Shooting for the Stars

How far are the stars? The short answer is “really far,” but let’s consider how far humanity's most distant spacecraft has traveled to give us a sense of what that means. The *Voyager 1* spacecraft was launched by NASA in 1977, and for the next several years it made observations of Jupiter, Saturn, and their moons. But afterwards, its mission was to journey past the planets into deep space, where no human-made object had ever been. It flew at speeds of 38,000 mph, or 17 km/s, away from the Sun, and today it’s the farthest human-made spacecraft from Earth. But even at these blazing fast speeds, it would take *Voyager 1* 85,000 years to reach the nearest star to our Sun, **Proxima Centauri.** Proxima Centauri is a small star that gets its name from the fact that it’s “proximal,” or close to, our Sun—a mere 40,208,000,000,000 kilometers away (that’s more than 40 trillion)!

Astronomers are excited about a recent discovery about Proxima Centauri: It has a planet orbiting around it! Just as Earth orbits the Sun, this newly discovered **exoplanet** orbits Proxima Centauri (**Figure 1**). An exoplanet is a planet that orbits a star other than the Sun. But even the most powerful telescopes can’t take a good image of this exoplanet; it’s just too far away.

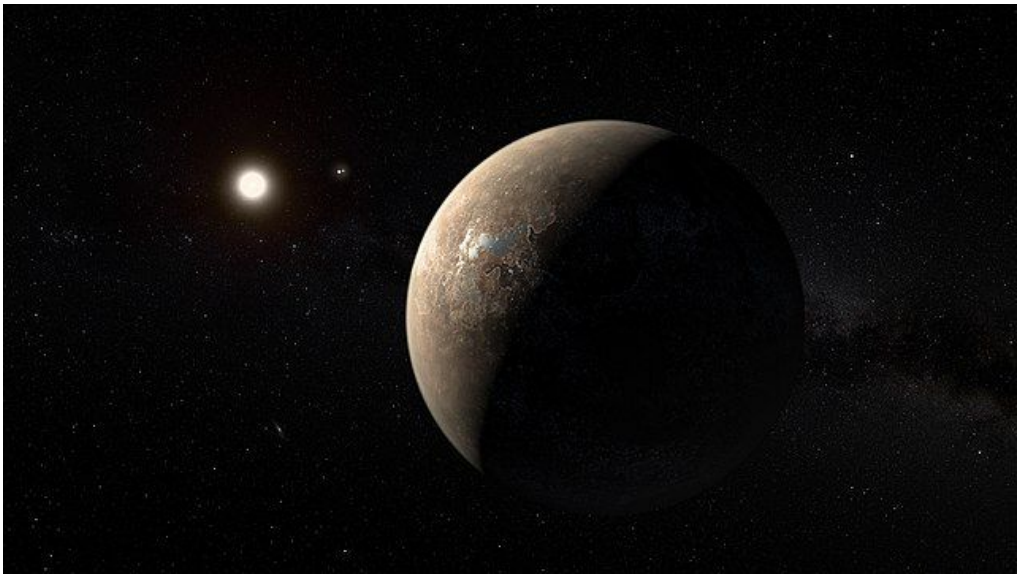

Figure 1. An artist’s conception of an exoplanet orbiting the star Proxima Centauri, seen as the bright “sun” in the background. *Source:* Wikimedia Commons.

So scientists have dreamed up another way to get a look at it: send a spacecraft there to snap a photo and transmit it back to Earth. Sounds easy, but we do not have a spaceship capable of traveling that far in a human lifetime. To do so would require a spacecraft traveling thousands of times faster than *Voyager 1*, or about 20% of the speed of light! The speed of light can be hard to wrap your head around. We know what 100 kilometers per hour (just over 60 miles per hour feels like), but it’s just a bit harder to grasp 1,079,252,848.8 km/hr feels like! The speed of light is the “speed limit” for the whole universe; nothing can travel faster. A single beam of light could circle the Earth eight times in one second!

Getting a spacecraft anywhere near the universal speed limit will be very difficult, especially given the mass of typical spacecraft. But it might be possible using an extremely light spacecraft—one with a mass of about one gram (approximately the same mass as a paperclip), called a **nanocraft**. A spacecraft that small couldn't carry its own power source, so it will have to be propelled by a **light sail** (**Figure 2**). The light sail will be set in motion by an array of powerful lasers on Earth—when the lasers strike the light sail, they provide a force, and that force accelerates the nanocraft. The lasers will fire for a few minutes, or until the nanocraft reaches 60,000,000 m/s. The nanocraft will then coast at constant speed for about 20 years, until it reaches Proxima Centauri.

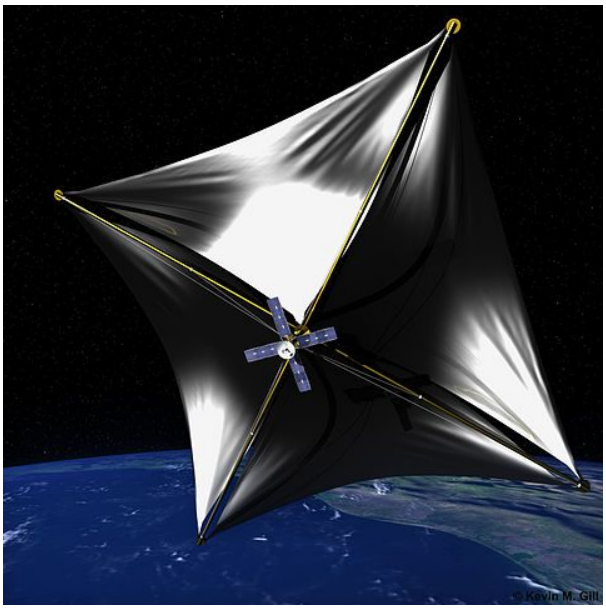

Figure 2. Sailing in Space. An artist's conception of a light sail. A 1-gram nanocraft would be attached to a sail (this one has 4-m sides, approximately the length of a car), which would reflect laser light to propel the spacecraft to Proxima Centauri. *Source:* Wikimedia Commons

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As it zips by Proxima Centauri, the nanocraft would snap pictures of the exoplanet, giving us the first ever up-close view of a planet around another star. But we wouldn't receive the picture right away; the signal would take more than four years to travel back to Earth at the speed of light. (That's why we say Proxima Centauri more than four **light years** away.)

The effort to build this nanocraft, called the Breakthrough Starshot project, is underway right now. There are still large technological challenges to overcome. The nanocraft has to be able to survive the intense heat from the laser and the extreme cold of interstellar space. Also, the space between the Sun and Proxima Centauri isn't totally empty; microscopic dust debris floats between the stars. When you're travelling 60,000 km/s, even a collision with a tiny dust particle can cause serious damage! So the spacecraft has to be durable as well as light.

Ultimately, Breakthrough Starshot may give us a whole new way to observe exoplanets. No longer limited to telescope observations, scientists may be able to send spacecraft to nearby star systems to take up-close measurements.

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BiteScientist Profiles

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