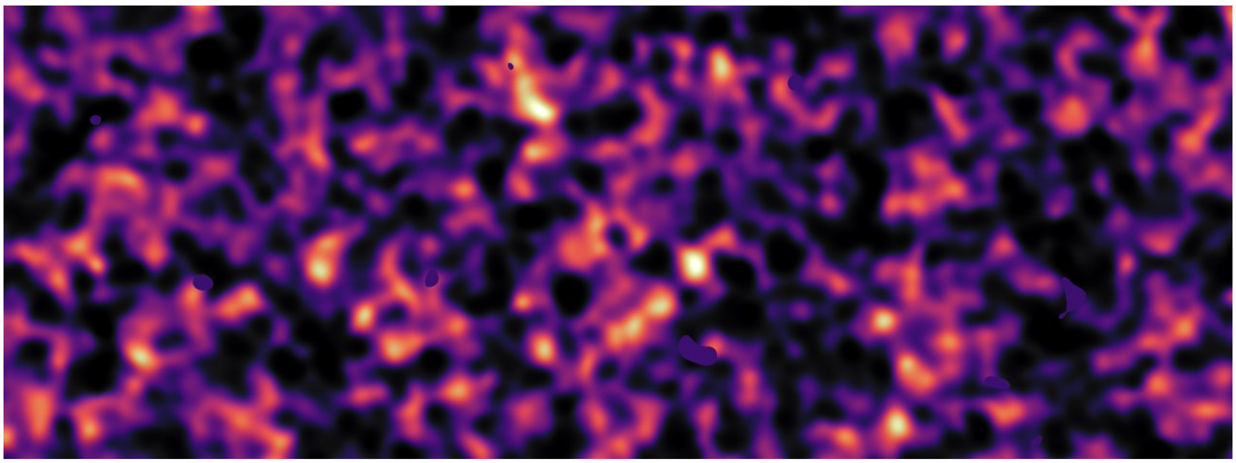
Scientists refine the search for dark matter

October 30 2018



Dark matter map of KiDS survey region (region G12). Credit: KiDS survey

Researchers from Lund University in Sweden, among others, have developed a more effective technique in the search for clues about dark matter in the universe. They can now analyse much larger amounts of the data generated at CERN.

At the CERN research facility, a long series of experiments is underway on protons colliding in the LHC accelerator at almost the speed of light. The amount of data is constantly increasing, as the accelerator's capacity improves. However, it is more difficult to process and store the vast amounts of data that are produced. This is why there is a continuous evaluation of which data the researchers should examine more closely.

"If we are not careful, we could end up discarding data that contains clues to completely new particles of which we are not yet aware, such as particles that form dark matter," explains Caterina Doglioni, a particle physicist at Lund University and a member of the ATLAS experiment at CERN.

She is one of the researchers behind a recent study focusing on better using CERN's enormous amounts of data. Instead of recording all the information from the experiment and then analysing it at a later date, much of the data analysis is done in a short amount of time so that a much smaller fraction of the event is retained. This technique, which has been employed by other LHC experiments as well, allows researchers to record and store many more events that could contain traces of new particles.

The hope is to find signs of hitherto unknown particles that could be carriers of forces that could create a connection between visible and dark matter, according to Doglioni. "These new particles, which we call 'mediator particles' can disintegrate into extremely short-lived pairs of quarks, i.e. the very building blocks of the protons and neutrons in atoms. When quarks disintegrate, a type of particle shower is formed that we can actually detect with our instruments," says Caterina Doglioni.

The research community has long sought answers about the elusive dark matter that makes up a large part of our universe. Only 5 percent of the universe is matter that we are currently able to perceive and measure. The remaining 95 percent is unexplored and referred to as dark matter and dark energy.

Among other things, this assumption is based on the fact that galaxies rotate as though there were significantly more matter than that which we can see. Dark matter is reported to make up 27 percent of the universe, while 68 percent is dark energy—considered to be what causes the universe to constantly accelerate in its ongoing expansion. Researchers have declared October 31st "Dark Matter Day," a day with many events dedicated to dark matter all over the world.

"We know that dark matter exists. Normally, it passes through our measurement instruments, but cannot be registered, but in the case of our research we hoped to see the products of particles connected to it," says Caterina Doglioni.

She doesn't dare to predict how long it might take before there is a breakthrough in the search for dark matter. Meanwhile, Doglioni observes that research initiatives provide spin-off effects as they proceed. Knowledge about how to process these vast amounts of data is also valuable outside the research community, and has led to the launch of various collaborations with industry.

More information: M. Aaboud et al, Search for Low-Mass Dijet Resonances Using Trigger-Level Jets with the ATLAS Detector in pp Collisions at s=13 TeV, *Physical Review Letters* (2018). DOI: 10.1103/PhysRevLett.121.081801

Provided by Lund University