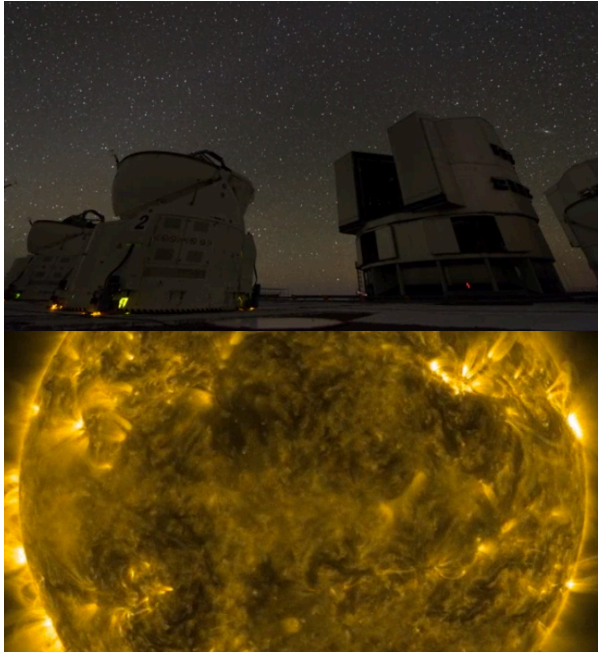



Key words: Magnetic field, Sunspot, Polarisation, Stellar magnetism



<p>ESOCast Episode 76: A Polarised View of Stellar Magnetism</p>	
<p>00:00 [Visuals start]</p> <p>1. ESO telescopes are being used to search for the subtle signs of magnetic fields in other stars and even to map out the star spots on their surfaces.</p> <p>This information is beginning to reveal how and why so many stars, including our own Sun, are magnetic, and what the implications might be for life on Earth and elsewhere in the Universe.</p>	<p>00:00 [Visuals start]</p>  The visual content is split into two horizontal panels. The top panel shows several large, white, dome-shaped ESO telescopes at night, illuminated from below, against a dark sky filled with stars. The bottom panel is a close-up, high-resolution image of the Sun, showing its bright yellow and orange surface with intricate patterns of solar activity and magnetic fields.
<p>00:32 ESOCast intro</p> <p>2. This is the ESOcast! Cutting-edge science and life behind the scenes of ESO, the European Southern Observatory.</p>	 The visual content is a light blue background with the ESOcast logo centered. The logo consists of the 'ESO' text in a blue square with plus signs, surrounded by concentric blue arcs. Below the logo, the text 'ESOCAST' is written in blue. At the bottom, in smaller blue text, it says 'Brought to you by the European Southern Observatory' and 'www.eso.org'.

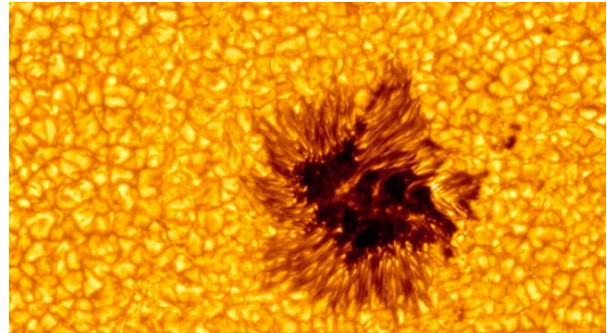
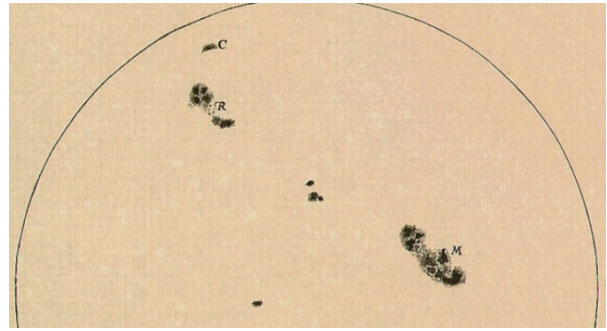
00:52

[Narrator]

3. More than four hundred years ago, Galileo Galilei became one of the first astronomers to note that the Sun's surface exhibited dark imperfections now known as sunspots.

What Galileo did not realise at the time was that these dark spots were a sign that the Sun is a magnetic star.

Sunspots appear dark because, in these regions, the strong magnetic field limits the transportation of heat to the surface. This process makes these locations much cooler — and thus darker in appearance — than the surrounding brilliant surface.



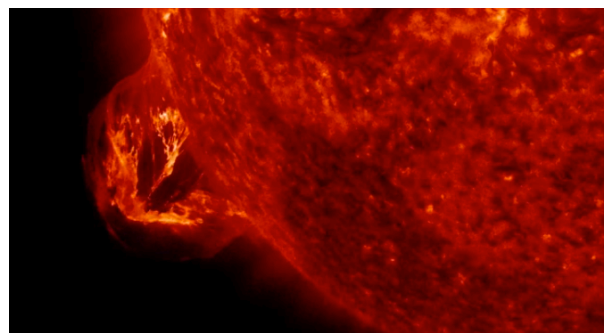
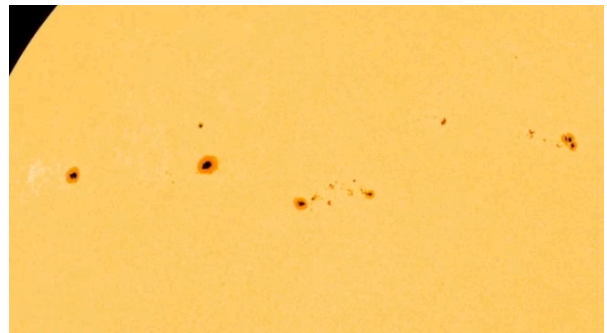
01:38

[Narrator]

4. As sunspots develop, the magnetic field increases in strength and complexity and becomes increasingly tangled.

Eventually, for some sunspots, the magnetic field snaps and, in an instant, the energy it holds is unleashed in a brilliant and violent flash.

Emerging as solar flares and solar storms, this energy is sent hurtling into space.



02:08

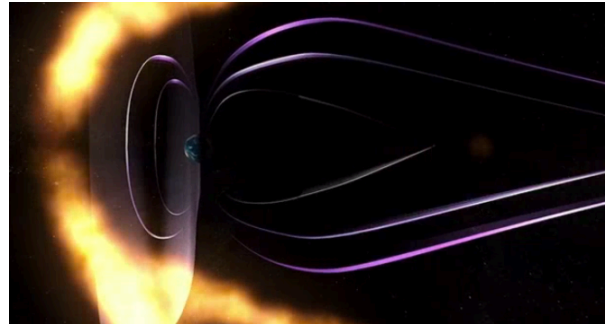
[Narrator]

5. When directed at Earth, this energy, arriving in the form of a stream of charged particles, is mostly deflected by the planet's own magnetic field. But some of the charged particles get through and create beautiful aurorae in the northern and southern polar regions.

But beauty here can also signify danger.

Solar storms, if powerful enough, can in turn spark geomagnetic storms on Earth capable of destroying satellites, interfering with air traffic communication and even crippling power grids.

In a technological era, this threat is reason enough to study solar magnetism.



02:58

[Narrator]

6. The Sun is not unique in being magnetic. Most stars in our galaxy harbour a magnetic field of some kind.

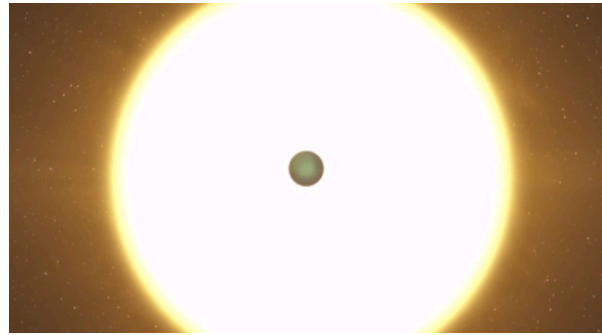
Although we do not fully understand the processes that create our own star's magnetic field other Sun-like stars are expected to have similar properties.

However, the processes that drive magnetism on some classes of distant stars — such as those that are much hotter and more massive than the Sun — may be very different.

But what is known is that solar flares and storms can impact life on Earth in a profound



way. Measuring a star's magnetic properties can help astronomers to evaluate how hospitable an orbiting planet might be for life.



03:53

[Narrator]

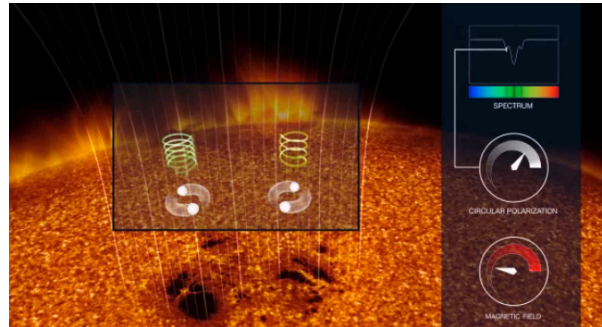
7. The magnetic field of a star can be measured through what is known as the Zeeman effect.

Chemical elements produce narrow dark absorption lines in the spectrum of a star. When a magnetic field is present, these lines split into triples (or even more complex groupings).

This splitting can be measured and used by astronomers to gauge the strength of the magnetic field.

But the Zeeman effect leads to an additional effect — the starlight becomes polarised. This polarised signal is the vital clue that can be used by astronomers to spot the presence of a stellar magnetic field.

ESO's telescopes and instruments — such as FORS on the Very Large Telescope — are equipped to detect polarisation. They are powerful tools with which to measure stellar magnetic fields.



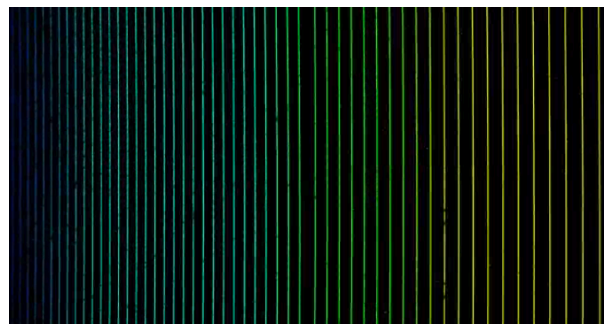
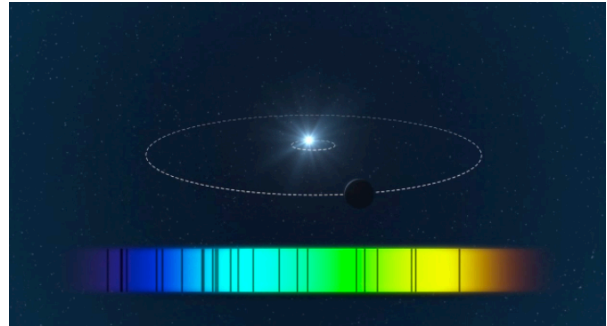
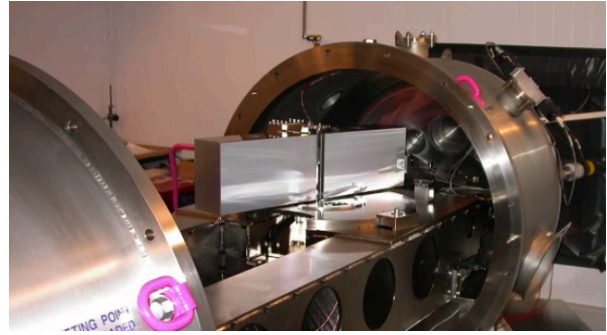
04:43

[Narrator]

8. One of these instruments is HARPS — the High Accuracy Radial velocity Planet Searcher. It is located at ESO's La Silla Observatory in Chile.

HARPS very accurately measures the Doppler shift of stellar spectral lines to look for the subtle signatures of exoplanets. But HARPS can also measure the polarisation of spectral lines to detect stellar magnetic fields.

For some stars, this spectrograph can measure thousands of spectral lines simultaneously, helping to detect signals from even the weakest magnetic fields.



05:35

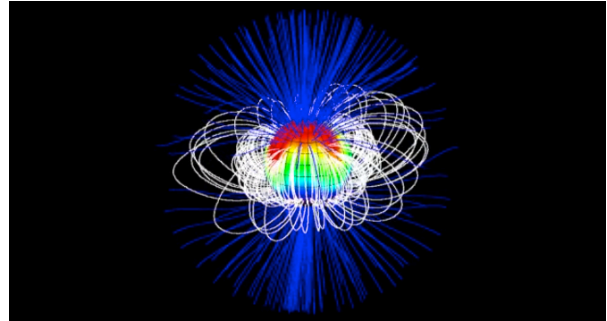
[Narrator]

9. By observing a certain star several times while it rotates, scientists can now use these polarisation measurements to create actual maps of the magnetism-related starspots present on distant stars.

Such images remain impossible to obtain directly with large telescopes, as almost all stars are simply too far away to be seen as anything more than points of light.

But, thanks to the huge amount of information contained in the polarised signals, we can uncover a great deal about stellar magnetic fields; revealing valuable data that would otherwise remain hidden.





06:18

[Narrator]

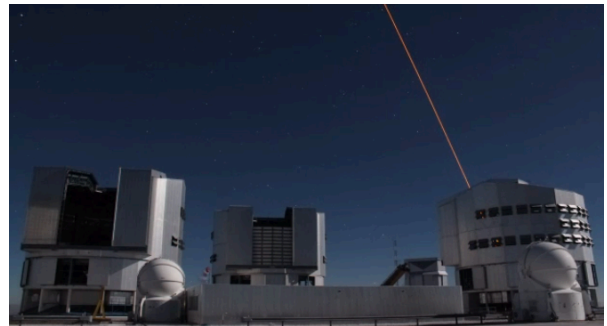
10. Astronomers have found that most stars are magnetic, but in very different ways. So different processes must be at work to generate and sustain these magnetic fields.

We now know that these magnetic fields in turn have a big impact on how stars behave throughout their lives. They play an important role in the complex processes of star formation. And at the other end of stellar lives, they are vital to explaining the bizarre behaviour of gamma-ray bursts, pulsars and — most extreme of all — magnetars.

Astronomers are now eagerly studying stellar magnetic fields to assess their impact on the habitability of rocky exoplanets around them.

A star's magnetic field can greatly affect the amount of radiation reaching a planet's surface. Intense flares on stars produce ultraviolet radiation that is hazardous to most forms of life: both primitive and advanced.

Magnetism has effects throughout the Universe, from the Earth's surface right out to the most distant exploding stars. Polarisation



measurements help astronomers to understand the magnetic properties of our own star, and all the other stars in the Universe.



07:55
[Outro]

ESOcast is produced by ESO, the European Southern Observatory.

ESO builds and operates a suite of the world's most advanced ground-based astronomical telescopes.