Seeking another Earth, by the numbers

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In a room with concrete block walls from which he can barely see the sky, Drake Deming explores the heavens.

Several days a week he can be found in his office at the University of Maryland, College Park, surrounded by three computer screens, analyzing information about planets outside our solar system. In these remote regions - no closer than four light years - roughly 24 trillion miles - and as far as hundreds of light years away - scientists hope one day to find an Earth-like world capable of supporting life.

A professor of astronomy and former senior scientist at NASA's Goddard Space Flight Center, Deming is among the leading researchers of extrasolar planets, or exoplanets - entities made of rock, iron or chiefly gas, orbiting their own suns. Last month he weighed in with his latest contribution to the field's literature: a review in the journal *Nature*

considering work done by two research groups on Kepler-78b, an exoplanet named for the Kepler Space Telescope, through which it was observed.

"That's an important planet," said Deming, now in his third year at College Park, where he taught in the late 1970s before spending 30 years with NASA.

His Nature review noted Kepler-78b as significant for its similarities to Earth - the closest in size among the more than 1,000 extrasolar planets yet found, according to NASA. With 80 percent more mass and a 20 percent larger radius, Kepler-78b is "a virtual twin of Earth by astronomical standards," Deming wrote.

The planet, some 400 light years away in the constellation Cygnus, appears from its density to be made of rock and iron, like the Earth. But unlike the Earth, which is about 93 million miles from the sun, Kepler-78b is less than a million miles from its sun.

That makes for hellish conditions: from 3,500 to 5,000 degrees Fahrenheit, with a surface likely consisting of molten rock. Hardly a conducive environment for the development of any known life form, but its mere existence suggests the likelihood of similar planets out there, perhaps not all so close to their suns, or orbiting cooler stars, Deming said.

In looking for other "Earths," planet size matters, Deming said. A life-sustaining planet would be massive enough to maintain an atmosphere, yet small enough so that its gravitational pull would not gather around it a massive gaseous cloak, turning it into a "gas giant" like Jupiter and Saturn.

For these reasons, Deming wrote, Kepler-78b "foreshadows leaps

forward in the search for life beyond the Solar System."

Deming knows about leaps forward in these matters, as he's been there himself.

In 2005, when he was with the Goddard Space Flight Center in Greenbelt, Deming led one of two research teams announcing simultaneously that their separate investigations resulted in the first confirmed direct observation of two extrasolar planets.

The teams from Goddard and the Harvard-Smithsonian Center for Astrophysics each analyzed information gathered by the Spitzer Space Telescope, launched in 2003 and designed to detect signals in the infrared spectrum.

The significance of the finding is hard for a layman to discern in the three-page article detailing calculations that confirmed the infrared radiation of the planet - some 150 light years away in the constellation Pegasus - as it passed behind its star.

An exoplanet scientist at the University of California, Berkeley, who was not a member of either team, put it more dramatically. In an interview with The New York Times, Geoffrey W. Marcy called the findings "the stuff of history books. ... With this result, we are closer to understanding our own human roots, chemically, among the stars."

Inclined to speak in more measured terms, Deming acknowledged that he's less taken with the grand meaning of it all than with data analysis. His astronomical pursuit is largely a mathematical project.

It's well-suited to Deming, 65, who did his undergraduate degree in mathematics at the University of Chicago before switching to astronomy for his doctorate at the University of Illinois at Urbana-Champaign. Pure

math, he said, seemed too "abstract."

Still, the discipline of a boy who grew up in Indiana relishing his math studies serves him well in work involving deep dives into oceans of numbers representing the observations of space and land-based telescopes. In the case of the infrared measurements, a Deming specialty, these are rows of numbers of photons, sent by the telescope.

Deming's challenge is to figure how to analyze the numbers for a reliable planet profile. How to distinguish the planet's signal from the much stronger one from the star? How to correct for distortion from the telescope itself? Is that the infrared light signature of a particular molecule in the planet atmosphere, or could something else account for the numerical pattern?

Astronomer Heather A. Knutson, who has collaborated with Deming, said he combines meticulous attention to detail with the ability to see how the small stuff fits into the larger picture, or how it doesn't.

"His reputation in the field is that he's someone very careful," said Knutson, a Johns Hopkins University alumna who's now an assistant professor of planetary science at the California Institute of Technology. "He's sort of an anchor for some of us who run off and think we see something. If Drake says he sees it, you really believe it."

She said Deming refined a method of analyzing infrared information from the Hubble Space Telescope that has become prevalent among astronomers trying to correct for distortions created by the telescope. Two papers now in review for Nature use this approach, she said.

Peter R. McCullough, an associate astronomer at Hopkins' Space Telescope Science Institute, which runs the science side of the Hubble mission, said Deming likes to "get dirt under his fingernails digging at

the little bits of information" coming from telescopes, including Hubble.

Deming said he usually has six or eight research projects going at once. Among his next projects will be examining the atmospheres of exoplanets roughly the size of Neptune, a "gas giant" considerably smaller than the Jupiter-like worlds he's been exploring for years, although still much larger than the Earth.

"Small planets are always more interesting; they're more like Earth," Deming said. He's happy analyzing uninhabitable exoplanets, he said, even if he knows finding an Earth look-alike is the "Holy Grail" in this field.

"That would be wonderful," he said.