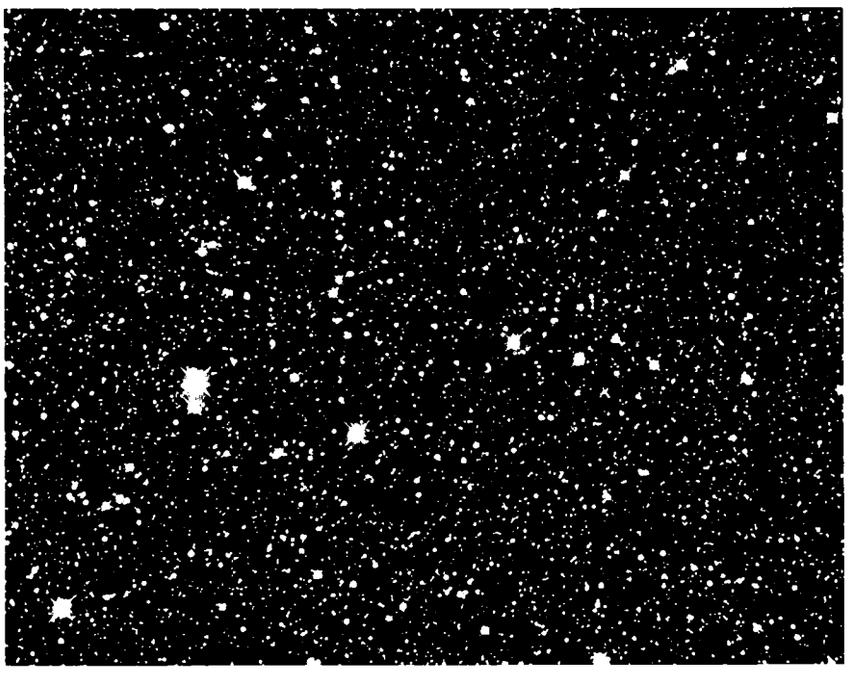

With the exception of how close it is to us, our Sun appears to be a random star.

Our Sun Is Not So Special

BY JOSE ROBLES AND CHARLES LINEWEAVER

The Sun seems to be a random star, blindly pulled out of the bag of all stars, rather than one selected for some life-enhancing property.

More than 300 planets have so far been detected outside our solar system, but whether they are capable of sustaining life is beyond the detection limit of current planet searches. However, we do have high quality data for thousands of stars in our solar neighbourhood, so it makes sense to compare these with our Sun to estimate how common habitable planets are likely to be.

If the origin of life and the evolution of observers on a planet is favoured by the special properties of its star, we would expect our Sun to be special with respect to these properties. On the other hand, if life doesn't require its star to have any special properties we would expect our Sun to be a common, random star.

There has been much confusion about the status of the Sun. Previous studies and astronomy textbooks have described the Sun as both typical and atypical. For example, the Sun has been regarded as a metal-rich star with an anomalously high iron abundance, or as an atypically massive star, or as a star living in an atypically massive galaxy. The Sun has also been regarded as a typical G-type dwarf and a typical main sequence star.

Proponents of the view that an intelligent designer – God – is responsible for life on Earth have been particularly interested in labelling the Sun as a very special star. After all, if the Sun is so very special then Earth must be so, and hence humans must be so.

Most of the previous claims for the Sun's status are the result of comparing a stellar property of the Sun with other stars. The problem with this is that analysing one property doesn't tell you if the anomaly was selected randomly or if it was selected specifically due to its correlation with habitability – a self-selection effect.

For example, suppose I introduce you to Mr X and ask: Can you tell whether I picked Mr X at random from a telephone book or have I selected him for some special reason? If Mr X is the tallest or richest or dumbest person you have ever met, you might suspect that he was selected for this feature and that he was not selected at random.

However, a randomly selected man will sometimes be the tallest simply by chance. If you look at 1000 features of Mr X, who has been selected at random from a group of 100 people, then Mr X is likely to have the largest value for 10 of the 1000 features. Mr X wasn't selected because he had the highest value, but you have looked at so many features that it was highly likely that Mr X would have the highest value for some of them. (How many is determined by how many features you look at.)

Replace Mr X with our Sun and you have the reasoning behind our analysis.

Rather than guess at what properties a star should have to enable life to exist around it, we selected 11 properties that could plausibly be connected with our existence, were maximally independent from each other and can be observed or

derived for a sufficiently representative stellar sample.

The 11 solar properties we compared with other stars were stellar mass, age, iron abundance, carbon-to-oxygen ratio, magnesium-to-silicon ratio, rotational velocity over the star around its axis, eccentricity of the star's galactic orbit, maximum height to which the star rises above the galactic plane, mean distance from the centre of the Galaxy, the mass of the star's host galaxy and the mass of the star's host group of galaxies.

The Sun's mass is the most anomalous of the properties studied here as the Sun is more massive than 95% of all stars. The Sun's orbit around the centre of the Milky Way is also more circular than the orbits of 93% of stars in the galaxy.

However, when analysing the 11 properties together, the Sun is consistent with being a star selected at random, rather than one selected for some life-enhancing property.

This can be seen in Figure 1, where the Sun is compared with each parameter's distribution. The closer the Sun is to the horizontal line (the median of the distributions), the more typical it is. The dark and light blue shades contain 68% and 95% (around the median) of the stars for each distribution. Despite the Sun being more massive than 95% of the stars, taking the properties together, it is consistent with being a random star.

Thus there doesn't seem to be anything special about the Sun. It seems to be a random star that was blindly pulled out of the bag of all stars.

If we have sampled all reasonable properties associated with habitability, then our results suggest that there are no special requirements for a star to host a planet with life. Our results suggest that there are no quirky feature associated with the Sun, and therefore probably nothing special about stars that host planets with life elsewhere in the universe.

If there is nothing special about the Sun, we have no reason to limit our life-hunting efforts to planets orbiting Sun-like stars, which had traditionally been an assumption by planet search campaigns and the SETI program.

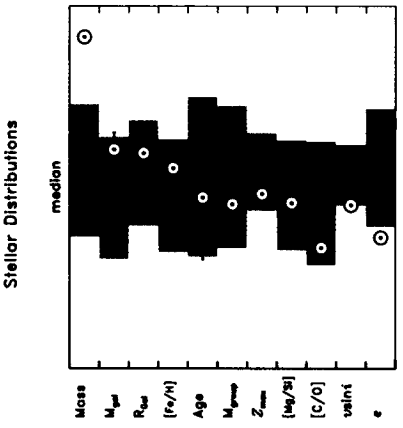

Figure 1. The Sun's position in the distribution for each of the 11 parameters. The horizontal line represents the distribution's median. The dark and light shades are equivalent to one and two standard deviations for the distribution's width.

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