The sixth BBVA Foundation Astrophysics and Cosmology lecture series

Amina Helmi, the "archeologist of the Milky Way," explains how our own galaxy could unlock the mystery of dark matter

- The Professor of Dynamics, Structure and Formation of the Milky Way at the Kapteyn Astronomical Institute of the University of Groningen (Netherlands) will visit the BBVA Foundation Madrid on Monday, December 11 to give a talk on "The Fascinating Milky Way"

- In her lecture, Helmi will explain how the study of the Milky Way may help clarify two of the great open questions in modern astrophysics: how the galaxies formed and the role of dark matter in the Universe

- The scientist is on the team of the European Space Agency's Gaia mission, currently characterizing the properties of a billion of our galaxy's stars (1% of the total) so as to plot a three-dimensional map of its origin, structure and evolution

- 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, December 11, 2017.- Unbeknownst to most of us, we live immersed in a huge Rosetta stone that holds the keys to unraveling some of the Universe's greatest enigmas. The Milky Way, a standard galaxy that shares traits with the vast majority of its fellows, can help explain two of the most urgent questions in modern astrophysics: how these giant cosmic structures came to be formed and the role played in the Universe by the mysterious dark matter. On Monday, December 11, Amina Helmi, Professor of Dynamics, Structure and Formation of the Milky Way at the Kapteyn Astronomical Institute of the University of Groningen (Netherlands) and one of the world's leading experts in the study of how the Milky Way was formed, will visit the BBVA Foundation's Madrid headquarters to explain what we are discovering about our cosmic backyard thanks to the ambitious Gaia mission of the European Space Agency (ESA), as part of the sixth edition of the astrophysics lecture series Science of the Cosmos. Science in the Cosmos.

In the late 1990s, while working on her PhD thesis, Helmi discovered a group of stars within the Milky Way all moving at the same speed in the same direction. These stars, it turned out, were from an ancient galaxy absorbed by our own; pulled into it by the force of gravity and by this means adding to its growth.

The idea had already been mooted that the merging of small galaxies could have played a major part in forming today's giant structures. Helmi developed the tools that were able to test this hypothesis and confirm that it held true, at least for the Milky Way. Today, the group of stars that set this discovery in motion is known as the Helmi Stream, in honor of today's speaker, who, meantime, continues her search for similar "fossils" with which to reconstruct our galaxy's past.

But this "galactic archeologist" also has a firm eye on the present as a member of the ESA's Gaia mission, whose space probe is currently measuring the properties of one billion stars across the Milky Way (1% of the total) in order to plot a three-dimensional map of its composition, formation and evolution.

A window onto the early Universe

The Milky Way is a standard galaxy. Disk-shaped, like 2/3 of the galaxies in the Universe, and of average brightness, it is typical enough that learning how it formed and evolved can elucidate the general dynamics of how these cosmic structures are assembled. "It is the galaxy we know best," remarks Helmi, "and the information and all the information we are gaining from Gaia cannot be obtained for other systems."

Among the keys to this study is the stellar halo, the spherical region of matter that surrounds spiral galaxies and falls within their realm of influence, since this is where we find the galaxy's most ancient stars.

These stars witnessed how the Milky Way formed. So from the way they move and how they are distributed, we can tell a lot about its history. Further, halo stars spend a lot of time in the regions dominated by dark matter. This implies that by mapping their motions we can also learn about the properties and distribution of dark matter in the galaxy.

But the importance of the halo goes further still. "Its stars formed very early on in the history of the Universe," explains Helmi, "and retain a memory of the physical conditions of the time. So by studying them, we can learn directly about the very young Universe."

Gaia will provide such a wealth of new data that besides characterizing a billion stars and mapping the Milky Way, it will help us find previously unknown objects, to understand more about others we know little about, to more accurately track the orbit of asteroids that could one day impact on Earth, and even to test whether we need a new theory of gravity.

Helmi takes up the story. "Because Gaia will be measuring exquisitely how stars move through the galaxy and its halo, we will be able to determine the distribution of mass and the force field very precisely, and we hope in this way to pin down the nature of dark matter, and to know whether a new theory of gravity (even beyond general relativity) will be required."

Within Gaia, Helmi leads a working group that verifies the information gathered by the space probe prior to its publication, the aim being to ensure the quality of data by checking how they fit with our current state of knowledge. This work comes under the remit of the Data Processing and Analysis Consortium (DPAC), made up of hundreds of scientists from more than eighty European companies and organizations, including ten Spaniards.

Launched in December 2013, the space probe was initially scheduled for retirement in 2018, but a request has gone in to extend its lifetime for another 3 to 5 years. Meantime, work has begun on new instruments to prolong and, in some cases, supplement its mission. "Gaia will find many interesting stars but does not, for instance, have the capability to measure their chemical composition," Helmi explains. In any event, "Gaia data is, and will remain for many years, fully revolutionary."

Bio notes

Amina Helmi is Professor of Dynamics, Structure and Formation of the Milky Way at the Kapteyn Astronomical Institute of the University of Groningen (Netherlands). She obtained her PhD from the University of Leiden, after which she held prestigious postdoctoral fellowships in Germany and The Netherlands.

She has received numerous prizes, including the 2004 Christiaan Huygens Award and the 2010 Pastoor Schmeits Prize for Astronomy. Helmi has also been awarded a number of high-level grants, including a VIDI and a VICI from the Netherlands Organization for Scientific Research Talent scheme, and an ERC Starting Grant from the EU.

She was a member of the Young Academy of the Royal Netherlands Academy of Arts and Sciences (KNAW), and since 2016 has been a member of the Royal Holland Society of Sciences and Humanities.

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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