THE AGE
Technology

Mysterious worlds

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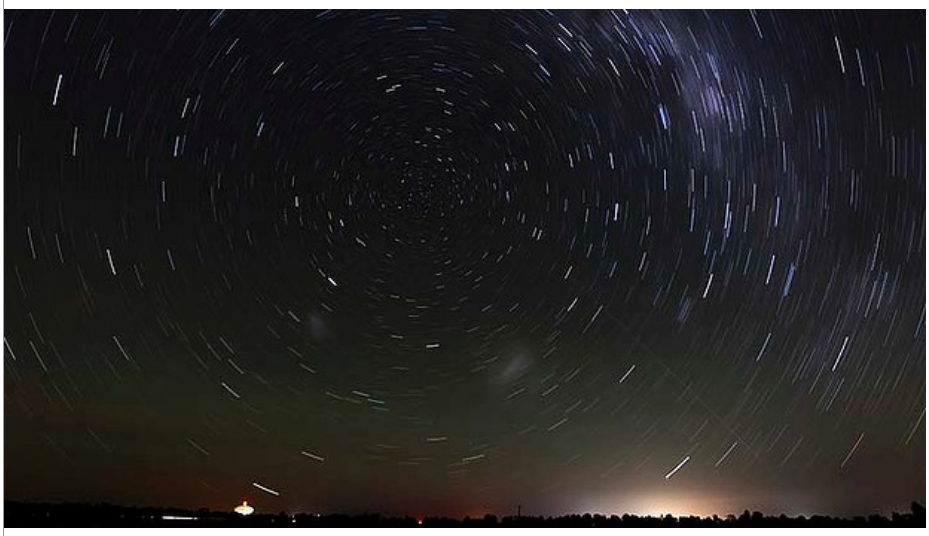
The hunt for life on distant planets continues to fire imaginations.



The night sky near Parkes radio telescope. *Photo: Nick Moir*

Exciting new findings are coming thick and fast. Scarcely a week goes by without scientists unearthing yet another distant exoplanet, as planets outside our solar system are called. Important advances in telescope technology are enabling scientists to discern the atmospheric make-up of these remote realms. The latest discovery, reported in the US journal *Science*, is of an exoplanet 130 light years away with an atmosphere of water vapour and carbon monoxide. (A light year is the distance travelled by light in one year, about 9,500,000,000,000 kilometres.)

This mysterious world, known prosaically as HR8799C, was studied by splitting its reflected light into different wavelengths to uncover the tell-tale signature of molecules in its atmosphere.

Chances of finding life there, at least as we know it, are low – HR8799C's atmosphere harbours no methane, which on Earth is emitted by many organisms.

The exoplanet is one of four planetary youngsters, estimated to be between 30 million and 100 million years old. They are all hot monsters, with surface temperatures exceeding 1000 degrees and masses ranging from five to 13 times that of our solar system's gas giant, Jupiter.

Some of their atmospheres bear traces of acetylene or the deadly gas hydrogen cyanide.

Normally, the light emitted or reflected from planets is too feeble to be detected when it is in the glare of a star's light, Monash University astrophysicist Rosemary Mardling says. "Most planet detection methods rely on observations of the star itself."

The method of directly detecting exoplanets involves blocking out as much light as possible from a parent star. "To do this, we use either a 'mask' to block out the starlight or try to 'null' the starlight – which lets us observe the remaining light reflected by the exoplanet" Dr Mardling says. "This is done using filters which only let through light at infra-red wavelengths, at which young exoplanets are brightest."

The idea is similar to noise-cancelling headphones that null background interference to enable music to be heard clearly.

Habitable zones

Surface water is unlikely to exist in liquid form on most of the bizarre worlds found so far. But, scientists agree, it is only a matter of time before more Earth-size exoplanets that might be favourable to life show up.

The nearest habitable orb may be little more than 6.5 light years away, the latest research suggests. "This will soon be tested by a newly approved NASA satellite, called TESS, which stands for Transiting Exoplanet Survey Satellite," Melbourne University astrophysicist Alan Duffy says. "It's expected to launch in 2017 and will find habitable, Earth-like exoplanets near us across the entire sky."

Other projects slated to start within the next few years include the Gemini Planet Imager and the Spectro-Polarimetric High-contrast Exoplanet Research, or SPHERE.

Two decades ago, Dr Duffy says, scientists knew of only one star with planets, our sun; today, more than 800 such systems have been catalogued. They range from giant planets larger than Jupiter but hotter than Mercury to frozen worlds orbiting moribund stars.

The latest revolutionary discoveries, Dr Duffy explains, beg the question: How many more exoplanets are out there, waiting to be found? "And, most excitingly, will any of them resemble Earth?"

Above all, how likely is it that any of these celestial bodies host life forms? Scientists are sharply divided over this question, their views ranging from near certainty that alien life exists to being almost as certain that it does not.

Countless books, radio and TV programs and films have been produced on the subject, yet science thus far been lacking in answers.

"The probability of life emerging on an Earth-like planet was considered to be virtually zero in 1970 and one, by some, today," says physicist and astrobiologist Paul Davies, director of the Beyond Centre for Fundamental Concepts in Science and co-director of the Cosmology Initiative at Arizona State University.

The scientific facts, he says, have not changed. "It can still be anywhere from zero to one, and nothing we currently know gives a clue. We have no way to estimate the probability that life will emerge even on an Earth-like planet, let alone non-Earth-like ones.

"The known facts are consistent with ours being the only planet in the universe with life."

Swinburne University astronomer Christopher Fluke agrees. "During the past 50 years, astronomers have searched without success for evidence that we are not alone," he says, referring to the global Search for Extraterrestrial Intelligence (SETI), which so far has drawn a blank, despite having monitored multiple radio frequencies for signs of anything odd. "Should we be trying to send messages of our own?" Associate Professor Fluke wonders.

Scientists ought to rid their minds of preconceptions as to what an extraterrestrial intelligence might be like or what sorts of technologies aliens may have acquired, Professor Davies suggests. This, he says, is imperative if we are likely to find ET.

His Beyond Centre is trailblazing an ambitious program to search for signs of alien microbes among some of the more extraordinary organisms on Earth that can withstand hostile conditions such as extreme cold, heat, acidity, radioactivity or saltiness.

"There are major unanswered questions in the search for recognisable, or even intelligent life," Melbourne University theoretical physicist Katherine Mack acknowledges. "What are the chances other life forms would be able to communicate across interstellar space?" she asks. "And if an alien civilisation exists, how likely is it we'd find it before it had time to destroy itself?"

Nearer by

Not all exoplanets are that far-flung. One strikingly similar to Earth – at least in terms of its mass – has been found just more than four light years away in the triple-star system of Alpha Centauri, our closest stellar neighbour.

The exoplanet is "the lightest orbiting a solar-type star and the closest to the solar system found to date", its discoverers, a Geneva-based team using the European Southern Observatory in Chile, write in the British journal *Nature*.

Most scientists dismiss the chance of life existing on the chunk of rock that orbits its parent star, Alpha Centauri B, at one-tenth of the distance Mercury orbits our sun. It's probably an utterly desolate place with a scorching surface of about 2000 degrees, they conclude.

Nonetheless, the finding has raised hopes of finding an Earth twin hiding somewhere in Alpha Centauri, perhaps in a habitable zone.

"The Swiss team should be congratulated on this discovery," NASA astrophysicist Mario Perez says in Washington. "The search for a planet around the closest star to our own is finally over. It demonstrates that the presence of such planets around stars may be fairly common."

For all we know, extraterrestrial life, if it exists, may lie within our own neck of the cosmic woods. NASA's Curiosity rover, for example, is hard at work scouring the desiccated deserts of Mars for life.

"Mars might still contain life in some protected and hospitable environments, such as those deep underground," says Mark Sims, a professor of astrobiology and space instrumentation at Britain's University of Leicester and former mission manager of the European Space Agency's Beagle 2 mission.

Curiosity is now tackling this question obliquely by trying to establish whether Mars has or once had potentially habitable environments. To do this, the rover is sampling soil and rocks on the way to a nearby mountain with interesting geologies, including clays and sulphates that might once

have been associated with water.

"The mountain enables one to have a cross-section of Martian history over several billion years," Professor Sims says.

NASA, and its European counterpart, ESA, meanwhile, are planning robotic missions to the solar system's icy outer suburbs. Prospects include the icy depths of subsurface oceans on Saturn's moons Enceladus and Titan, and on Jupiter's moon Europa.

Links

Learn more about the planned TESS telescope at: www.nasa.gov/home/hqnews/2013/apr/HQ-13088-Astro-Explorer-Mission-.html

Visit NASA's comprehensive exoplanet archive at: exoplanetarchive.ipac.caltech.edu/

VCAA links

VCE Biology: www.vcaa.vic.edu.au/Documents/vce/biology/BiologySD-2013.pdf

Physics: www.vcaa.vic.edu.au/Documents/vce/physics/PhysicsSD-2013.pdf

Astronomy – Detailed study 3.1 for Units 1 and/or 2 Physics – accessed at VCE Physics above, p21

F-10 Physics (sub-strand "physical sciences" in AusVELS): ausvels.vcaa.vic.edu.au/Science/Curriculum/F-10

Science at the Edge

Is ET not sending out signals? Or have we been searching in the wrong place, at the wrong time? Might it simply be that ET does not exist? The *Age* panel of experts will tackle these topics at The Edge, Federation Square, on Friday, April 19.

Bookings here

THE PANEL

Dr Alan Duffy, a postdoctoral research fellow at the University of Melbourne, studies the growth of galaxies and stars from the Big Bang to the present day. He uses supercomputers to create model universes to test theories of how systems like our own Milky Way galaxy form. He regularly publishes in international journals on topics as diverse as dark matter, dark energy and the birth and demise of stars.

Dr Rosemary Mardling is an astrophysicist who divides her time between Monash University's school of mathematical sciences and Geneva University's astronomy department, where 51 Pegasi B, the first exoplanet orbiting a sun-like star, was discovered in 1995. Among other things, she studies the gravitational interactions between planets and the ways planets form. She recently became an occasional planet hunter at the European Southern Observatory in La Silla, Chile.

Dr Katherine Mack, a theoretical astrophysicist at Melbourne University, holds an Australian Research Council Discovery Early Career Researcher Award. She spends her time finding new ways to explore the early cosmos and fundamental physics using astronomical observations. During her work at Caltech, Princeton, Cambridge and now Melbourne universities, she has studied dark matter, black holes and the first galaxies in the universe.

Associate Professor Christopher Fluke, an astronomer at Swinburne University's Centre for Astrophysics and Supercomputing, has a long-standing interest in the search for life in the universe. His research interests range from the study of supermassive black holes to pioneering technologies that improve the way astronomers work. Along with co-ordinating the 3D AstroTour school program, he was a consultant for the *Yelling@Stars* art project in 2008.

Please send bright ideas for new topics to pspinks@fairfaxmedia.com.au

21 comments

»«

»The universe is so big that there just has to be some kind of life out there, wherever it is.«

»«

Numbermaniac | April 15, 2013, 6:14PM

»«

»The universe breeds life. We are the first. There will be more once we start to seed the cosmos.«

»«

Kel | April 17, 2013, 11:07AM

»«

»Based on what evidence Kel?«

»Just because our planet is the only planet known to harbor life, does not mean that there is no other life and that our planet is therefore the first.«

»All it means is that we do not (yet) know of other planets that do harbor life.«

»I suspect that it is out there, we just can't find it yet with the technology at our disposal.«

»«

Joe | Geelong April 17, 2013, 11:16AM

»«

»Forget the entire universe, it is a mathematical certainty that life exists on a planet or moon within our own galaxy. There simply must be. The possibility that the inhabitants of those worlds are as advanced as we are technologically means that if we can't send out ships or probes to seek them out suggests that neither do they. We may never have factual evidence within our lifetimes, but it is a sure bet that life exists outside of little planet.«

»«

Jeda | Melbourne April 16, 2013, 11:13PM

»«

»Is there life outside this planet?«

»Pick your odds for life... one in a trillion?
There are 170 billion galaxies in the currently observable universe (disclaimer, "at least" 170Bn).
Average number of stars in a galaxy is 10 trillion (smallest around 10 million, largest around 100 trillion).
170 billion galaxies x ten trillion average star number = a lot. 1.7 followed by 24 zeroes.
That is a rough guess for the number of stars in the universe.
If you say life is 1/1000000000000 - that makes 17 trillion stars with life.
If you say its 1/100 trillion - that makes 17 billion stars with life
and so on and so forth.
I'll have $10 on "yes"«

»«

Nice odds | April 17, 2013, 8:08AM

»«

»Amazing intellect you must have to surmise this.«

»«

Kel | April 17, 2013, 11:08AM

»«

»@ Nice Odds. Maths is obviously NOT your long suit. Hope you do better with real gambling.«

»Life at 1 in a trillion you reckon? That's 1 to the power of 12. Not even close. For a soup of amino acids (that just happened to be there) to randomly arrange themselves into a simple 100 chain protein is odds of 1 to 100! (100 factorial). That's approx 10 to the power of 158. You are 146 orders of magnitude out! And that's just for the smallest of proteins. The simplest of life requires hundreds of proteins to assemble.«

»The chances of life spontaneously arrising are so infinitesimally small, it's hard to comprehend something so unlikely. Biologists steadfastly refuse to allow that life developed more than once on Earth (with all the right factors in place). That's why you don't look at moulds, & say they spontaneously arose, as also did single-cell animal cells, single-cell plant sells, etc.«

»Every now & then some scientist says they are investigating that a cyanobacterium may have been a 2nd example of life arising, but the research always shows they're wrong.«

»The likelihood of life arising again, anywhere is so infinitesimal it is effectively zero.«

»Sorry everybody.«

»«

Reality Check | April 17, 2013, 3:21PM

»«

»Reality Check is ignoring the true odds of life existing.
It is infact 1 - we know life exists on our planet so it is a certainty not some infiniteisimaly small number approaching zero.
The odds of you "reality check" being either your grandmothers daughter or grandfathers son could also be viewed as infinitesimaly small until you view it from the other perspective and realise, you are, and as such the odds are one.
Don't brag about your maths potent when you fail so epically.«

»«

Joe | Geelong April 17, 2013, 6:18PM

»«

»Well, if it is just us... it seems like an awful waste of space.«

»«

Mat | April 17, 2013, 9:34AM

»«

»Are you sure we are even in a universe? Anything is possible... You just have to think about it.«

»«

Kel | April 17, 2013, 11:11AM

More comments

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