

# Astronomer announces shortlist of stellar candidates for habitable worlds (Forwarded)

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*Source:* <http://sci.tech-archive.net/Archive/sci.astro/2006-02/msg00154.html>

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  - *Date:* Mon, 20 Feb 2006 21:33:17 -0500
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As of 14 February, 314-342-5805  
(AAAS Newsroom Headquarters,  
Room 260, America's Center, St. Louis)

18-Feb-2006

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In the search for life on other worlds, scientists can listen for radio transmissions from stellar neighborhoods where intelligent civilizations might lurk or they can try to actually spot planets like our own in habitable zones around nearby stars.

Either approach is tricky and relies on choosing the right targets for scrutiny out of the many thousands of nearby stars in our galactic neighborhood.

Margaret Turnbull, an astronomer at the Carnegie Institution of Washington, has devoted herself to the painstaking search for candidate stars that may harbor zones of habitability where life — primitive or otherwise — might thrive. Turnbull announced her shortlist of so-called "habstars" at the 2006 Annual Meeting of the American Association for the Advancement of Science in St. Louis.

Out of an initial catalogue of 17,129 "habitable stellar systems" that Turnbull and her colleagues published in 2003, she selected a handful of stars that she considers her best bets, based on a variety of screening criteria.

Turnbull offered five top candidate stars for those seeking only to listen for radio signals from intelligent civilizations — the Search for Extraterrestrial Intelligence or SETI — and five candidates for those who undertake the demanding job of trying to detect Earth-like planets in orbit around nearby stars.

Astronomers have found evidence during the past decade for dozens of planets around nearby stars by studying how an object's gravity affects the orbit of the parent star. Virtually all of the discovered planets are gas giants like Jupiter and are presumed to be inhospitable to life. There have been hints of smaller, rocky planets like Earth, but definitive detection of such terrestrial planets likely awaits the deployment of more capable space-based observatories in about a decade. "It's impossible to know the true nature of those planets

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until we can directly image them," Turnbull said.

NASA had a mission on the drawing board called the Terrestrial Planet Finder, which would consist of two complementary space observatories. The first, a visible–light coronagraph, had been scheduled for launch around 2016, but the project has been deferred indefinitely, according to NASA's 2007 budget plan. A precursor planet–finder, called SIM PlanetQuest, has been delayed until at least 2015.

Turnbull made her habitable choices "purely on the characteristics of the stars themselves," she said in an interview. "Stars are not all the same, and not all of them are like the Sun."

Her criteria included several related to age. The star has to be at least 3 billion years old, long enough for companion planets to form and complex life to develop. Variable stars that are prone to lots of flares and pyrotechnics tend to be too young to meet her criteria. Also, stars more than 1.5 times the mass of our Sun don't tend to live long enough to produce habitable zones.

Turnbull also considered the star's "metallicity." Stars and planets form out of the same parental cloud of dust and gas. If the star doesn't have enough iron in its atmosphere, it is likely the parent material did not contain enough heavy metals for planets to form. Turnbull's candidate stars had to have at least 50 per cent of the iron content of the Sun. Stars with higher metal content also tend to reside in more peaceful orbits in the plane of the galaxy, Turnbull said. She also stars that, like our Sun, that reside on the "main sequence" of stellar evolution. No red giants or white dwarfs allowed.

While her criteria are clearly Sun–centric, Turnbull said they make sense. "We are intentionally biased toward stars that are like the Sun," she said. Like the Sun, such stars tend to be toward the brighter range in luminosity and are more likely to live long enough for life–supporting planets to form.

"These are places I'd want to live if God were to put our planet around another star," Turnbull said.

The search for signals from extraterrestrial civilizations will benefit from a new network of radio antennas, called the Allen Telescope Array, now under development. Forty two of the planned 350 telescopes in the array should be operational this year.

Turnbull's top candidate star for such radio scans is beta CVn, a sun–like star about 26 light–years away in the constellation Canes Venatici (the Hound Dogs). (One light–year is about 5.9 trillion miles). Astronomers have been using currently available technology to search the star for accompanying planets but none has been found so far, Turnbull said. Her other top candidates for a SETI search:

\* HD 10307, another solar analogue about 42 light–years away. It has almost the same mass, temperature and metallicity of the Sun. It also has a benign companion star.

\* HD 211415, about half the metal content of Sun and a bit cooler, this star is in just a little farther away than HD 10307.

\* 18 Sco, a popular target for proposed planet searches. The star, in the constellation Scorpio, is almost an identical twin to the Sun.

\* 51 Pegasus. Already famous. In 1995, Swiss astronomers reported they had detected the first planet beyond our solar system in orbit around 51 Pegasus. An American team soon verified the finding of the Jupiter–like object and the rush to find more extra–solar planets was on. Turnbull thinks 51 Pegasus could harbor terrestrial planets as well.

Efforts to take direct images of Earth–like planets — the goal of the planned Terrestrial Planet Finder (TPF) mission — are extremely challenging. Astronomers want to find Earth–like planets orbiting close enough to the star — but not too close — for there to be an environment capable of having liquid water, a key

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ingredient of life. But such planets in orbits relatively close to the star simply get lost in the glare of the host star.

In choosing candidate stars for a TPF mission, Turnbull went for stars with enough intrinsic luminosity to suggest good prospects for a habitable zone but not so bright as to overwhelm efforts to image their planets. In her Goldilocks solution, the best candidates were K-class stars, objects that are intrinsically dimmer than the Sun.

Turnbull's top choice is epsilon Indi A, a star only about one-tenth as bright as the Sun. It is nearby, about 11.8 light-years away in the constellation Indus. The star is among the top 100 targets for a TPF mission.

Her other TPF candidates:

- \* epsilon Eridani. A star somewhat smaller and cooler than our Sun, located about 10.5 light-years away in the constellation Eridanus (the River).
- \* omicron2 Eridani. A yellow-orange star about 16 light-years away, roughly the same age as the Sun.
- \* alpha Centauri B. Part of the closest stellar system to the Sun, just 4.35 light-years away. Long considered one of the places in the Milky Way that might offer terrestrial conditions. This star is part of a triple star system.
- \* tau Ceti. Unlike the candidates in this group, Tau Ceti is a G-class star, the same brightness category as our Sun. Metal-poor compared to the Sun but long-lived enough for complex life forms to evolve.

Turnbull acknowledges that it is a toss up when it comes to naming just a few candidate habstars. "There are inevitable uncertainties in how we understand these stars," Turnbull said. "If I took the top 100, it would be very difficult for me to tell which one is the best." But the exercise is worthwhile, she said, and her selection criteria really did drive her toward a couple top choices and a handful of other candidates.

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