Fórum do Futuro
5 November 2018
Professor Michel Mayor

In the classical antiquity, the development of the Greek astronomy was an important tenet of the philosophic concept that the world was ruled by rational explanations. At about, 420 B.C., the Pythagorean Philolaus, described the Cosmos as composed by 10 bodies: the stars, the planets (Hermes, Aphrodite, Ares, Zeus and Kronus, better known today by their Latin names: Mercury, Venus, Mars, Jupiter, Saturn), Sun (Helius), Moon (Selene), Earth (Gaea) and a counter-Earth (Antichthon). In fact, we use the Greek word "planêtês", wanderer, to refer to the objects whose motion is apparently erratic with respect to the background of fixed stars.

We must bear in mind that, in the classical Greece, astronomy was regarded as a branch of mathematics as it was thought that the planetary motion could be understood in geometrical terms. In the Timaeus, written about 360 B.C., Plato briefly described the two-sphere model, later developed by the younger mathematician Eudoxus of Cnidus, (390-347 BC). In the two-sphere model, the Cosmos was divided into two regions, a spherical Earth, central and motionless, and a heavenly realm centered on Earth, which contained multiple rotating spheres.

Jumping to our era, after the posthumous publication of the *De revolutionibus orbium coelestium* in 1543, authored by the polymath Nicolaus Copernicus, Earth was placed, at equal footing, among the other known planets of the Solar System. In 1576, the Dominican Friar, Giordano Bruno was accused of heresy for defending Copernicus and for stating that the Universe was infinite and that the stars were like our sun. In 1583 he took refuge at Oxford, where he completed his six "Italian Dialogues" which included the text "De l'infinito, universo e mondi". In this work, Bruno's main argument was theological: based on the omnipotence of God, it would follow that the Creator would inevitably engender infinite suns each with their own planets. In 1593 he returned to Italy and was arrested by the Roman Inquisition charged of apostasy for his cosmological views, for denying the Trinity, the divinity of Christ, the virginity of Mary and the transubstantiation. He was convicted with the heaviest sentence and was burned at the stake in the Campo de' Fiori in Rome in 1600.

On a more cheerful note, in the second half of the XIXth century, the French astronomer, François Arago entertained thousands of readers with his 4 volumes of astronomy, which included detailed and imaginative descriptions of the planets of the Solar System. Since then, readers were used with the diversity and the richness of conditions existing in the various planets and somehow prepared for their putative abundance in the Universe.

Inspired by the observations of “canali” of Mars by the Italian astronomer, Giovanni Schiaparelli, which were fervently popularized by the American astronomer Percival Lowell, in 1897, Kurd Lasswitz in Germany wrote “Auf zwei Planeten” and, in the following year in Britain, H. G. Wells, wrote “The War of the Worlds”. In these novels the Earth was visited and, in the second one, invaded by Martians. These two pioneering works of science fiction did prepare the collective imagination to the possibility of habitable worlds besides Earth.

However, it was only in 1995 that science catch fiction and that thanks to the incredible achievement of our guest, Professor Michel Mayor, who, with his Ph.D. student Didier Queloz, discovered the first exoplanet around the 51 Pegasi b star at about 51 light-years from Earth. This was possible due to the development of a special spectrograph, ELODIE, which allowed detection, through the method of radial velocities, of tiny variations on the luminosity of a star surrounded by an orbiting planet. A spectrograph is an instrument that separates light in its wavelengths and records the data. ELODIE was capable of detecting minute changes in a reference wavelength of the light of the star due to its motion. Indeed, according to Newton’s third law of motion, the force that a body A exerts on a body B, action, ensues a reaction of body B on body A. Thus, as a star pushes a planet, leading it to orbit around, on its hand, the planet pushes the star, causing a small change in its position, meaning that it wobbles and that its luminosity changes slightly. The effect is that the spectral lines, the fingerprints of the stars, will turn successively redder and bluer than the spectral lines when neither the source nor the observer move. This shift in frequency is known as Doppler effect.

Today, thanks to the radial velocity, transit and other techniques, 3891 exoplanets were detected (numbers of October 4th 2018), actually in 2828 systems and 155 Earth-like. In 2009, NASA launched the Kepler Space Telescope dedicated to find exoplanets and thousands have been discovered. According to Kepler’s statistics, about 17% of the stars in the galaxy might have Earth-like planets; this means, that there should exist about 17×10^9 planets similar to Earth in the Milky Way. In March 2018, Kepler’s mission ended.

Of course, discovering Earth-like and life supporting planets is the holy grail of this line of research. It is worth mentioning that the fraction of stars that admit a planetary system and Earth-like planets with life are entries in the famous Drake equation, the equation that estimates the number of civilizations with which we could potentially communicate in our Galaxy.

After this lengthy prelude, let me formally introduce our speaker. Professor Michel Mayor is a most distinguished scientist. He is Emeritus Professor at the Department of Astrophysics at the University of Geneva. As mentioned, his discovery of 1995 opened a new chapter of astronomy and had a profound impact on the theory of formation of planetary systems. He is a foreign member of the French Academy of Sciences and of the National Academy of Sciences of the United States. He is the recipient of several prizes for his achievements, such as the Marcel Benoit Prize in 1998, the Albert Einstein Medal in 2004, the Astronomy Shaw Prize in 2005, the Karl Schwarzschild Medal in 2010, the Viktor Ambartsumian International Prize with Garik Israelian and Nuno Santos in 2010, the Gold Medal of the Royal Astronomical Society in 2015, the Kyoto Prize in 2015 and Israel's Wolf Prize in 2017.

Actually, Professor Michel Mayor has a close connection to Porto, given that Dr. Nuno Santos of my Department, Departamento de Física e Astronomia da Faculdade de Ciências da Universidade do Porto, and who, I usually refer to as "our planet hunter", was his Ph.D. student.