Is Alpha Centauri the right place to search for life elsewhere?

13 April 2016, by Jonti Horner, University Of Southern Queensland

Alpha Centauri is actually the outer star (bottom right) of The Pointers, which point to the Southern Cross. Credit: Y. Beletsky (LCO)/ESO, CC BY

It sounds like science fiction. From the people who brought you the project Breakthrough Listen to search for extraterrestrial life, comes a new research program that's looking at sending a tiny spacecraft to the nearest stars.

The US$100 million plan is to push these probes out at speeds up to a fifth of the speed of light. To do this would require huge technological innovation, but it's certainly not beyond the bounds of possibility.

But if the project is to bear fruit, where should these minute spacecraft be sent? The first suggested target is the Alpha Centauri system, the closest stars to the solar system.

The first stop on an interstellar journey

Alpha Centauri appears a single star when seen with the unaided eye, and is the third brightest star in the night sky. But when observed through binoculars or a telescope, you can see the star is double – a binary star system.

The two bright components, Alpha Centauri A and B, are similar to our sun. One (A) is a bit brighter and bigger than our star and the other (B) a little fainter and smaller.

They move together in lockstep, orbiting their common centre of mass roughly every 80 years. As they do, they follow an elliptical path, with their closest approach (periapse) roughly 11 times further than the Earth is from the sun.

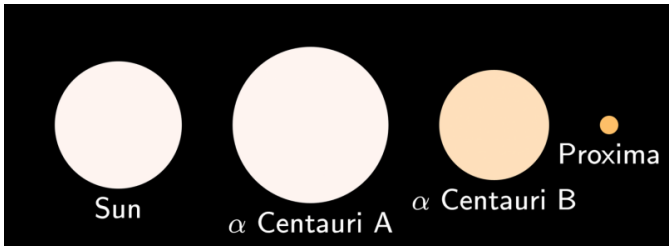
Alpha Centauri (the left-hand bright star), and Proxima Centauri (circled) are the closest stars to the sun. Beta Centauri (right-hand bright star) is almost a hundred times farther away. Credit: Skatebiker

And the two are not alone; they are accompanied by Proxima Centauri. Proxima is a dim red dwarf star, about an eighth the mass of the sun.

It currently lies a little closer to the Solar System than the other two, and so holds the distinction of being the closest star to the sun. Despite this, it is so dim that it is far too faint to see with the unaided eye.

Sunlike stars, but where are the planets?

As our nearest stars, the Alpha Centauri system has been an obvious target for the search for exoplanets. Dedicated search programs, such as the Mt John Alpha Centauri Project, look at the stars every single clear night, trying to uncover even the slightest hints that they might host planets.



The relative sizes and colours of the stars in the Alpha Centauri system and the sun. Credit: David Benbennick

Other programs on the world's largest telescopes observe less frequently, but with exquisite precision.

The result? Well, a few years back, the discovery of a planet around Alpha Centauri B was announced to much fanfare.

Had that planet been real, spotting it would have been groundbreaking. A tiny, broiled world, skirting the top of the star's atmosphere.

Sadly, though, as more observations have come in, the planet's existence has fallen into doubt. An extensive reanalysis has effectively added it to the pile of planets that never were.

Our stellar neighbours

List of all known stars within 10 light-years of the sun and with a travel time of less that 50 years, at one-fifth the speed of light.

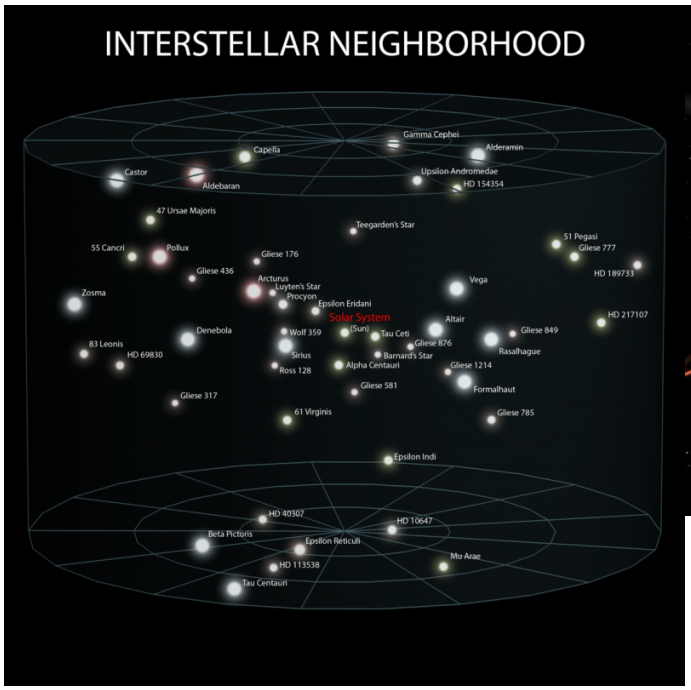
System	Distance (light years)	Travel time at 20% speed of light (years)	Number of stars	Type of star	Sunlike?
Alpha Centauri	4.37	21.5	3	G, K and M dwarfs	Yes
Barnard's Star	5.96	29.8	1	M dwarf	No
Luhman 16	6.59	33.0	2	L, T dwarf	No
WISE 0855-0714	7.2	36.0	1	Y dwarf	No
Wolf 359	7.78	38.9	1	M dwarf	No
Lalande 21185	8.29	41.5	1	M dwarf	No
Sirius	8.58	42.9	2	A dwarf, white dwarf	No
Luyten 726-8	8.73	43.7	2	2x M dwarf	No
Ross 154	9.68	48.4	1	M dwarf	No

So why go to Alpha Centauri?

Given that Alpha Centauri is currently viewed as a planet-free zone, why would we want to go there?

Probably the first and foremost reason is that it is nearby, closer than any other star. If the new spacecraft were to achieve the proposed fifth of the speed of light, it would only take 21 years or so to get there (depending on the time taken to accelerate). That is far shorter than the travel time to any other known star.

Sending our first probes out to Alpha Centauri would mean we get our first closeup look at another star, far sooner than for any other known star. We'd also get a two-for-one peek, whizzing past Alpha Cen A and B up-close and personal.

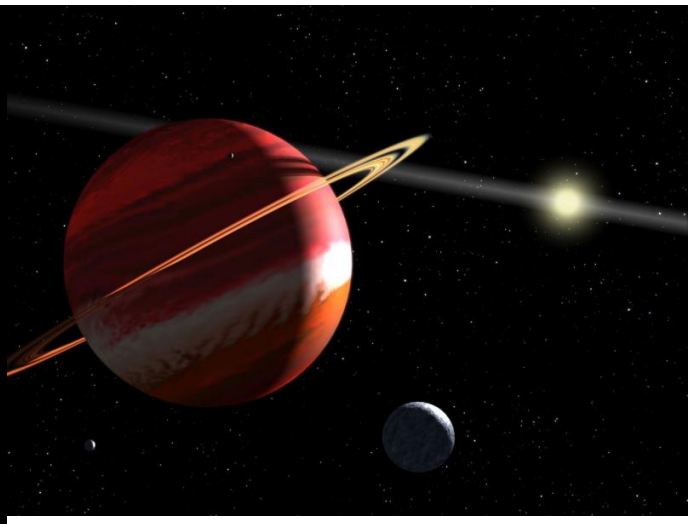


The relative locations of some famous stars, relative to the sun. Credit: Andrew Z Colvin

We'd even get a wealth of data on Proxima Centauri, thrown in for good measure. We couldn't get all that close, though, since these spacecraft are going to be more like bullets than racing cars, fired outward from Earth.

And if there are planets around these stars, then we'd see them. In fact, if there are planets there, they'd likely be found before our tiny explorers reach the area (given the rate at which our techniques and telescopes are improving).

So we'd be able to let the spacecraft know, and plan its observations to take advantage.



Artist's impression of Epsilon Eridani b, with the system's asteroid belt visible in the background. Credit: NASA, ESA, G. Bacon

Looking further afield

Let's say the mission to Alpha Centauri is a success. Where should we go next?

One exciting target lies just a little further away than the stars in our table (above) and that's Epsilon Eridani. At just 10.5 light years distant (a travel time of a meagre 55 years for our tiny explorers), it is still one of our nearest neighbours.

Where Alpha Centauri is a multiple star system, with its sun-like stars so close as to render the formation of truly Earth-like planets challenging, if not impossible, Epsilon Eridani is a solitary wanderer, just like the sun.

A little smaller and dimmer than our star, it is known to have two disks of debris orbiting around it. Again, this is just like our sun. The inner disk looks a bit like our asteroid belt, around the same distance, around the same size.

Observations have revealed the presence of at least one massive planet in the system, moving on an orbit just outside the inner asteroid belt. Just like Jupiter in our solar system. There may well be others, lurking and awaiting discovery.

If we want to explore a system that might just be uncannily like our own, then Epsilon Eridani is probably the place we should look. But with a travel time of more than 50 years with the proposed technology, it makes sense to shoot for the closest stars first.

All aboard for Alpha Centauri!

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