A problem-solving matter

ASK A SCIENTIST

A visitor to the Otago Museum's Tuhura Otago Community Trust Science Centre asks:

What is dark matter?

Dr Chris Gordon, an astrophysicist at the University of Canterbury, responded:

GETTY IMAGES

Dark matter is a type of substance that has been proposed as an explanation for a large number of puzzling astronomical observations.

One such observation is the rotation of stars in galaxies. Most galaxies are disc-like configurations of hundreds of billions of stars. You can think of galaxies as something like a Frisbee in their shape and motion, except that they are typically a billion billion kilometres wide, so quite a lot larger!

The Frisbee analogy, however, is quite accurate in that all the stars are typically rotating as though the galaxy was a solid object. So a star twice as far from the centre of the galaxy is rotating around twice as fast.

It is puzzling as it is not how we would expect the galaxy to behave if all that it was made of was normal matter. As the gravitational force decreases with distance, we expect the stars at the edge of the galaxy to be rotating slower than the ones closer to the centre — similar to a big bowl of soup if it is stirred at its centre.

Instead they behave like the Frisbee in that the ones at the edge rotate faster than the ones closer to the centre.

Ask a question

- Send questions to: Ask-A-Scientist, PO Box 517, Dunedin 9016
- Or email question.aas@gmail.com

The dark matter proposal is that the disc-like galaxies are actually sitting inside a ball of a new type of matter which does not emit or absorb light. This extra ball of dark matter, which the disc of the galaxy is proposed to be sitting in, then implies due to the gravitational forces exerted by the dark matter on the stars, that the stars at the edge of the galaxy should be rotating faster than the ones closer to the centre.

There are many other similar observations that have convinced most cosmologists that dark matter really exists. However, the final confirmation will only be made if we can detect dark matter in some other way besides its gravitational effects.

We know from the required properties of dark matter that it can't be made of atoms like ordinary matter. Some new type of particle is needed.

Some theories of these new dark matter particles predict that they sometimes do interact with ordinary matter and sometimes annihilate with each other to create high-energy gamma rays.

Current experiments are searching for these new interactions to try to provide conclusive evidence for the dark matter proposal.

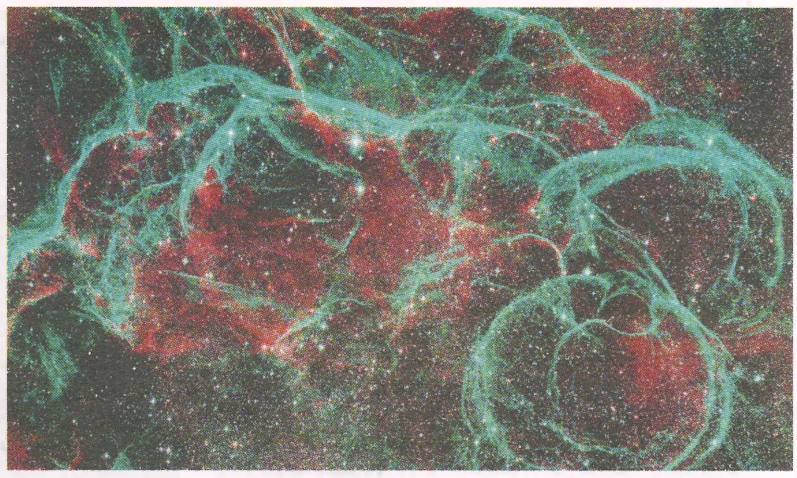


PHOTO: IAN GRIFFIN

A cool kind of glow

SKYWATCH
IAN GRIFFIN
Otago Museum

Last weekend, I was observing at the University of Canterbury's Mount John Observatory. I arrived in Tekapo early on Friday afternoon after a pleasant drive on mostly deserted roads.

The first night was disrupted by clouds and high winds. However, the second and third nights were stunningly clear. This good weather, combined with a very young moon, created perfect conditions for astronomy. My main targets for the weekend were the planets. Using the observatory's 0.6m telescope, I managed to get excellent images showing exquisite details on Mercury, Mars, Jupiter, Saturn, Uranus and Neptune.

Whenever I go to Mount John, I try to get as many photographs as possible. That's why I take extra telescopes and cameras with me. I was keen to test a new bit of kit, called a dual-band narrowband filter, on this visit. This helps make dimly glowing clouds of celestial gas easier to detect. To test the system, I selected a very dim object that I have never managed to see before. I fired up my camera and attached it to a small wide-field telescope. I pointed the system towards a seemingly empty part of the sky where my target was located.

It was only when I got back to Dunedin that I had a chance to check whether I had caught anything interesting. To be honest, I was blown away when I saw the pictures. This week's accompanying image is the result of 55 minutes of exposure. It shows the gassy tendrils of the Vela supernova remnant spreading across more than three degrees of sky. Resembling veins wrapping around a human heart, they are the visible remnants of a star that astronomers think exploded more than 10,000 years ago.

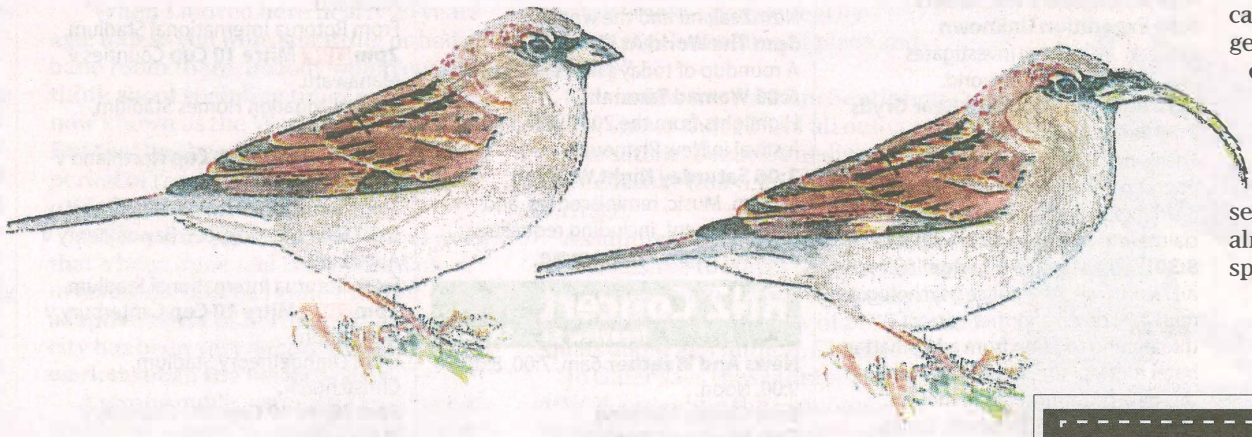
There are two types of supernova. One is caused when a massive star reaches the end of its life. The other occurs when material falls on to a white dwarf star, triggering a runaway nuclear explosion. In both cases, the star is ripped apart, with the explosion blasting hot gases into the cosmos, where their glowing cooling remnants bring smiles to the faces of distant stargazers.

Portobello bird tweets with the pick of the beaks

NATURE FILE
ANTHONY HARRIS

Recently, a female house sparrow with an upper bill three and a-half times the normal length has been seen in and around Portobello on Otago Peninsula. This looks somewhat like the bill of a female huia, but only the lower bill is elongated. It curves widely, narrowing greatly from halfway along to about 2mm wide at the tip.

This bird cannot feed normally, having to place the whole side of its head on the ground sideways and then open its bill very wide in order to get food into its mouth. The bird may also have difficulty preening and removing feather and body lice. Nevertheless, it looks healthy and feeds with a small flock of house sparrows, which behave towards it as though it was a normal bird.



A normal female house sparrow (left). Right: Female house sparrow currently in and around Portobello, with enormously enlarged lower bill, superficially like the lower bill of a female huia.

PHOTOS: SUPPLIED

A bird's bill comprises three parts — the inner bony structure, the dermotheca (a thin layer of cuticle containing the nerves and blood vessels) and the rhampotheca (the outer, visible, horny sheath). The rhampotheca forms when cells from the dermotheca move out and become keratinised and hardened. For some reason, the rhampotheca of the Portobello bird has kept growing out at an abnormal pace. The cause of this deformation may be genetic, environmental (for example, exposure to a chemical), or the result of a physical injury to the lower jaw.

In 1994, I was shown several clear photographs of an almost identical, "huia-billed" sparrow from Portobello.