THE AGE
Technology

The lone rangers

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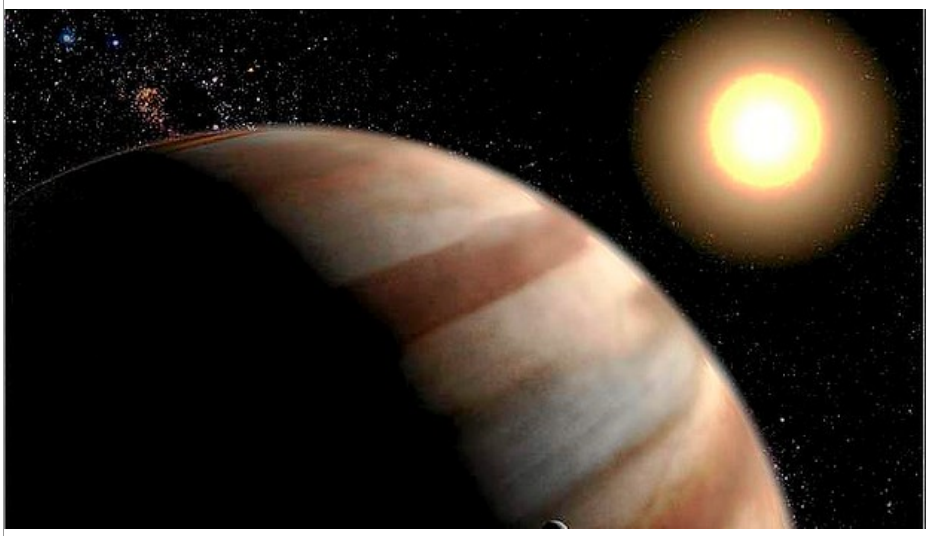

Astronomers using the Hubble Space Telescope made the first direct detection of the atmosphere of a planet orbiting a star outside our solar system.

Call them cast-outs, if you will. Legions of lost worlds, once confined to the realm of science fiction, are fast becoming science fact. These are so-called rogue planets that have been cruelly ejected by their parent stars and are now destined to roam footloose and fancy-free through the cold depths of interstellar space.

Untethered by gravity to particular stars, these wandering exoplanets, as planets outside our solar system are called, are free to move across the galaxy. Some might even harbour alien life forms, a panel of experts concluded at last week's Science at the Edge event at Federation Square.

"Not all exoplanets have a nice childhood," explains panellist Alan Duffy, an astrophysicist at Melbourne University. "Some are violently flung from their orbits through interactions with other stars – or even large siblings. The rejects then wander through space alone as rogue planets."

Emitting very little light themselves, these cosmic vagabonds are notoriously difficult to find. All the same, scientists have now clearly identified one that is most likely a rogue.

"It's the closest such object at a distance of about 100 light years," Dr Duffy says. "It is close enough that they've even estimated the temperature of its atmosphere."

The object, catalogued as CFBDSIR2149, was found by the European Southern Observatory's Very Large Telescope and the Canada-France-Hawaii Telescope. The technique used to detect it, called gravitational micro-lensing, picks up the tiny, but just discernible, amplification of a star's brightness as an exoplanet passes between the star and telescope.

Astronomers believe the cosmos might teem with rogues. Some scientists, in fact, reckon they might be twice as common as stars in the observable universe.

More discoveries support this view. An exoplanet, labelled Fomalhaut b, was recently found to have an orbit so strange that astronomers resolved it was a rogue orb. Located roughly 25 light years away in the constellation of Piscis Austrinus, the finding, by the Hubble Space Telescope, was

reported at a recent meeting of the American Astronomical Society.

In another study, a two-year scan of the sky, an international team stumbled upon 10 rogue exoplanets drifting aimlessly between 10,000 and 20,000 light years away in the direction of our Milky Way's central galactic bulge.

The orbs are anything but small or Earth-like. Calculations suggest they are roughly the size of our gas giant, Jupiter, whose mass is twice that of the other planets combined. As yet, no host stars have been detected within about 10 astronomical units of the rogues (or 10 times the distance between the sun and the Earth).

Such discoveries have not surprised some scientists. "I've long believed that there is more planetary real estate wandering the interstellar spaces than tethered to stars," says acclaimed physicist Paul Davies, director of the Beyond Centre at Arizona State University in the US.

Exactly how rogues become orphaned is open to debate. In his book *The Eerie Silence* (Allen Lane), Professor Davies writes: "Theoretical analysis of planetary motion suggests that orbits can be destabilised by planets 'ganging up', resulting in objects being flung out of a star system altogether. As a result, there could be many 'rogue planets' wandering the dark interstellar spaces, perhaps accompanied by a retinue of moons. Quite possibly our solar system started out with more than the eight planets we see today, the rest being ejected."

For some time it's been known that planetary collisions could eject planets from regular orbits into the interstellar medium or between planetary systems, says NASA astrophysicist Mario Perez in Washington. It's possible, he says, that these large planets are not truly untethered – they might be loosely connected by gravity with stars.

Bodies the size of Jupiter, however, are normally found in orbits closer to their parent stars. "So the probability of being in large orbits with undetected host stars is small," Dr Perez says.

Life prospects

Might these rogue realms host life, probably not as we know it? "That would be fairly tough to say either way," Dr Duffy says. "I wouldn't assume them to be the likeliest places for life."

This, he says, is because rogue objects drifting in space are without nearby sources of light and heat. "Although one could imagine moons orbiting them like Europa that are heated internally by tidal forces, leading to a subsurface ocean."

The case of planet Earth is instructive, Dr Duffy says. "Life without the sun is possible – such as around the 'black smokers' deep under the sea that use the Earth's internal heat, via chemical reactions, to grow. The biggest issue is that heat from radioactive decay alone might not be sufficient to prevent the oceans freezing."

At this stage, there is little reason to believe rogue planets are more numerous than "bound" exoplanets, says another panellist, Monash University astrophysicist Rosemary Mardling. "And so there is little reason for them to be more common life-bearers."

Tidal heating of rogue moons might be a source of energy over long periods to allow life to evolve inside them, Dr Mardling says. "While such moons might offer more stable places to live, the very stability of these environments might inhibit evolution."

More the merrier

The more exoplanets there are in the universe, the more places where some kind of life might have had time to develop," says panellist Chris Fluke, an astronomer from Swinburne University.

There are also many hazards that might threaten the long-term sustainability of life, Associate Professor Fluke says. "Over many millions of years, life on Earth has survived variations in the output of our sun's energy and catastrophic collisions with asteroids – but it could have been much different."

Perhaps rogue exoplanets offer a marginally safer environment for life to thrive, away from the dangers of a solar system, he suggests. "Without a sun to call their own, though, an alternative heat source is likely to be crucial."

Professor Davies' preferred scenario for life on these orphan worlds is in the deep subsurface. "Many of them will be icy planetesimals [large objects, bigger than boulders, formed from dust, rock and other materials that sometimes evolve into planets with deep crusts of solid ice] with cores that remain liquid for billions of years, and offering possible abodes for microbial life."

Yet he finds it hard to imagine how advanced life would get going. "Even if more complex biological entities were to evolve, one can only speculate what life would be like in such a location," Professor Davies writes.

"How long would it take sentient beings, confined to their pitch-black liquid habitat by a solid sky hundreds of kilometres thick, to discover that there was a vast universe beyond their world's apparently impenetrable roof? It is hard to imagine that they would ever break out of their ice prison and beam radio messages across space."

Oceans of possibility

It is not the first time scientists have raised the prospect of finding rogue exoplanets. In an article published in the British journal *Nature* in 1999, an American astronomer, David Stevenson, writes: "During planet formation, rock and ice embryos of the order of Earth's mass may be formed, some of which may be ejected from the solar system as they scatter gravitationally from proto-giant planets. These bodies can retain atmospheres rich in molecular hydrogen."

Bodies of this sort, he reckons, might have oceans of water "whose surface pressure and temperature are like those found at the base of Earth's

oceans. Such potential homes for life will be difficult to detect."

Since exoplanets as big as or bigger than Jupiter are unlikely to have solid surfaces, life would be near impossible to find there, even if it did exist, Dr Perez says. If these gas giants were frozen, on the other hand, then they might have solid surfaces after all.

"If it turned out that there was life there, it'd be a very lonely ET indeed!" Dr Duffy concludes.

Links

Learn what the Hubble Space Telescope uncovered
Watch the movie *Hubble 3D*, part of IMAX Melbourne's schools education program.
NASA's Exoplanet Archive

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F-10 Physics (sub-strand "physical sciences" in AusVELS)

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