寻找外星人的想法越来越有创意

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人类一直未停止寻找外星人，其中最著名的 SETI 计划，是唯一由官方牵头，寻找外星人的计划。

文章指出：墨西哥州的Very Large Array (VLA)射电天文台将开始将其所有收集到的数据发送给cosmic，这是一个专门用于搜寻外星生物智慧的计算机集群。自去年 12 月以来，南非的Meerkat天文台也使用了类似的系统。在接下来的两年中，VLA单独将对 4 千万星星进行观察。计算机还将从以前的射电和可见光频率调查中挖掘数据，寻找任何不属于地球的不自然物。如果银河系中有许多高度发达的文明，并发出强烈的信号，这可能是一种正确的方法。

原文

This month the vla (Very Large Array) radio-astronomy observatory in New Mexico will begin sending every bit of data it harvests for astronomers' research projects to cosmic, a computer cluster dedicated to the search for extraterrestrial intelligence (seti). A similar system has been piggybacking on the Meerkat observatory in South Africa (pictured) since December.

Over the next two years, the vla alone will cast an eye over 40m stars. Computers will also be mining data from past surveys, in radio frequencies and in visible light, for anything that seems both unnatural and not from Earth, says James Davenport, an astronomer at the University of Washington who works with such surveys.

If there are many technologically advanced civilisations in the galaxy, emitting powerful signals, this might well be the right approach, according to Steve Croft of the University of California, Berkeley. Some of them will then be where users of the vla happen to be looking. Either that, or they will be close enough to be detectable from existing survey data.

But if extraterrestrial civilisations are rare, and thus mostly far away, or if they rarely broadcast with a lot of power, they will be found only by selecting promising sources in advance and staring at them for a long time. This is done by the Green Bank Telescope, a large radio dish in West Virginia, for which the Berkeley seti Research Centre has contracted 20% of the observing time, with Dr Croft as project scientist.

Dr Davenport and Dr Croft were both addressing a session on detecting extraterrestrial intelligences at a meeting of the American Astronomical Society, held in Seattle from January 8th-12th. This is a field that goes in and out of fashion, but at the moment fortune is smiling on it in the form of the Breakthrough Listen project, paid for by Yuri Milner, a Silicon Valley venture capitalist.

Breakthrough Listen, which began in 2016, is scheduled to last for ten years, and will disburse $100m over that period. The money is paying for observations by the Green Bank Telescope, Meerkat, the Parkes radio observatory in Australia and the Automated Planet Finder telescope at the Lick Observatory in California.

A question preoccupying Dr Croft is how to select Green Bank's targets. One answer is to try to get inside et's head (or equivalent brain-containing part of the anatomy). Starting from the assumption (admittedly generous) that there are beings out there who actively wish to talk to their galactic neighbours, how would they go about it?

As luck would have it, one obvious approach does et-seekers' work for them. A good way to discover planets orbiting other stars is by looking for transits—brief diminutions in the light from a star caused by a planet passing in front of it, as seen from Earth. So far 3,941 planets orbiting other stars have been discovered that way. This method would also be obvious to extraterrestrial intelligences, and it would make sense for them to concentrate their broadcasts on planets they have discovered. For Earthbound seekers after aliens, this means they have to orient their antennas towards the Earth Transit Zone, a band across the sky from which Earth could be seen to transit the sun. Directing his telescope at planets known of in that zone would be a good gambit for Dr Croft.

Another suggestion is that garrulous ets might use supernovae to flag transmissions. That, Dr Davenport explained, might work like this. An extraterrestrial intelligence which wanted to make itself known would broadcast high-power signals of its existence every time its astronomers observed a supernova—and then wait.

What happens next is a complicated geometrical dance. Two wavefronts of electromagnetic radiation—one from the supernova and one from the et—are now spreading through space at the speed of light. For most potential listeners, they would arrive at different times, depending on their location with respect to both.

Galactic semaphore

It would make no sense for those seeking their galactic neighbours to start listening precisely when they saw a supernova, for they would not know where to look for any signal that might have been sent in response to it. But what such listeners, including those on Earth, could do, is go back to their archives and choose a supernova they saw in the past, say 1,000 years ago. The next step would be to see if there are any stars for which the time the supernova signal would take to travel there, plus the time for the broadcast it may have triggered to travel to Earth, would add up to 1,000 years as well. Those would be the stars from which signals could potentially be arriving at that moment.

As he told the meeting, Andy Nilipour of Yale University has been doing just this for supernovae described in 1054 by Chinese astronomers, in 1572 by Tycho Brahe, in 1604 by Johannes Kepler and in 1987 by many, many astronomers. Using data from Gaia, an orbiting observatory belonging to the European Space Agency, he is able to measure the locations of many stars with a precision of a few light-years. He has found 465 that fit the bill.

Such a level of precision is available, though, only for stars that are fairly close by. A complementary approach, proposed recently by Seto Naoki of Kyoto University, overcomes that by looking not at stars a certain distance from a supernova, but in a certain direction relative to it.

This would, Dr Seto outlined in a paper he published in 2021, work somewhat like a rugby player passing the ball to another who is running at full tilt. At any given time, there is a special direction to throw the ball, so that it will arrive while moving at right angles to the direction of the receiving player. In a similar way, you can at any particular moment find a special direction for two planets and a supernova. With luck, both parties will know to look in that direction to make contact. Mr

Nilipour has also found 403 stars for which this approach would work, for a total of 868 between the two methods.

These approaches do, though, depend on et wishing to be found. Other civilisations may be shy, or simply not care. It may nevertheless be possible to discover where they are hiding.

In 2013, Andrew Siemion, who now works at the seti Institute, a non-profit organisation that has been active in the alien-searching business since 1984, proposed looking for systems where planets not only transit their star as viewed from Earth, but also regularly occult each other, which means two of them line up precisely in the direction of Earth. If both were inhabited by members of the same intelligent species, one having been settled from the other, they would presumably be in communication. That would require fairly powerful signals—and in this case they would be aimed in exactly the right direction to travel onward to Earth.

Evan Sneed of the University of California, Riverside, Sofia Sheikh of the seti Institute, and Nick Tusay of Penn State University are now doing the calculations for 60 promising systems where transits happen, to work out a calendar for observing them. So far, they have looked at seven.

Mr Tusay also told the conference about his search for extraterrestrial probes in the solar system. That such things exist is an even longer shot than looking for radio signals from afar. But that, in the view of seti enthusiasts, is not a reason not to try.

The question is, where to scout around? In principle, such probes could be anywhere. But there are places where they might be especially useful to their owners. These are where the sun's gravity would concentrate light or radio waves from particular nearby star systems. It is easy to calculate that any signal from, say, Alpha Centauri, would be enhanced along a line pointing away from the sun in opposition to that star system, starting 550 times as far from the sun as Earth is.

That Alpha Centauri or any other nearby star system is home to an et is the longest of long shots. But, doubling down on what such civilisations might be capable of, Mr Tusay suggests probes like this might be relay stations, passing signals on to others in communication with other systems. This would make the solar system a node in a galactic internet of sorts.

Such probes might also exchange signals with counterparts in the centre of the solar system, closer to Earth, keeping an eye on what was happening there. That means those signals might be detectable.

Mr Tusay looked for such signals with the Green Bank Telescope, but found none. However, in the grand tradition of seti research, the motto of which seems to be “never give up”, this has not made him discard the idea just yet. Probes like this might communicate in ways no one has looked at or even thought of, or maybe they happened to be silent when the observations were done.

Spiders, but not from Mars

Carmen Choza of the Berkeley seti Research Centre, meanwhile, presented the results of a so-far fruitless search for beacons not in nearby star systems in the Milky Way, Earth’s home galaxy, but in 97 others. To be detectable from such distances any radio broadcasts would have had to be unbelievably powerful—and so presumably produced by civilisations that can harness the power of whole stars.

An intelligent species with such energy requirements would have a hard time hiding, if it even cared to. It might even become what Clément Vidal, a philosopher, calls a stellivore civilisation. Tapping the power of entire stars would require engineering on a grand scale. Dr Nilipour plans to look in this context at a special kind of star system called a spider pulsar.

Spider pulsars are thought to be neutron stars with a low-mass ordinary star orbiting so close that it is being destroyed by the neutron star’s emissions. Mr Nilipour wants to see if there is anything going on here that might not be quite natural.

His first step will be to spot stars in the growing Gaia catalogue which are on their way to having a close encounter with a spider pulsar. Anything about their relative motion that would require the influence of more than regular gravity would suggest a stellivore preparing to tuck into its next meal. He has already found some semi-promising candidates—in particular, some stars that may fall victim to such attention in 10,000 years or so.

There is no spider pulsar near Earth, fortunately. But such ideas, wild as they are, do raise the question of whether human beings should do more than just listen for signs of et. Talking, albeit with a time delay of decades or even centuries, with other intelligent species would be exhilarating. But if it involved organisms with that sort of power, it might also be pretty dangerous.

雅思词汇

单词	音标	中文释义
radio-astronomy	ˌreɪdɪoʊəˈstrɑːnəmi	无线电天文学
observatory	əbˈzɜːrvətɔːri	观测站
harvests	ˈhɑːrvɪsts	收获
astronomers	əˈstrɑːnəmərs	天文学家
research projects	ˈriːsɜːrtʃ prəˈdʒekts	研究项目
cosmic	ˈkɑːzmɪk	宇宙的
computer cluster	kəmˈpjuːtər klʌstər	计算机集群
extraterrestrial	ˌɛkstrətəˈrɛstriəl	外星的
intelligence	ɪnˈtɛlɪdʒəns	智能
Meerkat	ˈmɪrkæt	豹猫
piggybacking	ˈpɪgibækɪŋ	搭便车
visible light	ˈvɪzəbl laɪt	可见光
frequencies	ˈfriːkwənsiz	频率
unnatural	ʌnˈnætʃərəl	非自然的
Green Bank Telescope	ˈgriːn bæŋk ˈteləskəʊp	绿银望远镜
radio dish	ˈreɪdɪoʊ dɪʃ	无线电盘