Thaxted Astronomical Society

News
Features

NF0083

Ghost Particles Emitted By The SUN

https://www.dailymail.co.uk/sciencetech/article-8989525/Physics-Ghost-particles-emitted-SUN-shed-light-massive-stars-shine.html

Ghost particles' emitted by the SUN shed light on the reactions that make massive stars shine

Daily Mail 26th Nov 2020 >

- **The Sun produces its energy by the nuclear fusion of hydrogen into helium**
- **This occurs in two processes, one of which is rare in the Sun but not larger stars**
- **Physicists in Italy were able to detect the elusive emissions from this process**
- **They used a giant tank of a liquid that lights up when the particles pass through**
- **The finding may help explain how stars larger than the Sun form and evolve**

Elusive 'ghost particles' produced deep within the Sun have been detected for the first time, helping to shed light on the reactions that make massive stars shine.

Researchers were able to capture evidence of the particles as they passed through a special detector buried beneath a mountain near the town of L'Aquila, Italy.

The rare emissions — which travelled 90 million miles to reach us — are produced in certain nuclear reactions that account for less than a per cent of the Sun's energy.

https://www.dailymail.co.uk/sciencetech/article-8989525/Physics-Ghost-particles-emitted-SUN-shed-light-massive-stars-shine.html

Ghost particles' emitted by the SUN shed light on the reactions that make massive stars shine

Daily Mail 26th Nov 2020 >

Now we finally have the first, ground-breaking, experimental confirmation of how stars heavier than the sun shine,' said paper author and astroparticle physicist Gianpaolo Bellini of the University of Milan.

Stars are powered by the fusion of hydrogen into helium, which can occur by two different processes — the first being the so-called proton-proton chain, which involves only isotopes of hydrogen and helium. This is dominant in stars like the Sun.

In larger stars, however, the so-called carbon–nitrogen–oxygen (CNO) cycle — in which these three elements help catalyse the nuclear reactions — becomes a more significant source of energy. It also releases ghostly particles called neutrinos.

These are nearly massless — and are capable of passing through ordinary matter without giving up any indication of their presence.

Physicists have wanted to study these emissions from the Sun, however, as better understanding how the CNO cycle works in our star will offer insights into how larger stars — where this process is dominant — burn their nuclear fuel.

https://www.dailymail.co.uk/sciencetech/article-8989525/Physics-Ghost-particles-emitted-SUN-shed-light-massive-stars-shine.html

Ghost particles' emitted by the SUN shed light on the reactions that make massive stars shine

Daily Mail 26th Nov 2020 >

To detect the sun's CNO neutrino emissions, physicists used the so-called 'Borexino detector' — a 55-feet-tall, layered, onion-like machine which contains at its heart a spherical tank called a 'scintillator' that is filled with 278 tonnes of a special liquid.

When neutrinos pass through this liquid, they can interact with its electrons — releasing tiny flashes whose brightness is indicative of the neutrino's energy, with those produced by the CNO cycle being on the more intense end.

These are picked up by camera-like sensors and analysed by powerful hardware.

To ensure that the detector only picks up the rare neutrino signals — and is not overwhelmed by cosmic radiation — the Borexino experiment is both buried underground and further shielded by being cocooned in a water tank.

'This is the culmination of a thirty years long effort which began in 1990 — and of more than ten years of Borexino's discoveries in the physics of the Sun, neutrinos and finally stars,' said Professor Bellini.

https://www.dailymail.co.uk/sciencetech/article-8989525/Physics-Ghost-particles-emitted-SUN-shed-light-massive-stars-shine.html

Ghost particles' emitted by the SUN shed light on the reactions that make massive stars shine

Daily Mail 26th Nov 2020 >

According to physicist Gioacchino Ranucci, also of Milan, the success of the experiment should be credited to the 'unprecedented purity' of the solution.

The detection of the CNO neutrinos has revealed how much of the sun is made up of the elements carbon, nitrogen and oxygen.

Despite the exceptional successes previously achieved and an already ultra-pure detector we had to work hard to further improve the suppression and understanding of the very low residual backgrounds,' Dr Ranucci added.

This, he continued, allowed them to 'identify the neutrinos of the CNO cycle.'

The finding finally confirms that some of the sun’s energy is indeed made by CNO cycle reactions — a notion that was first proposed back in 1938.

'It is the crowning of a relentless, years-long effort that has led us to push the technology beyond any previously reached limit,' said Borexino Experiment spokesperson Marco Pallavicini, who is a physicist from Genoa University.

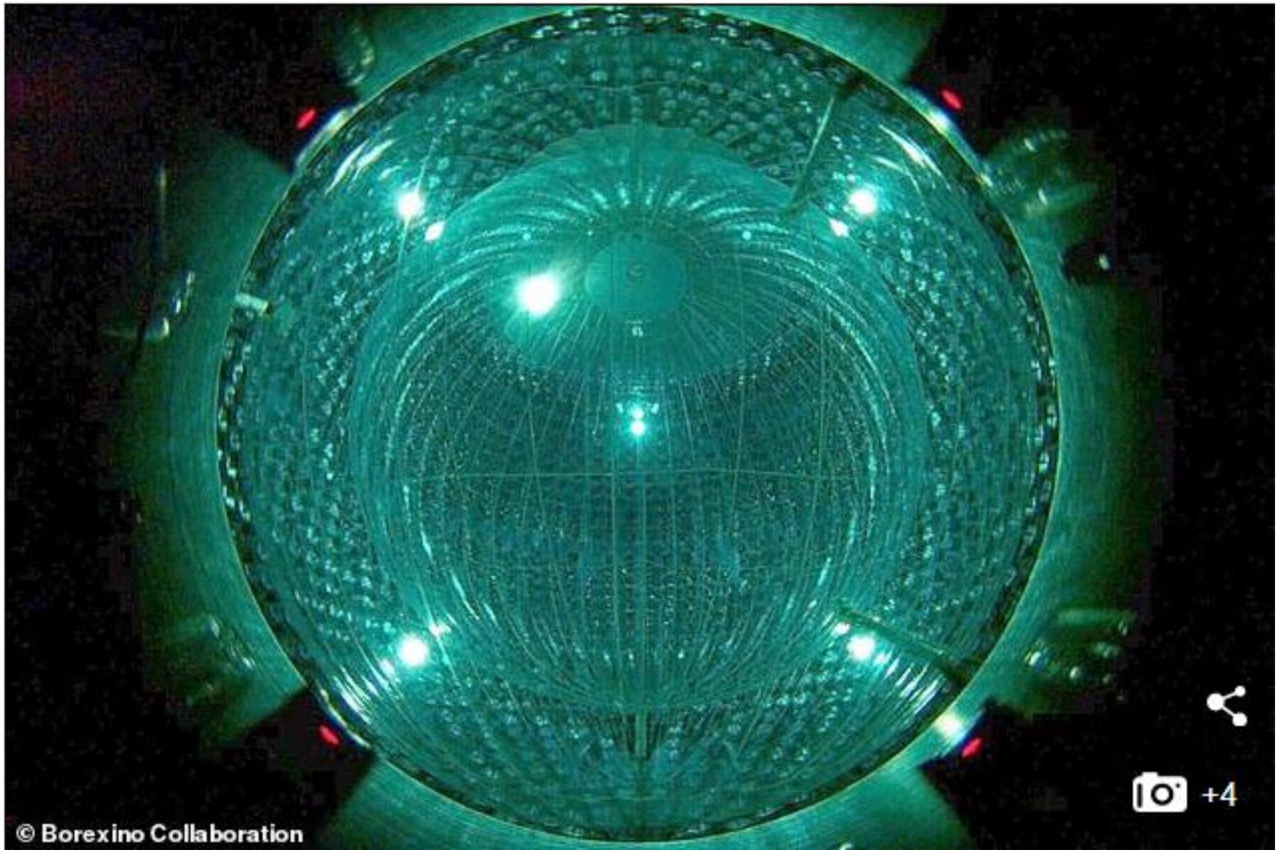
This, he added, has made 'Borexino's core the least radioactive place in the world.'

https://www.dailymail.co.uk/sciencetech/article-8989525/Physics-Ghost-particles-emitted-SUN-shed-light-massive-stars-shine.html

Ghost particles' emitted by the SUN shed light on the reactions that make massive stars shine

Daily Mail 26th Nov 2020 >

Elusive 'ghost particles' produced deep within the Sun have been detected for the first time, helping to shed light on the reactions that make massive stars shine. Researchers were able to capture evidence of the particles as they passed through a special detector buried beneath a mountain near the town of L'Aquila, Italy. Pictured, the core of the Borexino detector



https://www.dailymail.co.uk/sciencetech/article-8989525/Physics-Ghost-particles-emitted-SUN-shed-light-massive-stars-shine.html

Ghost particles' emitted by the SUN shed light on the reactions that make massive stars shine

Daily Mail 26th Nov 2020 >

To ensure that the detector only picks up the rare neutrino signals — and is not overwhelmed by cosmic radiation — the Borexino experiment is both buried underground and further shielded by being cocooned in a water tank