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'Frozen' stars could shed light on dark matter

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17:41 24 June 2008
NewScientist.com news service
Ker Than

The universe's first stars were the rock stars of the stellar world: they lived fast and died young, burning out in only a few hundred thousand years.

But new research suggests some of them might still be around as a result of interactions with dark matter, which halted their growth and curbed their blazing excess.

"These stars can be frozen for timescales longer than the age of the universe," said Gianfranco Bertone of the Paris Institute of Astrophysics in France.

Such frozen stars might still linger at the centre of the Milky Way, scientists say, and could provide important insights into the elusive nature of dark matter.

Many of the stellar firstborns, called population III stars, are thought to have formed inside dense dark matter clouds.

If dark matter particles are made up of heavier versions of already known particles, an idea known as supersymmetry, as many scientists believe, they could lose energy through interactions with normal matter and sink to the centres of the stars.

Arrested development

Trapped, the dark matter particles would collide and annihilate into a spray of elementary particles and energy.

A star that captured enough dark matter particles would still emit radiation, but its fires would no longer be fuelled by nuclear reactions. As a result, it would be caught in a state of arrested development.

Previous modelling work suggested population III stars could remain in this frozen state for hundreds of thousands of years before using up enough local dark matter to resume normal stellar evolution.

However, new research by Bertone and his team shows that if the first stars were born in exceptionally dense dark matter regions – such as those near the centres of galaxies, they could remain frozen indefinitely.

Bigger and colder

"There could be conditions in the early universe where stars form in big enough reservoirs of dark matter to last until the present day," Bertone told **New Scientist**.

And the team says these stars could be detected. "A frozen star would appear much bigger and colder than a normal star with the same mass and chemical composition," says colleague Marco Taoso.

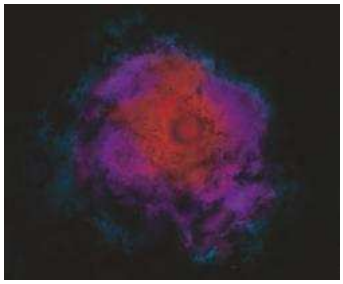
Indeed, astronomers might have chanced across such stars already without knowing it, comments Igor Moskalenko of Stanford University in Palo Alto, California, US.

Finding primordial dark matter stars would provide long-sought evidence for supersymmetry, Moskalenko told **New Scientist**: "If we find the dark matter burners, it would mean that the dark matter indeed consists of supersymmetrical particles, or 'superpartners'."

Stellar resurrections

Other types of stars might also be transformed by dark matter. Present-day stars born in regions of high dark-matter density could also be affected, scientists say.

Dark matter might even have the power to resurrect dead stars. White dwarfs, the corpses of Sun-like stars, are extremely dense and could make excellent dark matter absorbers.



Dark matter might stunt the growth of stars in the early universe; prevented from burning matter in their cores through fusion as normal stars do, they would appear bigger and colder than their normal counterparts (Illustration: University of Utah)

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Gianfranco Bertone, Paris Institute of Astrophysics
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If a roving white dwarf were to wander into a region of abundant dark matter, it could be transformed into a dark matter burner, Moskalenko says: "They could shine like 30 Suns just because they are burning dark matter."

The research has been submitted to the journal *Physical Review Letters*.

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