Listening to dark matter

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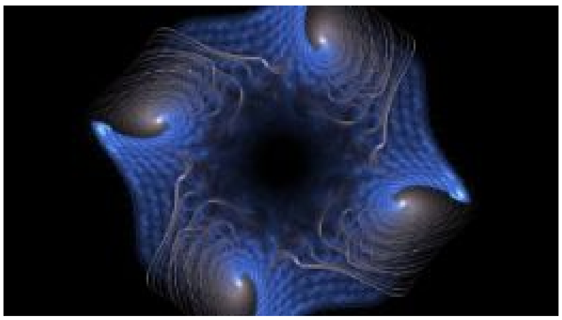

(PhysOrg.com) -- A team of researchers in Canada have made a bold stride in the struggle to detect dark matter. The PICASSO collaboration has documented the discovery of a significant difference between the acoustic signals induced by neutrons and alpha particles in a detector based on superheated liquids.

Since neutron induced signals are very similar to dark matter induced signals, this new discovery, published today, Thursday, 16 October, in the *New Journal of Physics,* could lead to improved background suppression in dark matter searches with this type of detector.

So far, alpha particles have been an obstacle to the detection of dark matter's weakly interacting massive particles (WIMPs) in PICASSO. This detector, which is based on the operation principle of the classic bubble chamber, is sensitive to alpha particles over exactly the same temperature and energy range, therefore making it very difficult to discriminate between the two types of particles.

Alpha particles are relatively common on Earth, emitted by radioactive nuclei such as uranium, and thorium, and are therefore also present in traces in the detector material itself. WIMPs are thought to fill the large spaces between galaxies, concentrating around them in gigantic clouds. As the Earth moves together with the sun through the Milky Way's dark matter cloud, researchers hope to detect occasional collisions of a WIMP particle with an atom in their detectors.

Teams of researchers around the globe work deep underground to create the best conditions to isolate WIMPs from their travelling companions, namely neutrons, which are created by cosmic rays. Underground, teams in the US, Canada, England, Italy, Japan, Korea and Russia have long been sparring over the best detection methods for WIMPs.

The Canadian-American-Czech team based at SNOLAB, using their PICASSO detector, experimented with very sensitive Fluorine-based superheated liquids and analysed acoustic signals following phase transitions induced by alpha particles and WIMP like, neutron induced recoil nuclei. To their surprise they found a significant difference in amplitudes of the acoustic signals, which has never been observed before.

As experiment spokesperson Viktor Zacek (Université de Montréal) said, "When we looked at our calibration data taken with neutrons and compared them with our alpha background data we saw a peculiar difference which we attributed first to some detector instabilities or gain drifts in our electronics. However when we checked the data and refined the analysis the discrimination effect became even more pronounced."

Detection of WIMPs is the first challenge in the struggle to understand dark matter. Much of our understanding until now has been hypothetical. There is convincing astronomical evidence to suggest that 23 per cent of the Universe is made up of dark matter – different from the matter with protons, neutrons and electrons that we are accustomed to.

This dark matter is between a hundred to a thousand times heavier than a proton and interacts extremely weakly with itself and 'ordinary' matter. It is believed it was created during the Big bang and that it now surrounds most galaxies, and also our Milky Way in gigantic clouds.

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