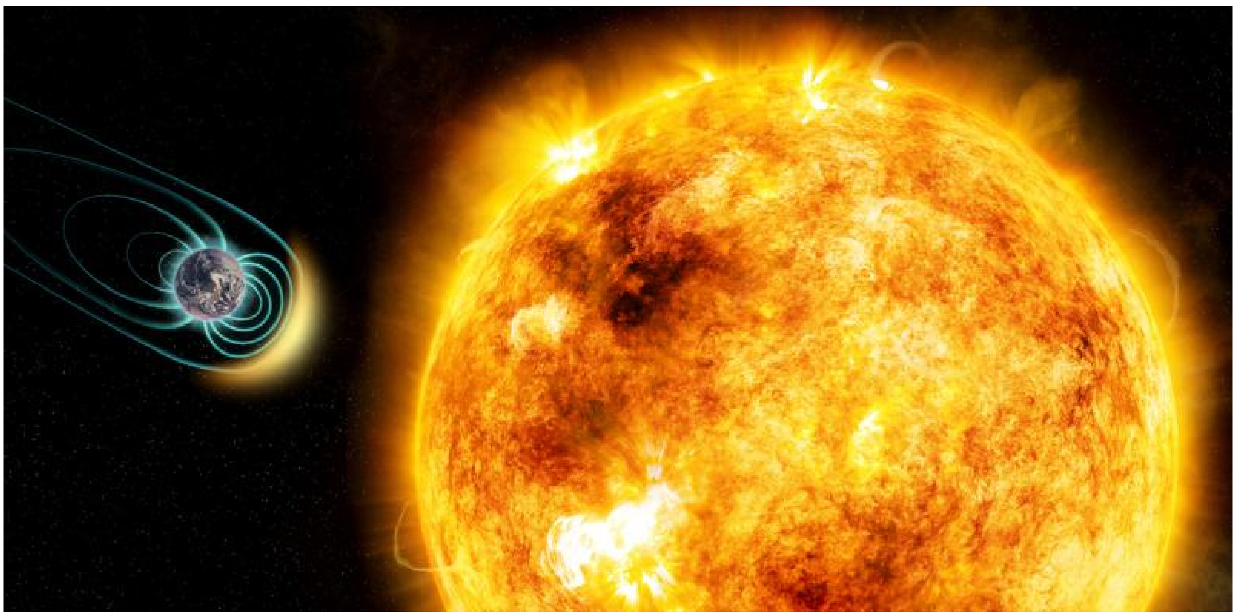
What the 'weather' is like on a star can help in the search for life

March 17 2016, by Jonti Horner, University Of Southern Queensland



An artist's illustration of Kappa Ceti whose stellar winds are 50 times stronger than our sun's. Any Earth-like planet would need a magnetic field to protect its atmosphere if it was to stand a chance of hosting life. Credit: M. Weiss/CfA

Scientists are studying the "weather" around young sun-like stars in an attempt to understand the conditions needed for a system to have planets that would stand a chance of hosting life.

Kappa Ceti is a relatively nearby star that resembles our sun in its youth, when it was just half-a-billion years old. But the results of a detailed study of Kappa Ceti released overnight reveal a star far more violent and active than our modern-day sun.

When we look at stars in the night sky, we often imagine serene glowing balls of gas that will illuminate the universe for billions of years.

But stars give off more than just light. They shed material, continually flooding their environment with a stellar wind. They also emit vast explosions of material, flares and mass ejections, continually flinging their outer layers into space.

This flood of material spewing from a star is known as space weather and, until recently, it has proven incredibly challenging for astronomers to study on any star other than the sun.

Measuring a star's activity

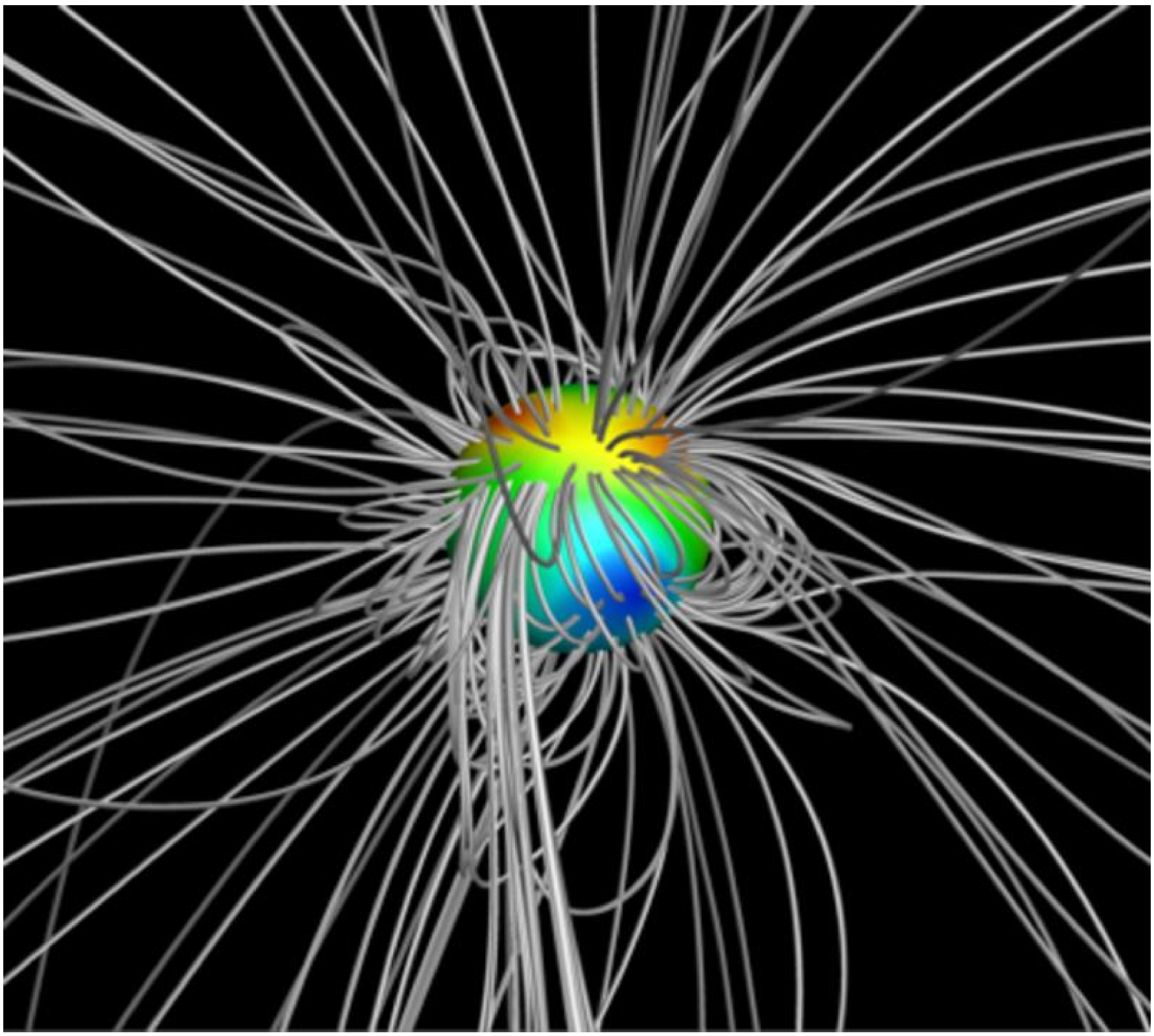
An important question in astrobiology is: "how normal is our sun?". Is our star unusual, with life an accidental beneficiary? Or are there other sun-like stars capable of hosting planets with life?

The problem is that stars are very far away. Even the most powerful telescopes can barely resolve the disks of even the largest stars. So how can we study the weather generated by those stars?

To do this, the scientists in the BCool consortium take advantage of the fact that stars, particularly active ones, have strong magnetic fields that are intimately tied to the star's activity.

As light (an electromagnetic wave) passes through a strong magnetic field, it becomes polarised. The degree and type of polarisation depends on both the direction and the strength of the magnetic field.

It is this polarisation that the BCool scientists measure to study the magnetic fields of sun-like stars. They observe those stars in polarised light (a bit like putting polarised sunglasses on the telescope), which allows them to map the magnetic field on the surface of the star.



A computer model showing the magnetic field lines of Kappa Ceti (gray lines) looping out from the star's surface. These magnetic fields generate a stellar wind 50 times stronger than our sun's. Credit: TCD / A Vidotto Do Nascimento et. al (2016). ApJLetters

From this, they calculate how the field extends outward from the star, and how it evolves with time. This allows them to determine the stellar wind and to model the impact of that wind on any orbiting planets.

A younger star

Kappa Ceti is located 30 light-years from Earth, in the constellation of Cetus (the Whale).

It is very similar to our sun – about as massive, as bright and as hot. But while our sun is very much middle-aged, Kappa Ceti is far younger. At between 400 and 800 million years old, Kappa Ceti is probably a good analogue for what our sun was like back when life was first getting a foothold on Earth.

Similar to other young stars, Kappa Ceti has been found to be very magnetically active. Its surface is littered with large starspots – stellar acne resulting from the cooling effect of magnetic fields erupting through the stellar surface.

While our sun also has spots, those on stars such as Kappa Ceti are far larger and more numerous, the result of a much stronger magnetic field.

Such a strong magnetic field propels a stream of plasma (ionised gas) into space, with this stellar wind being 50 times stronger than that of our sun.

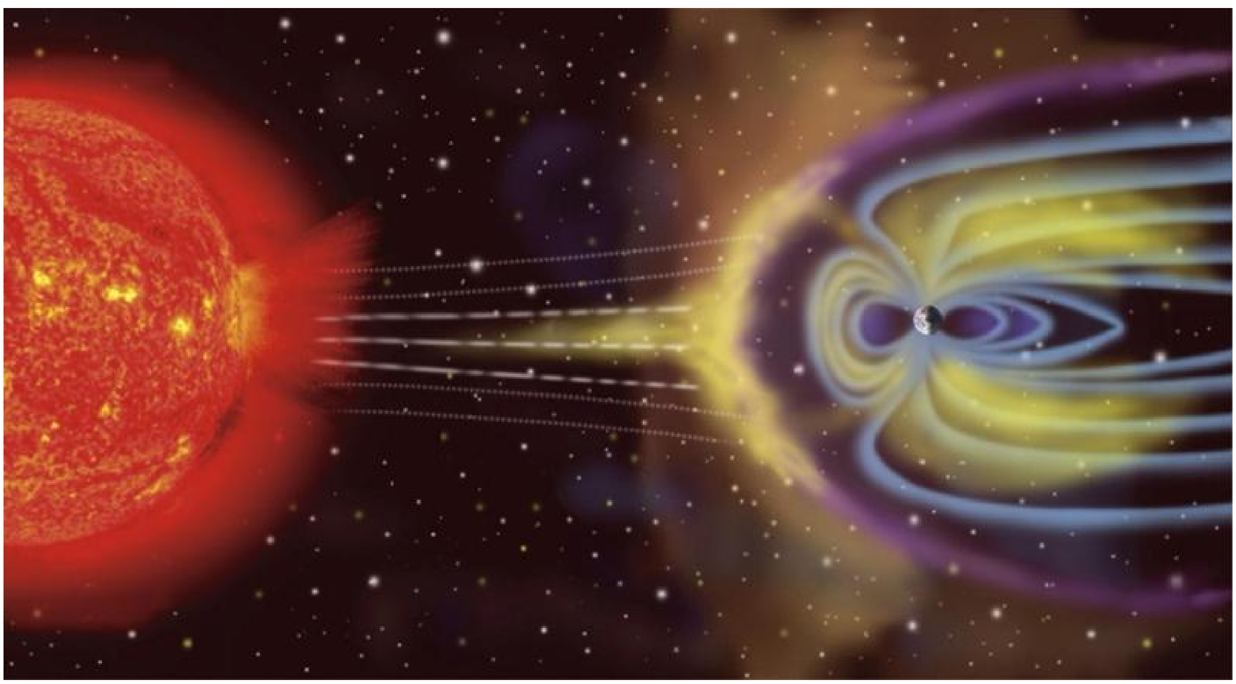
What would that mean for any planets around such a star? Would they be able to survive the onslaught?

Stellar winds and atmospheres

Stellar winds can be dangerous things. Without protection, a star's wind can strip the atmosphere from a planet, leaving it an airless husk. And a stronger wind poses more of a threat than a weaker one.

Fortunately, planets often come with their own shield, a magnetic field of their very own that can protect them from their host star's worst excesses.

This is nicely seen here on Earth. The great majority of the solar wind is deflected around our planet. Only the most energetically flung particles break through, following the Earth's magnetic field to the poles, where they trigger the beautiful Aurora Borealis and Australis.



Artist's rendition of Earth's magnetosphere. Credit: NASA

But would the Earth's magnetic field stand up to a wind as strong as Kappa Ceti's? The BCool team looked into this. It's thought that when the Earth was young, its magnetic field was probably no stronger than it is today.

As it turns out, our magnetic field would have been enough, even if our sun was once as active as Kappa Ceti. The Earth's shield, the magnetosphere, would have been compressed, shrunk to about one-third its current size. But it would have endured, protecting Earth and allowing our planet to remain habitable.

Mars, however, was not so lucky. It's a smaller planet and its interior cooled more quickly than the Earth's, quashing the internal dynamo that drives our planet's magnetic shield.

Without a strong magnetic field, Mars was exposed to the full force of the sun's youthful rage. Over the aeons, its atmosphere has been slowly stripped away. At the same time, the remains were drawn down, chemically trapped in the planet's surface.

The result is a frigid, arid world, with an atmosphere just a tenuous wisp of its former glory.

The search for life out there

Astronomers should soon begin to discover the first truly Earth-like planets orbiting other stars, and the race will be on to search for evidence of life upon them. But where should we look?

To choose the most promising targets, those scientists will have to consider the many factors that can make one planet more liveable than another. So the nature of the planet's host star will play a vital role.

By studying stars such as Kappa Ceti, we are building an understanding of how stars and planets interact. Once those first exo-Earths are found, it will be possible to measure and characterise the winds of their host stars. This will then help us determine which of those planets to target in the search for life elsewhere.

This article was originally published on The Conversation. *Read the* original article.

Source: The Conversation

Citation: What the 'weather' is like on a star can help in the search for life (2016, March 17) retrieved 3 April 2024 from https://phys.org/news/2016-03-weather-star-life.html