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## ONE OF THE OLDEST STARS?

**Ken Tapping, 19 February, 2019**

Among the stars of our galaxy, the Milky Way, there is a small, dim red star that is attracting a lot of interest. It is only about 14% of the mass of the Sun, barely enough to graduate as a star. It is one of a class of stars known as red dwarf stars. There are lots of red dwarf stars, but this one is of particular interest, because it is estimated to be 13.5 billion years old, almost as old as the universe. How could we possibly know this? Unlike many issues in science, this one is reasonably simple. Let's start with the star we know the most about.

The Sun formed from a big cloud of gas that collapsed into a ball. In the core, nuclear fusion converts the Sun's fuel – hydrogen – into other elements, and produces the energy that makes the Sun shine. Those waste products will stay hidden in the Sun's core until it dies, when most of its material will be ejected into space, to be added to the clouds that will eventually make new generations of stars. When we analyze the visible part of the Sun, that yellow ball in the sky, we are looking at the unprocessed, raw material from which the Sun formed. The composition of that material tells us the star generation in the history of the universe to which the Sun belongs. This fact about stars has led to an intriguing discovery: one of the oldest stars in the universe.

When the universe began, almost 14 billion years ago, it consisted almost totally of just two elements, hydrogen and helium. The carbon, oxygen, phosphorus, iron and other elements making up our bodies and our world did not exist. Then the first stars formed. They were blue supergiant giant stars that shone brightly and rapidly turned hydrogen into the other elements. They got through their fuel in millions of years or less, blew up and distributed those elements into the surrounding clouds.

Those stars are long gone, and the ones we see in the sky, including the Sun, are of later generations. We know this because the Sun's unused fuel,

which forms its surface layers, contains elements manufactured by earlier generations of stars. We know the elements we see there did not originate in the fusion reactions in the Sun's core because all those "waste products" stay there.

This brings us back to that ancient red dwarf star. Its outer layers contain nothing much other than hydrogen and helium, which means it formed from material so old that there had been no build-up of waste materials from earlier generations of stars. We could be looking at a "first generation star". However, the big question is why, in an era of blue, supergiant stars, there was born a red dwarf?

Our Solar System provides a clue. When it formed, only one lump of material became big enough to become a star. However, we also have some giant planets, the largest of which is Jupiter, currently visible in the eastern sky before dawn. If the lump of material that became Jupiter had just been a few times larger, it would have become a red dwarf star. It is just possible that long, long ago, when a blue supergiant star formed, one of that first burst of star formation in the young universe, some of the material from its birth cloud formed a second, much smaller star – a red dwarf.

Even though red dwarfs have low masses, they are so frugal with their energy production they can shine almost indefinitely. They can have lives as long as the universe. It would be interesting to wonder about ancient beings on ancient planets orbiting such stars, but back then there was nothing from which to make those planets. Having material to make planets and people had to wait a few more stellar generations.

Mars lies in the southwest after dark. Venus lies in the southeast in the early hours, with Jupiter and Saturn (the fainter of the two) close together in the dawn glow. The Moon will be Full on February 19 and will reach Last Quarter on February 26.

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