The Moon is shrinking!

Plus nine more out-of-this-world facts explained

1 The Milky Way smells of rum and tastes like raspberries

This unlikely discovery was made by astronomers studying interstellar objects for new molecules. They had the IRAM radio telescope trained on Sagittarius B2 – a gas cloud at the centre of the Milky Way galaxy – when they found a chemical called ethyl formate. This is one of the aroma compounds that creates the sweet scents of fruit, wine and flowers, and it smells a lot like rum. It is also the chemical that gives raspberries their distinctive flavour.

Ethyl formate is made from ethanol – a common molecule found in star-forming gas clouds – with formic acid, which is a mix of hydrogen, oxygen and carbon atoms. It's visible to radio telescopes because ethyl formate molecules absorb the radiation from the stars and re-radiate it at radio wavelengths. Ethyl formate molecules are some of the largest molecules ever found in space and are among the building blocks of amino acids, which are vital for life as we know it.

Even though Sagittarius B2 is extremely dense as far as star-forming regions go, it still only has around 3,000 molecules per cubic centimetre, compared to around 25 million trillion molecules per cubic centimetre in the air that we breathe on Earth. So, even if you could breath in the nebula, it would sadly be too rarefied to actually smell the rum or taste the raspberries.

DID YOU KNOW? There are around 200 billion stars in the Milky Way alone, the majority of which are red dwarf stars

2 There's a planet with a tail

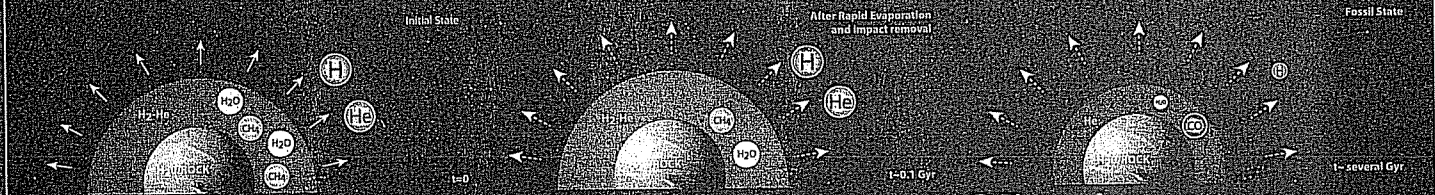
Some exoplanets are just bizarre, and none more so than Gliese 436b. It's what astronomers call a hot-Neptune – a Neptune-sized world that is extremely close to its star and therefore is very hot. What makes Gliese 436b – which is about 33 light years away – even weirder is its tail, which resembles that of a comet.

The planet has a thick gaseous hydrogen atmosphere, but since it orbits a mere 4 million kilometres (2.5 million miles) away from its parent star, this atmosphere is evaporating due to stellar radiation. The resulting cloud of dispersed hydrogen creates a huge comet-like tail that trails behind the exoplanet as it speeds around the star, completing an entire orbit in just 2.6 Earth days. Scientists estimate that Gliese 436b has lost as much as ten per cent of its atmosphere during its lifetime. It also shed hydrogen at a much greater rate in the past, while its star was more active.

An artist's impression of the huge trail of water vapour streaming away from Gliese 436b

How a planet can sprout a tail

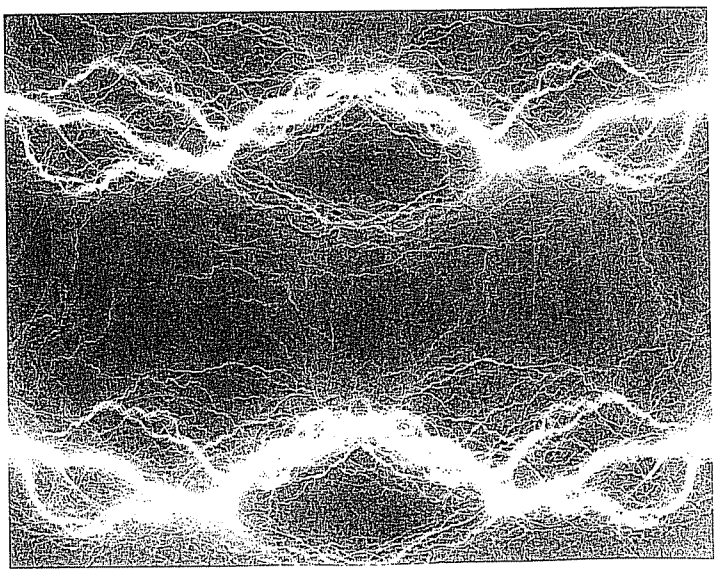
The process behind this strange phenomenon



1 Moving in closer
Hot-Neptunes like Gliese 436b probably don't start out close to their stars, but migrate inwards early in their lives. At first, their atmospheres are a mix of hydrogen and helium, with water and methane too.

2 A swollen atmosphere
Having migrated in so close to their stars that they complete orbits in just a few hours or days, hot-Neptunes begin to heat up, causing their atmospheres to expand and the water to evaporate.

3 Blown away
Hydrogen is a light gas and over billions of years is stripped away from the atmosphere, creating a tail of gas trailing in its wake. As the hydrogen is boiled away the planet is left with a helium-dominated atmosphere.



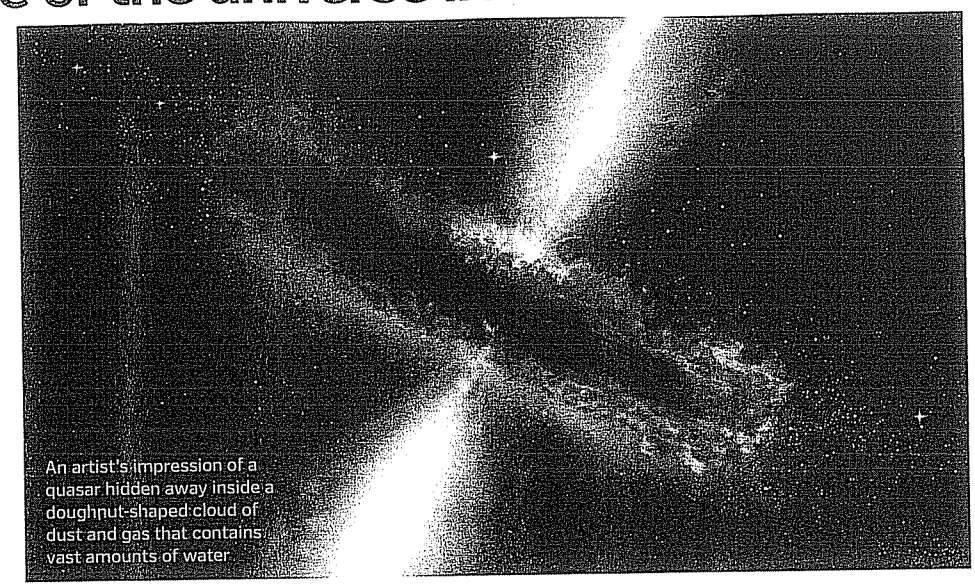
3 Cosmic jets create extragalactic electricity

Buzzing in the distant galaxy 3C303 is a huge electrical current with the same raw power as 1 trillion bolts of lightning. This immense current measures 1 million trillion amps, making it the most powerful electrical current ever found in the universe. Even scarier is how this electricity is being generated, in a jet of matter moving at almost the speed of light and blasting out from a huge black hole at the centre of 3C303 (its name means it is the 303rd object in the Third Cambridge Catalogue of Radio Sources). The black hole is consuming huge amounts of matter – gas, stars, planets and asteroids – and before it is swallowed this matter is ripped apart and finds itself in a super-hot disc of gas around the black hole. The disc is entwined with powerful magnetic fields, which are able to funnel some of the gas away into the jets. Somehow, within this maelstrom, the mighty electrical current is also being generated. Luckily, it is all happening far away from us, at a distance of two billion light years.

4 On the other side of the universe lies a world of water

In a distant galaxy 12 billion light years away is a huge volume of water vapour, totalling 140 trillion times more than all the water in Earth's oceans. The discovery of this water was made by scientists from NASA's Jet Propulsion Laboratory who used radio telescopes to identify the signature of water molecules in the light of the quasar named APM 08279+5255.

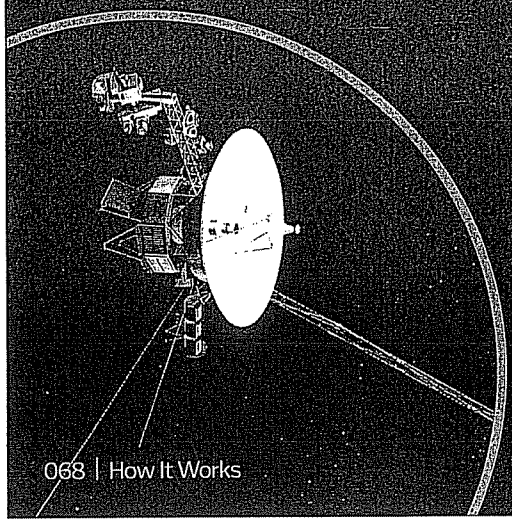
A quasar is an active galaxy powered by a supermassive black hole that is firing a jet of radiation almost directly at us. The quasar produces a thousand trillion times more energy than the Sun, and APM 08279+5255 in particular contains an estimated 4,000 times more water than the Milky Way galaxy. The water was found within a gaseous region hundreds of light years across that surrounds the galactic centre, and will possibly end up being swallowed by the black hole, giving it a drenching.



An artist's impression of a quasar hidden away inside a doughnut-shaped cloud of dust and gas that contains vast amounts of water.

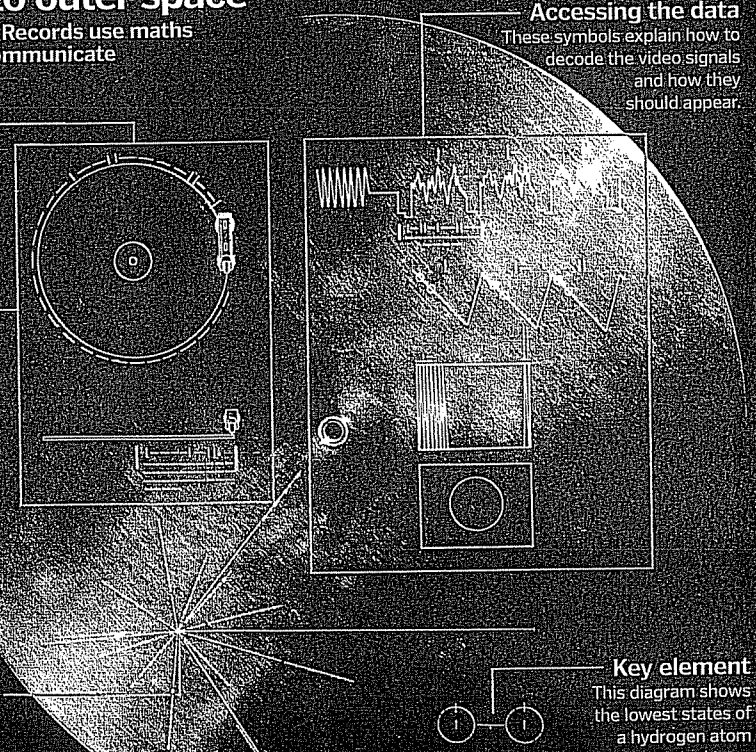
5 Voyager carries messages for aliens

The Voyager spacecraft – launched in 1977 and still going strong – are headed into deep space now that they have completed their tour of the planets. On the off-chance that they may be found by aliens, or even humans in the future, each Voyager spacecraft carries onboard a golden phonographic record, devised by famous astronomer Carl Sagan. The record plays natural sounds, music, images and greetings from Earth in 55 languages, while its cover contains technical information describing the world that the Voyager spacecraft have come from, and how to play the messages for any aliens who are unfamiliar with record players.



Messages to outer space

The Voyager Golden Records use maths and astronomy to communicate



Binary code
A lot of information about the record is given in binary because it is the simplest numbering system.

How to play
These are instructions on how to play the Golden Record with a stylus, included on each probe.

We are here
This diagram is a map of nearby pulsars (stars that regularly flash like cosmic lighthouses). This would help another civilisation find our Sun.

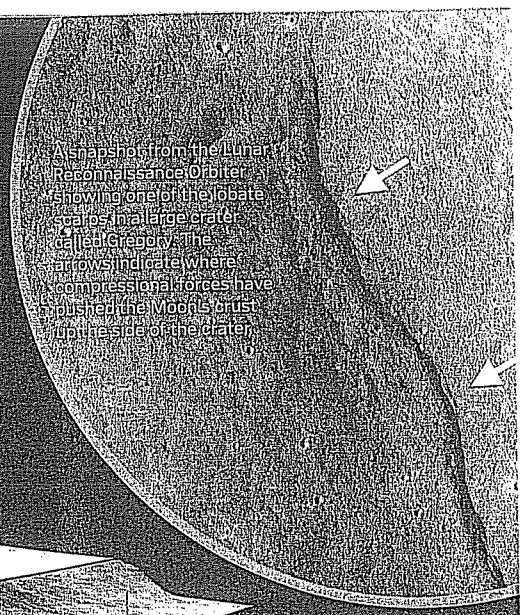
To whom it may concern
Scientists hope that an advanced alien civilisation would be capable of deciphering all these symbols.

Accessing the data
These symbols explain how to decode the video signals and how they should appear.

Key element
This diagram shows the lowest states of a hydrogen atom and is the key to accessing all the information on the records.

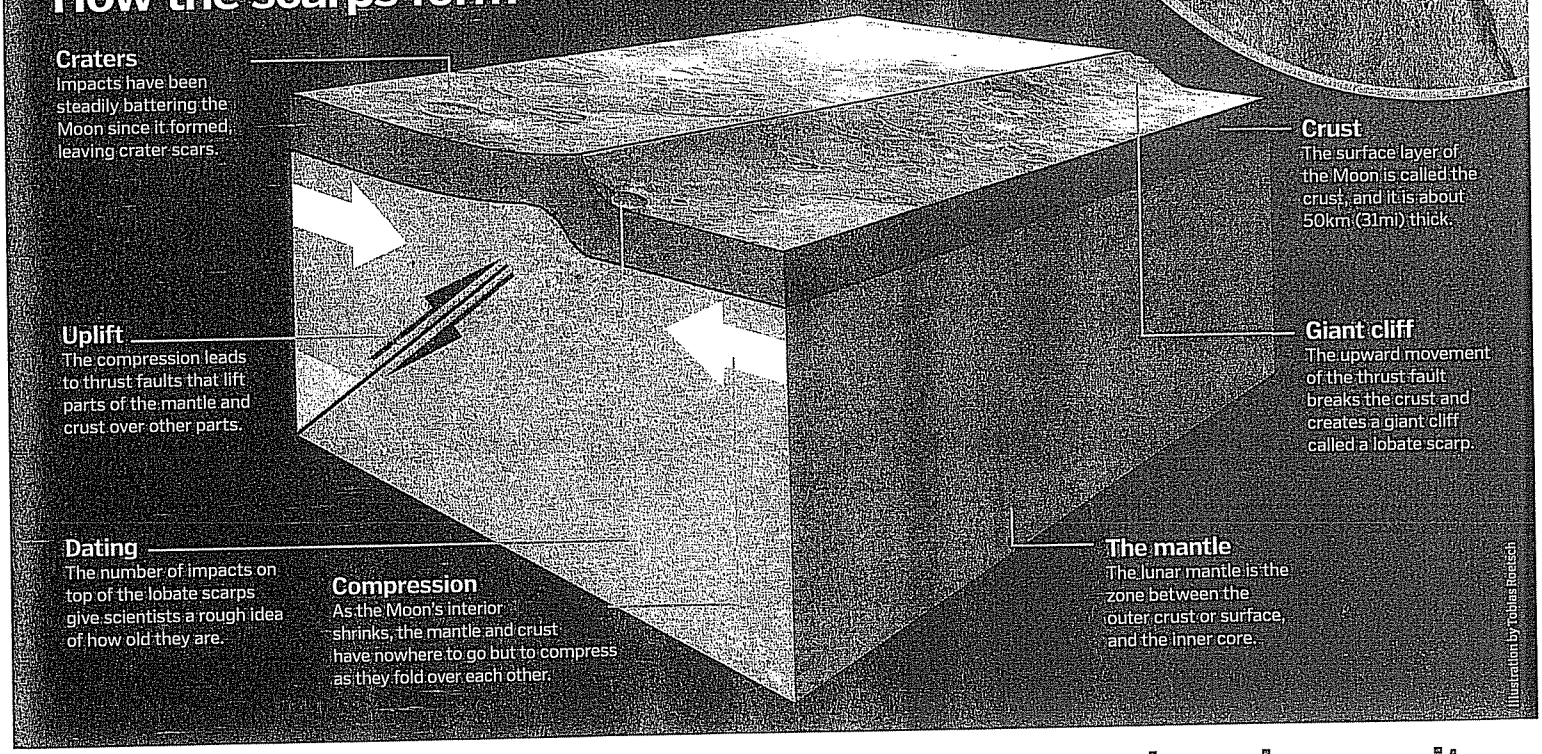
6 The Moon is shrinking!

Our Moon didn't have an easy start in life. It was likely formed in the furnace of a massive collision between Earth and a protoplanet, and has since suffered a multitude of asteroid strikes. These impacts, together with the decay of radioactive elements on the Moon, generated heat. Over millions of years our lunar companion has cooled and, as a result, shrunk. Like an apple that goes bad, its surface has wrinkled, folded and broken. NASA's Lunar Reconnaissance Orbiter has imaged giant cliffs on the lunar surface called lobate scarps, which formed when the Moon's interior contracted as it cooled and the surface, like loose skin, wrinkled. Based on the size of the biggest scarps, which formed sometime in the last billion years, the Moon's radius has shrunk by about 91 metres (300 feet).

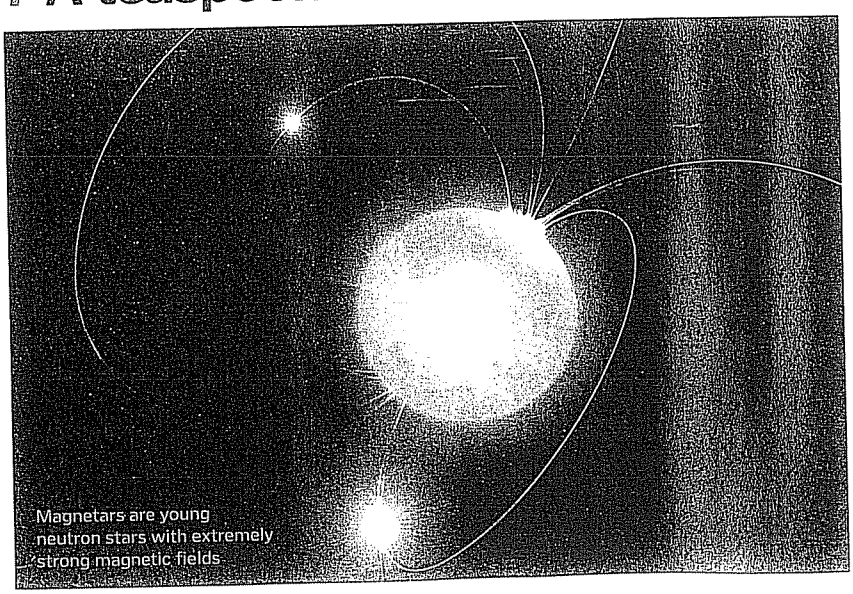


A snapshot from the Lunar Reconnaissance Orbiter showing one of the lobate scarps in a large crater called Gregory. The arrows indicate where compressional forces have pushed the Moon's crust up the side of the crater.

How the scarps form



7 A teaspoon of neutron star weighs as much as humanity



Magnetars are young neutron stars with extremely strong magnetic fields

Everything about neutron stars is extreme. They pack up to twice the mass of the Sun into their tiny volumes and are incredibly magnetic. The most magnetic are called magnetars and if one were in orbit around Earth like the Moon, its magnetic field would be able to wipe every credit card on the planet. Stand on their surface and you would feel gravity 200 billion times stronger than on Earth. If the neutron star is spinning, it will fire beams of energy from its rotational axis as particles are accelerated near its magnetic poles – if we are in the line of sight of these rotating beams, we see them pulse as a pulsar.

Neutron stars are created when giant stars die in supernovas. Fusion ceases and the star collapses in on itself, compressing the core. A shock wave rebounds off the core and obliterates the star in a supernova, leaving behind the squashed core that has become so dense that it is only 11.3 kilometres (seven miles) across and electron and proton particles have been compressed together to create an object made entirely of neutron particles. A teaspoon of this would weigh ten billion tons.