Discovering Earthlike Planets by **Dr Anglada-Escudé** on 18 May 2018

Dr Anglada-Escudé briefly explained what is known about Proxima B. It orbits the nearest star to the Sun, Proxima Centauri, 4.2 light-years away, in the constellation Centauri. The planet's orbital radius is 7½ million km with a "year" of about 11.2 Earth days. Its mass would be 1.3 times that of the Earth if the orbit is edge on to the line of sight from the Earth, but more if it is at an angle (if the orbit were perpendicular to the line of sight the planet would be invisible).

Dr Anglada-Escudé gave a rough guide to distance in relation to the speed of light. The:
- Earth's diameter - 4ms Moon's distance - 1 s Sun's distance – 8 min Neptune - 10 hr
- Proxima Centauri - 40,000 hr

Even though a planet would emit a negligible amount of light, and cannot itself be seen, it can be detected (if in an Earth alignment). There are two methods:

Transits – light from the star is dimmed at regular intervals;

Doppler - light from the star is Doppler shifted as the planet orbits it (the tail wagging the dog). A planet and the star around which it orbits actually rotate about the centre of their combined centre of gravity. Thus the star moves, as the planet goes round it, alternately approaching an Earth based observer and receding – giving a doppler shift in light reaching the observer. Starlight spectra have many dark absorption lines, of excited atmospheric elements, all affected by the doppler shift - which can be measured. The average of many lines is used to even out turbulence – Dr Anglada-Escudé alluded to, but did not elaborate on, the extremely sensitive equipment attached to the telescope that makes this possible.

The Milky Way galaxy is about 100 light years across and contains 200 to 400 billion stars. However, the search for exoplanets is within the nearer parts – with perhaps 110,000 stars and 22,000 planets.

The first exoplanet to be found, in 1995, was Jupiter sized, orbiting close to its star with a very short orbital period. Such a system is quite unlike the solar system and it is suggested that it was formed by the star capturing the planet. At the time a (large) bright star with a large enough planet to be detectable was the subject of the search. There are few very large stars, more medium stars (the Sun at the lower end of this range), but mostly red dwarf stars. Planets come in sizes ranging down from: Giants; hot Jupiters; warm Neptunes; Super Earths; Earths; etc, the latter being rocky planets. The first Earth sized planet was found in 2010.

Within the Solar system Venus, Earth and Mars are within the Sun's "Habitable Zone" (not that Venus or Mars are now inhabited). A red dwarf would have a habitable zone much closer in, so a closely orbiting small planet might be inhabited – and might produce detectable amounts of methane or oxygen. These rapidly break down and would need to be continuously generated by a life form to be present.

It is likely that closely orbiting planets are tidally locked to their host star, one side permanently illuminated, the other side dark. Winds might raise temperatures on the dark side; the hot side would have little protection from any solar wind.

Dr Anglada-Escudé realised that a small, Earth sized, planet orbiting a small red dwarf should be detectable, and organised a project (getting time on a telescope at the Southern European Observatory in Chile) and devising the necessary equipment to find such a planet.

The Proxima B planet was found using the Doppler method, orbiting the nearest star to the Sun, Proxima Centauri, 4.2 light-years away. The radial velocity of the host star relative to the Earth is varies with an amplitude of about 1.4 m per second. The planet's orbital radius is deduced to be 7.5 x 10^6 km with a period of about 11.2 Earth days. Its mass would be 1.3 times that of the Earth if the orbit is edge on to the line of sight from the Earth, but more if it is at an angle. It is in the range of Super Earths, about three times the mass of the Earth and having a large hydrogen atmosphere.

The planet's atmosphere could be examined by seeing its effect on the star's light passing through it but would need a better telescope. NASA's James Webb space telescope is due to be launched in 2020 but is experiencing delays. By 2030 a very large telescope should be built (ground based, with active compensation for atmospheric disturbance of incoming light).

The Proxima B planet's proximity to Earth offers an opportunity for robotic exploration of the planet with the Starshot project (a small spacecraft with a thousand StarChips on board – not at present technically achievable); or at least in the coming centuries.