Tentative dark matter hits fit with shadow dark sector

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Deep in Minnesota's Soudan mine, the invisible stuff thought to make up about 80 per cent of the universe's matter may finally have made an appearance.

Though the latest dark matter signal is still too weak to claim a discovery, it matches another from the same mine. Meanwhile, its energy fits with a host of recent theories that suggest dark matter is not a single entity, but a dark sector of particles that could include dark antimatter. "This may be the start of a very big deal," says dark matter theorist Dan Hooper of Fermilab in Batavia, Illinois.

Mine of information *(Image: CDMS)*

Dark matter must be out there because the matter we see does not provide enough gravity to account for the way stars and galaxies move. In the Soudan mine, two detectors – CDMS-II and CoGeNT – wait for weakly interacting massive particles, one potential form that dark matter could take.

These WIMPs would stream past undetected, but very rarely, one should ricochet off the nucleus of an atom, releasing charge and heat. CoGeNT uses a cooled germanium crystal to measure charge, while CDMS-II measures charge and heat using cooled germanium and silicon: the latter is more sensitive to light WIMPs, the former to heavy ones.

Mirror world

On 13 April, CDMS-II team member Kevin McCarthy told the American Physical Society meeting in Denver, Colorado, that the silicon detectors had picked up possible signs of three WIMPs. Their statistical significance is just three sigma – not quite the five sigma (1 in 3.5 million chance that it is produced by other processes) required for a discovery.

But it is nonetheless intriguing because the mass of the WIMPs – if that's what triggered the signal – is 8.6 gigaelectronvolts, which fits with a tentative measurement made by CoGeNT in 2011. "It is right smack on the CoGeNT region of interest," says Juan Collar, who leads the CoGeNT collaboration.

The result supports theories on the existence of a dark sector. The conventional view is that dark matter is monolithic, made of one type of WIMP with a mass of 100 GeV. In the new dark sector model, myriad particles interact via their own dark forces, more like normal matter. "Think of it as a mirror of the visible world," says Kathryn Zurek at the University of Michigan at Ann Arbor.

Suggestive mass

One of the simplest dark sector models assumes the same proportions of dark matter and dark antimatter as the normal sector, which would mean that dark matter particles lie in the range 1 to 10 GeV. "The fact that CDMS-II finds a mass in this range is very suggestive," says Zurek, a dark sector pioneer.

Results from the XENON 100 experiment under the Gran Sasso mountain in Italy seem to cast doubt on the signal. After 225 days, it should have detected a WIMP of 8.6 GeV if one exists – and it has not. But Jonathan Feng, at the University of California in Irvine, says this may be because WIMPs could scatter differently from xenon nuclei. "We've a long way to go," says Zurek. "Still, it's very exciting."

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