Asteroids

Fascination of their Exploration – History, Origins and Influences

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With the comets, asteroids belong to the so-called “minor planets” of our Solar System. While comets could certainly have been observed by people in the starry sky thousands of years ago due to the formation of their very striking dust and gas tails near the Sun, the discovery of the first asteroids only came about after the invention of the telescope at the beginning of the 17th century. Around 1800 astronomers from the "sky police" founded in Lilienthal near Bremen went in search of a missing planet between Mars and Jupiter around 1800. Johann Daniel Titius (1729–1796) had empirically found a numerical relationship in 1766, which was announced by Johann Elert Bode (1747–1826), according to which the measured distances of most planets from the sun can be derived using a simple mathematical formula and the number of their order. With the help of the formula $a_n = 0.4 + 0.3 \times 2^n$ for n = $-\infty$, 0, 1, 2, 4 and 5, the mean distances of the planets Mercury, Venus, Mars, Jupiter and Saturn from the Sun can be taken as successively multiples of the astronomical unit (1AU≈149 597 871 km), the mean distance of the Earth from the Sun, estimated surprisingly well. Only then for n = 3 no planet could be found, then as now. Instead, according to current knowledge between Mars and Jupiter, more than 100 million rock-like celestial objects, which were described as asteroids by William Herschel (1738-1822) in 1802 and presumably asteroids, run on quite complexly

structured orbits with very different eccentricities and different angles of inclination to the ecliptic of the Solar System around.

In this lecture, which is particularly vividly illustrated by images and video sequences, the early history of discovery of the asteroids, which is primarily associated with Guiseppe Piazzi (1746-1826), Wilhelm Olbers (1777-1855) and Karl Ludwig Harding (1765-1834), is described. In 1801, 1802, 1804 and 1807 these astronomers first discovered the rather large asteroids Ceres, Pallas, Juno and Vesta from Palermo, Bremen, Lilienthal and again from Bremen. It was only almost 40 years later that another fifth asteroid Astraea was found by Karl Ludwig Hencke (1793 - 1866). In the course of his life, Max Wolf (1863 - 1932), the founder and director of the Baden State Observatory Heidelberg-Königstuhl discovered 228 asteroids alone. And to date, the existence of millions of minor planets of various sizes has been demonstrated. The second part of this lecture defines and describes in more detail what is meant by the term asteroid, what different properties these small objects around the Sun have, and where they can be found everywhere in the Solar System. They rotate and, surprisingly, sometimes also have stronger magnetized inclusions.

In order to understand how and where the asteroids presumably originated in the course of the development of our solar system, the following part of this lecture will present different, classic and modern theories on the formation of the protoplanets in the accretion disk surrounding the young proto-Sun. The "Gran Tack" model explains the initial inward and subsequent outward migration of the gas planets Jupiter and Saturn, the formation of Mercury, Venus, Earth and Mars and why the wide asteroid belt between Mars and Jupiter could have formed. The "Nice" model describes the subsequent dynamic developments in the area of the outer ice planets Uranus and Neptune, the emergence of the Kuiper belt, also enriched with asteroids, beyond the Neptune orbit and the Oort cloud, which is much further outside the heliosphere formed by the solar wind of our Solar System as a place of origin, of especially long-period comets. In the context of the “Tandem” model of planet formation, the so-called magnetorotation instability is ultimately made responsible for the characteristic distribution of the rock-like as well as the gas and ice planets in the inner respectively outer area and thus also for the formation of the asteroid belt between Mars and Jupiter. According to current knowledge, a wide variety of magnetic processes, in addition to the often dominant gravitational forces and the rotational movements, obviously also play a decisive role in the course of the development history of not only our Solar System.

In the two concluding parts of this lecture, on the one hand, the satellite missions to the most diverse asteroids are presented, and, on the other hand, possible arguments are presented for why researching the asteroids personally could be of some importance for humans and for the future of human life on Earth. Impressive images from NASA's DAWN mission to the Vesta and Ceres asteroids, ESA's Rosetta mission to comet Churyumov-Gerasimenko, and Japanese JAXA's Hayabusa 2 mission, which has even collected soil samples and is currently on ist way from the asteroid Ryugu back to Earth. Researching the asteroids enables deeper insights into the formation of our Solar System and life on our planet. Space agencies, business circles and people impressed by the successes of previous space missions today dream of transporting larger quantities of valuable raw materials from asteroids flying by to Earth in the future. Finally, the question arises whether and by what means it might be possible in the future to

effectively prevent the collapse of a larger asteroid on Earth, which is so threatening for our lives, with the help of modern human space technology. In just a few years, NASA and ESA want to use the DART and the HERA missions to investigate how far a massive celestial object can be braked and at least moved a little out of its trajectory as part of an impact event on the double asteroid Didymos / Didymoon.

Topics of the Lecture

1. Early History of Asteroid **Discoveries**
2. Asteroid **Properties** and **Locations** in the Solar System
3. Asteroids and the **Development** of the **Solar System**
4. Asteroid Exploration by **Satellite Missions**
5. **Importance** of the Asteroids for our **Earthly Life**

You can get **more information** about the lecture from

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