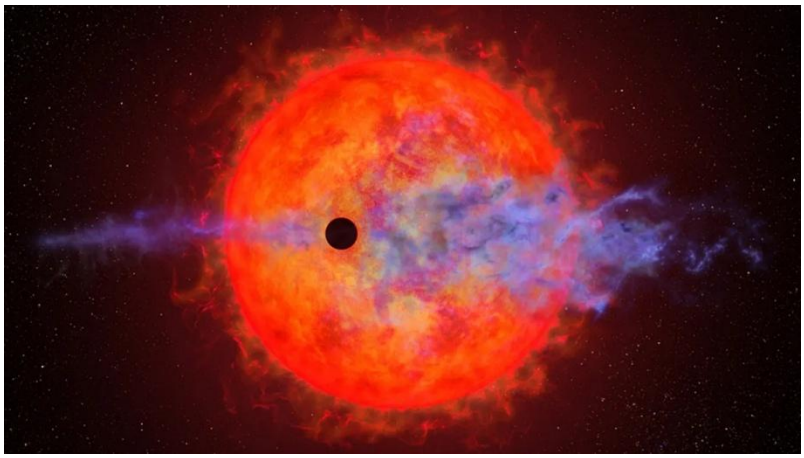
TRAPPIST-1

TRAPPIST-1 is a red dwarf star lying about 40.7 light-years away. It is of particular interest because it has seven earth-like planets orbiting around it. The star was discovered using the Transiting Planets and Planetesimals Small Telescope (TRAPPIST), hence the rather strange name.

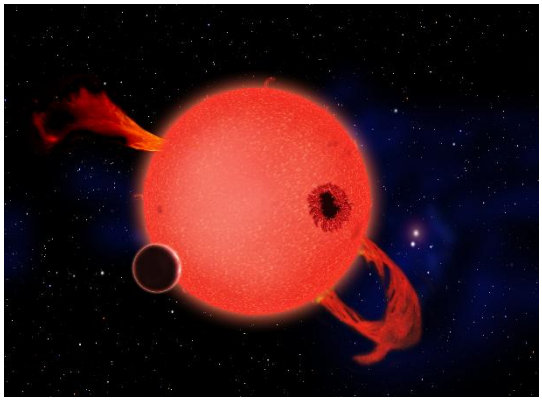
The planets were found by carefully monitoring the brightness of the star. It the planets have orbits taking them between the star and us, we will detect a tiny dimming of the star. Amazingly, just from observing these transits, we can infer a lot about the planet in question. How long the planet takes to transit across the star's disc and the interval between these transits gives us a good idea of the planet's diameter, and how long it takes to orbit its star. This in turn gives us its distance from the star. Since we know how bright the star is, we can calculate how much energy is falling on the planet. From that we can make a pretty good estimate of the planet's surface temperature.

In some cases we can do a bit better than this. If the planet has an atmosphere, some of the starlight reaching us will have passed through it, picking up the signatures of the gases present. In that way we can determine the main constituents of the planet's atmosphere. We have yet to find another planet, with the exception of ours, with a lot of oxygen in its atmosphere.



Red dwarf stars have both advantages and disadvantages for the existence of life on any planets they might have. The big plus is that red dwarf stars have very long lives over which their energy output does not change much. Although TRAPPIST-1, a typical red dwarf star has a mass of only about 10% the mass of the Sun and a surface temperature of less than 3,000 C, it is so miserly with radiating energy it will last much longer. It has been estimated that this system is over 7.5 billion years old and the star is still doing fine. The Sun is around 4.5 billion years old; when it reaches 7.5 billion years old, it will have become a red giant, fried its plants, and then become a white dwarf star. So, planets of red dwarf stars have far more time for life to develop and evolve.

Because red dwarf stars are so dim, to be warm enough for liquid water to exist on their surfaces, any planets have to be orbiting much closer to the star, and the range of distances where these conditions exist - the "Goldilocks Zone" - is much narrower. However, for Trappist-1, there are up to four planets orbiting in the Goldilocks Zone, with orbital periods of three weeks or less.



The big minus for being a planet orbiting closely around a red dwarf is that although these stars shine steadily for a long time, they are prone to super-sized versions of solar flares, and planets orbiting close by are in point-blank range. On our world solar flares disrupt our technology. A planet orbiting a red dwarf could have its atmosphere stripped away. This would be a major impediment to life getting started and then surviving.

Maybe this helps us get a clearer idea of what sort of stars are most likely to allow life to develop and evolve on their planets. Red dwarfs last a long time, but are dim, so planets have to orbit close to them, which makes them vulnerable to flares. Really bright stars mean inhabitable planets would orbit at great distances, and be less vulnerable to flares, but such stars have short lives. So we come back to sun-like stars, a compromise between brightness and long-term stability that seems to fit the bill, in at least one case.

The planetary parade is still fully in place, but Mercury, the closest planet to the Sun, and the most elusive, is now dropping back into the sunset glow. Saturn is still close by. Moving to the left, that is eastward, find brilliant Venus, then Jupiter, almost as bright; and Mars, conspicuously red. Start by looking in the western sky, as soon as the Sun has gone. The Moon will be Full the 14th.

Ken Tapping, 11th March, 2025

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