Some Thoughts on the Discovery of Earth's Bigger, Older Cousin

(Hold the celebrations: We will find an even better one soon!)

Salman Hameed

The light from the star Kepler 452 dimmed just a fraction. Then, 385 days later, it did it again. Astronomers now know that a planet - only a little bigger than the Earth - is causing the dimming as it blocks some of the light heading our way. It is orbiting a sun-like star and is the closest analog to Earth discovered yet.

This way of detecting planets is called "Transit Method" and it has turned out to be one of the most successful ways of identifying other worlds. So far astronomers have detected 5583 planetary candidates around stars other than our Sun, with 1879 already confirmed (you can track the latest number of planets from this website: Planet Quest - http://planetquest.jpl.nasa.gov/).

Wait. Take a deep breath. Now imagine almost 1900 confirmed planets outside our solar system! To put this in perspective, though the entire history of humanity, save the last two decades, we knew of planets only in our own solar system (we even managed to demote one of them!). It was only in 1995, that astronomers confirmed the existence of the first extrasolar planet – 51 Peg and the number of planets is now steadily increasing.

Most of the planets discovered so far are much bigger than the Earth and often lie quite close to their parent star (much of this is a selection boas as detection techniques are better in detecting these kinds of planetary systems). But, of course, we want to find Earth-like planets – small, rocky worlds, orbiting sun-like stars at a distance where water can exist in liquid form. This last bit is potentially important for life. Neither too hot, nor too cold. This is called the Goldilocks zone or more formally, the *Habitable Zone*. In our own solar system, Venus is too close to the Sun and Mars just a little too far. But Earth is in the middle of the habitable zone and has ably supported life for the past four billions years!

If we can find earth-sized planets in their respective habitable zones, the thinking goes, then these may be the likely places where life may have also originated. And on at least some of these worlds, biological evolution would have led to the development of complex organisms as well.

But wait. One step at a time. First we have to detect earth-sized planets in habitable zones. In 2011, astronomers discovered an earth-sized planet, Kepler 20e. But its orbit was only 6-days long and therefore too close to the Sun. The same year came the discovery of Kepler 22b. This time the planet was in the habitable zone of a sun-like star, but it was double the size of the Earth and it is quite likely that it is made of predominantly gases (like Jupiter and other big planets of our own solar system). Then in April of last year, astronomers discovered Kepler 186f. It is an Earth-sized planet in the habitable zone. It is a promising candidate but with just one potential catch. It orbits a star that is smaller and dimmer than our Sun. Its habitable zone, therefore, is closer to its star. I think this is a great candidate for a planet that might host life. The only thing is that it does not orbit a sun-like star.

That brings us to Kepler 452b. This planet is 60% bigger than the Earth. It orbits a sun-like star and it takes 385 days to go around its star. Astronomers think that it has an atmosphere thicker than the Earth and that it also has active volcanism on its surface. So far so good. However, it is located 1400 light years away. Even if we were to find a way to travel fast, this will still be a little too far away. In addition, the planet is 1.5 billion years older than the Earth. This can be both good and bad. This older age gives the planet plenty of time for life to develop. On Earth, life started early, but then it took several billion years to develop complex species like the Turtles, the elephants, and the species that are looking for life on other planets. Just because it happened this way on Earth is no guarantee that it will happen the same way on another planet. But having more time – 1.5 billion more years – nevertheless is probably good when it comes to possible diversity of life.

On the other hand, the central star of Kepler 452b is also 1.5 billion years older, and it means that it is also a bit brighter than our Sun. Stars like our Sun brighten up a little as they age and that can have potentially devastating impact on the habitability of planets. Our own Sun will get 10% brighter in the next billion years or so, and this extra heat will probably result in the evaporation of oceans on Earth making our planet inhospitable to life as it exists today. It is impossible to predict the future of humanity – or whatever our future descendants will be called – that far into the future. Nevertheless, relocation will be the only option for survival, if they still reside on our planet. But we don't know for sure if the slightly larger size and being slightly farther away from the sun will give Kepler 452b some extra time for habitability or not.

Kepler 452b is a great candidate for life. But hold the celebrations. Astronomers estimate that 10% of stars in our galaxy host Earth-sized planets that may exist in the habitable zone. In a galaxy of 200 billion stars, that leaves us with 20 billion potentially habitable planets! I am quite sure – no, I am certain that within the next few years, we will find even more promising candidates much closer to home. And I am quite sure that on at least one of these worlds, we will detect an atmosphere that has been transformed by the existence of life on that planet.

Now that will be something worth celebrating. Stay tuned.

An artist conception of Kepler 452b *(Credits: NASA Ames/JPL-Caltech/T. Pyle)*