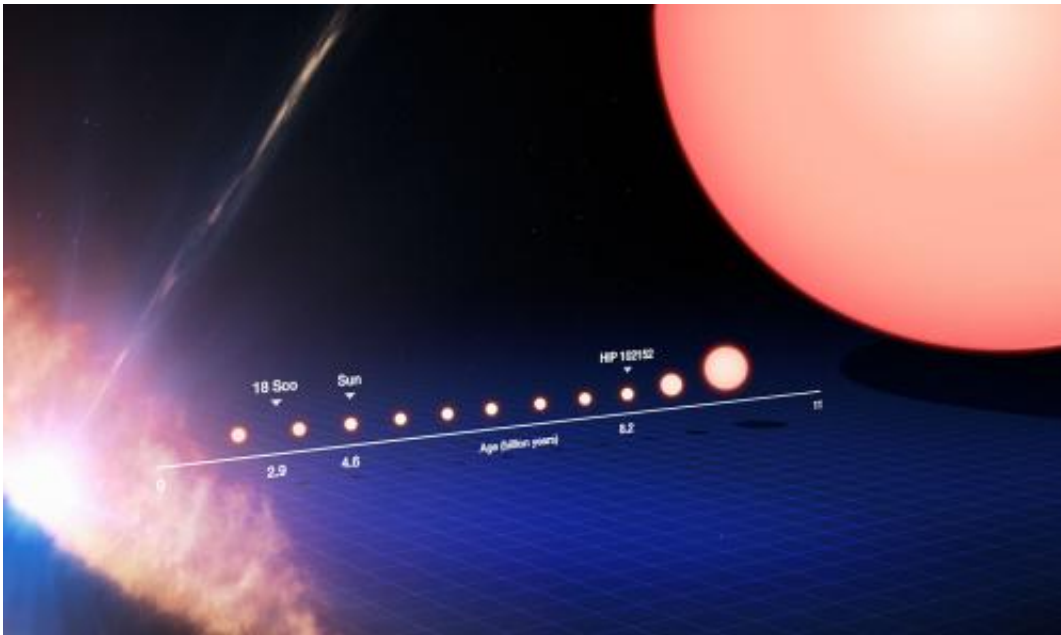


# Oldest solar twin identified: VLT provides new clues to help solve lithium mystery

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This image tracks the life of a Sun-like star, from its birth on the left side of the frame to its evolution into a red giant star on the right. On the left the star is seen as a protostar, embedded within a dusty disc of material as it forms. It later becomes a star like our Sun. After spending the majority of its life in this stage, the star's core begins to gradually heat up, the star expands and becomes redder until it transforms into a red giant. Following this stage, the star will push its outer layers into the surrounding space to form an object known as a planetary nebula, while the core of the star itself will cool into a small, dense remnant called a white dwarf star. Marked on the lower timeline are where our Sun and solar twins 18 Sco and HIP 102152 are in this life cycle. The Sun is 4.6 billion years old and 18 Sco is 2.9 billion years old, while the oldest solar twin is some 8.2 billion years old -- the oldest solar twin ever identified. By studying HIP 102152, we can get a glimpse of what the future holds for our Sun. This image is

illustrative; the ages, sizes, and colours are approximate (not to scale). The protostar stage, on the far left of this image, can be some 2000 times larger than our Sun. The red giant stage, on the far right of this image, can be some 100 times larger than the Sun. Credit: ESO/M. Kornmesser

(Phys.org) —An international team led by astronomers in Brazil has used ESO's Very Large Telescope to identify and study the oldest solar twin known to date. Located 250 light-years from Earth, the star HIP 102152 is more like the Sun than any other solar twin—except that it is nearly four billion years older. This older, but almost identical, twin gives us an unprecedented chance to see how the Sun will look when it ages. The new observations also provide an important first clear link between a star's age and its lithium content, and in addition suggest that HIP 102152 may be host to rocky terrestrial planets.

Astronomers have only been observing the Sun with telescopes for 400 years—a tiny fraction of the Sun's age of 4.6 billion years. It is very hard to study the history and future evolution of our star, but we can do this by hunting for rare stars that are almost exactly like our own, but at different stages of their lives. Now astronomers have identified a star that is essentially an identical twin to our Sun, but 4 billion years older—almost like seeing a real version of the [twin paradox](#) in action.

Jorge Melendez (Universidade de São Paulo, Brazil), the leader of the team and co-author of the new paper explains: "For decades, astronomers have been searching for solar twins in order to know our own life-giving Sun better. But very few have been found since the first one was discovered in 1997. We have now obtained superb-quality spectra from the VLT and can scrutinise solar twins with [extreme precision](#), to answer the question of whether the Sun is special."

The team studied two solar twins—one that was thought to be younger than the Sun (18 Scorpii) and one that was expected to be older (HIP 102152). They used the UVES [spectrograph](#) on the Very Large Telescope (VLT) at ESO's Paranal Observatory to split up the light into its component colours so that the chemical composition and other properties of these stars could be studied in great detail.

They found that HIP 102152 in the constellation of Capricornus (The Sea Goat) is the oldest solar twin known to date. It is estimated to be 8.2 billion years old, compared to 4.6 billion years for our own Sun. On the other hand 18 Scorpii was confirmed to be younger than the Sun—about 2.9 billion years old.

Studying the ancient solar twin HIP 102152 allows scientists to predict what may happen to our own Sun when it reaches that age, and they have already made one significant discovery. "One issue we wanted to address is whether or not the Sun is typical in composition," says Melendez. "Most importantly, why does it have such a strangely low lithium content?"

Lithium, the third element in the periodic table, was created in the Big Bang along with hydrogen and helium. Astronomers have pondered for years over why some stars appear to have less lithium than others. With the new observations of HIP 102152, [astronomers](#) have taken a big step towards solving this mystery by pinning down a strong correlation between a Sun-like star's age and its lithium content.

Our own Sun now has just 1% of the lithium content that was present in the material from which it formed. Examinations of younger solar twins have hinted that these younger siblings contain significantly larger amounts of lithium, but up to now scientists could not prove a clear correlation between age and lithium content.

TalaWanda Monroe (Universidade de São Paulo), the lead author on the new paper, concludes: "We have found that HIP 102152 has very low levels of lithium. This demonstrates clearly for the first time that older solar twins do indeed have less lithium than our own Sun or younger solar twins. We can now be certain that stars somehow destroy their lithium as they age, and that the Sun's [lithium](#) content appears to be normal for its age."

A final twist in the story is that HIP 102152 has an unusual [chemical composition](#) pattern that is subtly different to most other solar twins, but similar to the Sun. They both show a deficiency of the elements that are abundant in meteorites and on Earth. This is a strong hint that HIP 102152 may host terrestrial rocky planets.

**More information:** This research was presented in a paper to appear in "High precision abundances of the old solar twin HIP 102152: insights on Li depletion from the oldest Sun", by TalaWanda Monroe et al. in the *Astrophysical Journal Letters*. Research paper [PDF](#)

Provided by ESO

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