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Looking for worlds like this one

NASA's Kepler mission is the best shot yet at detecting an Earth-sized planet elsewhere in the Galaxy.

An unblinking eye will soon take a long stare at stars in the constellation Cygnus looking for something familiar: a small, rocky planet that takes a year or so to orbit its star.

The eye is a photometer, the single instrument on board Kepler, a US\$600-million NASA spacecraft set to launch on 6 March. It will hunt for Earth-like 'exoplanets' — planets beyond the Solar System. Project scientists expect to find hundreds of such worlds, including perhaps the first exact Earth analogue. But it will take patience.

Kepler will detect exoplanets by watching them passing, or 'transiting', in front of their star, dimming the starlight temporarily. It needs to do this at least three times to confirm a planet; if an exoplanet is in an Earth-like orbit, that will take three years.

Of the 342 exoplanets spotted to date, most have been found through the radial velocity method (see graphic), which picks up slight wobbles in a star's position caused by the gravitational tug of an orbiting planet. This method is most likely to find large planets close to their stars, however. Transits are better suited to finding something more like Earth in size and orbit. So far, 58 transiting planets have been found.

The COROT satellite, launched by the French space agency CNES in 2006, has found seven of those transiting planets, and is in many ways a forerunner to Kepler. Kepler, however, will orbit the Sun rather than Earth, as COROT does, which means it can spend more time looking at the stars. Kepler also has a bigger telescope: its mirror is 1.4 metres across, compared with COROT's 30 centimetres.

Kepler will stare at 100,000 preselected Sun-like stars 180–920 parsecs away, sending data back to Earth every 30 days. Scientists will scan those data for planets that might be habitable: not too close to their parent star, nor too far away that liquid water won't exist. "You're really looking for a planet that's in the Goldilocks region," says William Borucki, the project's principal investigator at NASA's Ames Research Center in Moffett Field, California.

The Kepler mission has been a long time coming. First touted three decades ago, the project didn't get approved until 1999 — just after the first transiting planet, HD 209458b, was detected from the ground.

Although COROT beat Kepler into space, the closest it has got to finding another Earth is a suspected planet less than 11 Earth masses orbiting a star 140 parsecs away.

NASA

The Kepler space telescope (pictured) sees more than its European forerunner, COROT.

COROT has had some minor problems coping with the number of energetic particle impacts it receives in Earth orbit. These can cause some pixels in its detector to behave erratically for a while. Kepler's orbit is expected to keep it from experiencing the same problem.

Kepler's data will complement other space-based measurements. David Charbonneau of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, plans to use the Spitzer infrared space telescope — even after its coolant runs out this spring — to look at exoplanet candidates for information on their temperature. Later, the James Webb

Space Telescope, slated for launch in 2013, will also be able to study the temperatures and atmospheres of exoplanets.

The future for other exoplanet-spotting missions is currently unclear. NASA will shortly decide on whether to go ahead with a Transition Exoplanet Survey Satellite to seek transiting planets around the nearest and brightest stars in the sky. Elsewhere, one version of a 2009 spending bill wending its way through Congress (see page 18) suggests that \$20 million may be allocated to continue development of SIM Lite, a scaled-down version of the Space Interferometry Mission, which would look for Earth-like planets around nearer stars. More ambitious space-based missions are unlikely to fly in the near future: the Terrestrial Planet Finder in the United States, and Darwin in Europe, have been deferred indefinitely for budgetary reasons.

That leaves planet-hunters keen to see what Kepler can do. "We all hope this mission will deliver what is promised," says Giovanna Tinetti, a senior research fellow at University College London. "If Kepler comes up with empty hands," adds Alan Boss, an exoplanet theorist from the Carnegie Institution in Washington DC, "that will be truly astonishing."

Even if Kepler doesn't identify any Earth-like planets, Borucki would not be disappointed. "If we don't find any," he says, "that means our Solar System really is unique."

Katharine Sanderson

EXOPLANETS DETECTED TO DATE

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