The sixth BBVA Foundation Astrophysics and Cosmology lecture series

Kepler mission scientist Dimitar Sasselov discusses the latest discoveries of "habitable" Earth-like planets

- On Tuesday, October 24, the Harvard University Professor of Astronomy will give a talk on "Other Earths and the Origins of Life," as part of the Science of the Cosmos. Science in the Cosmos lecture series held in the BBVA Foundation's Madrid headquarters

- Sasselov is a co-investigator on NASA's Kepler telescope mission, which has successfully identified thousands of new planets beyond the Solar System, at least 30 of them of a size comparable to Earth and found in the "habitable" zone of their respective stars

- The Bulgarian-born astronomer is also founding director of the Harvard Origins of Life Initiative, a cross-disciplinary institute that joins biologists, chemists and astronomers in searching for the starting points of life on Earth, and possibly elsewhere

- From its beginnings in 2011, the BBVA Foundation lecture series Science of the Cosmos, Science in the Cosmos has welcomed world authorities in the most active areas of astrophysics and cosmology

Madrid, October 23, 2017.- Is life an isolated cosmic phenomenon confined to our own planet, or does it thrive in many other corners of the Universe? Astronomical exploration has lately delivered huge advances in the search for a firm answer to this question. Thanks to the power of such instruments as NASA's Kepler space telescope, a total of over 3,500 planets have already been discovered beyond the Solar System. At least thirty of these worlds are of a size comparable to Earth and located in the "habitable" zone of their stars. On October 24, Dimitar Sasselov, one of the scientists responsible for the Kepler mission's historic discoveries, will talk about the importance of these findings in his lecture "Other Earths and the Origins of Life" in the Madrid headquarters of the BBVA Foundation, as part of the sixth edition of the astrophysics lecture series Science of the Cosmos. Science in the Cosmos.

"In the past several years, science has confirmed that 'other Earths' exist and are very common, thanks to the observations of the Kepler telescope." By "other Earths," the Bulgarian-born scientist means planets of Earth-like size that orbit stars similar to our Sun at a distance supporting a relatively temperate climate, and thus the existence of liquid water on the surface. "Under those conditions, many scientists call such planets habitable," Sasselov explains, "since they receive an amount of stellar heat comparable to what the Earth receives from the Sun."

Since its launch in 2009, the Kepler mission has detected 2,470 planets outside the Solar System (exoplanets) by looking for transits; the dimming or "mini-eclipse" that occurs when a body passes across the face of its star. So far, says Sasselov, the most Earth-like world encountered has been Kepler-452-b, which "orbits a star similar to the Sun and is within the habitable zone." However it is also 1,400 light years away, too great a distance for any kind of detailed study, so for the moment, he admits, "we know very little about its nature and environment."

To decide whether a given planet meets the conditions for sustaining life, says Sasselov, "we must first study the composition of its atmosphere to detect gases that might indicate the presence of living organisms." The Harvard astronomer is convinced that this will be achievable in the not too distant future, when we will have the technology in place to check whether a habitable world is in fact inhabited.

"Within 10-20 years, the next generation of space-borne telescopes (the James Webb, to be launched in 2018) and new ground-based telescopes (the Extremely Large Telescope and the Giant Magellan Telescope, now being built in Chile), will allow astronomers to explore the atmospheres of many 'other Earths' among the exoplanets orbiting nearby stars. If life is truly common, we will find signatures of gases (and combination of gases) in some of those atmospheres that are due to life," Sasselov affirms. And indeed, planets of Earth-like size have recently been found in the habitable zones of relatively close stars, such as Proxima Centauri or Trappist-1 at just 4.2 and 39 light years respectively. "We know these are rocky worlds that might harbor water oceans, and soon we will be able to study their atmospheres."

Life forms "manufactured" in the lab

Sasselov points out that even with these new telescopes it will be no easy task to find irrefutable proof of life on "other Earths," given the difficulties involved in interpreting their observations. "The main obstacle is the possibility that life on other planets is very different, and interacts with its planetary environment in unexpected ways that make it hard to understand the data." Precisely for this reason, he is strongly supportive of future spaceship and robot missions to explore parts of our system where signs of water have been found. These include the planet Mars and Europa and Enceladus, moons of Jupiter and

Saturn respectively. "I believe there is little possibility of these places harboring life, but searching for it is worth the effort, because we would get to examine samples directly. In the case of exoplanets, we rely on remote sensing with telescopes. However probes sent to Mars, Europa or Enceladus could examine the surface and collect samples from the subsoil," he explains.

In order to fine-tune analysis of the data gathered exploring "other Earths," Sasselov founded the Harvard Origins of Life Initiative, a cross-disciplinary institute that brings together biologists, chemists, and astronomers. Among its aims is to artificially simulate the creation of microbes so as to better understand the biochemical processes giving rise to life, and thereby improve our chances of identifying it on other worlds.

"Our team is trying to find pathways to synthesizing a living chemical system under planetary conditions in the lab, and use that knowledge to interpret better the remote sensing data we collect from exoplanets during our search for life." Sasselov believes firmly that the best way to elucidate the roots of life and its possible emergence elsewhere in the Universe is "to construct artificial models of living organisms" using novel synthetic biology techniques.

The challenge is a daunting one that will call for a major interdisciplinary collaboration, but Sasselov is convinced that the prize is worth the price. In his view, confirming that life exists beyond Earth would be "a new Copernican revolution" just as world-changing as the first, which removed the Earth from the center of the Universe and transformed perceptions of our place in the cosmos. Because for this Harvard astronomer, the hunt is spurred after all by "humankind's most inner and unique feature - to always move and explore."

Bio notes: Dimitar Sasselov

Born in the Bulgarian capital Sofia in 1961, Sasselov's interest in science developed early, under the influence of his father, an archeologist, and his mother, a horticulturist. After earning a PhD in Physics from Sofia University in 1988 and publishing a series of papers in international journals, he was offered a scholarship at the University of Toronto (Canada). Though initially refused an exit visa by the Bulgarian authorities, the collapse of the Soviet Union soon left him free to take up the place at Toronto, where he completed a second PhD, in Astronomy, in 1990. One year later, he joined the research team at the Harvard-Smithsonian Center for Astrophysics, and since 1998, he has held the appointment of Phillips Professor of Astronomy at Harvard University.

In 2002, he led the team that discovered OGLE-TR-56b in the constellation of Sagittarius, then the furthest away planet ever detected. Since Kepler's launch in 2009, Sasselov has served as a co-investigator on this pioneering NASA mission. He has also advised on space security at the World Economic Forum Conference in Davos, and lectured at the DLD (Digital Life Design) and TED conference series. His book *The Life of Super–Earths* (Basic Books, 2012)

describes the renewed search for life beyond the Solar System.

About Science of the Cosmos, Science in the Cosmos

Since it began in March 2011, the lecture series Science of the Cosmos, Science in the Cosmos has explored some of the main open questions in modern astrophysics. Experts from the top ranks of the world scientific community have shared their vision of the origins of the Universe, the search for life on other planets, how chemical elements are forged in the heart of stars, or the nature of dark matter and energy. The whole of the current series will be available for viewing, along with videos of past editions, on www.fbbva.es and our YouTube channel https://www.youtube.com/user/FundacionBBVA

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