COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

STUDII ŞI COMUNICĂRI 2019	Vol. 28: 72 - 79

2019 ACTIVITIES OF ”MATEI ALEXESCU” ASTRONOMY CLUB

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ABSTRACT

În lucrare este prezentată activitatea Clubului de astronomie „Matei Alexescu” din anul 2019, activitate ce include seminare pe teme de astronomie și astronautică, observații astronomice, concurs și expoziție de desene și machete pe teme de astronomie și astronautică, precum și o Școală de vară de astronomie. Tematica parcursă în timpul acestor activități a cuprins subiecte precum constelațiile, instrumente astronomice, Sistemul Solar, misiuni spațiale, viața în microgravitație, gruparea stelelor în Univers, clasificarea stelelor, producerea energiei stelare, evoluția stelară, planetele extrasolare, structura și evoluția Universului. Prin intermediul acestor activități s-a dorit ca membrii clubului să-și dezvolte competențele și abilitățile de documentare și cercetare în domeniul astronomiei.

Key words: constellations, planets, stars, nebulas, galaxies

Introduction

Curators Maria Velea and Ana Maria Botezatu within *Victor Anestin* Astronomical Observatory of Bacau founded “Matei Alexescu” Astronomy Club in 2017 which is a club meant for children.

The activities of “Matei Alexescu” Astronomy Club include astronomy and astronautics seminars, astronomical observations, contest and exhibition of space drawings and 3D models, as well as an astronomy summer school.

This paper presents the activities of the club in 2019, the educational project ”Matei Alexescu” Astronomy Club with the activities scheduled on the February – July period.

In 2019 the activity of the club started on the 16th of February with a seminar about the planets of the Solar System. The theoretical part of the seminar consisted in watching the planetarium show *Journey through the Solar System*, show that presents the structure of the Solar System, making the audience familiar with the main components of the System.

The central object is the Sun and it represents the light and heat source for all the other objects around it. The show explains the source of the solar energy (the nuclear fusion reactions), as well as the main phenomena that occur in the solar atmosphere: sunspots, solar flares, coronal mass ejections. The solar wind is also presented in the show as well as the way in which earth’s magnetosphere protects us from it and it reveals the ways in which the solar wind influences the formation of polar auroras. The Moon is then introduced, with its main physical characteristics, and its most widespread landforms. The 8 planets of the Solar System and their main characteristics are then showed. Small Mercury without an atmosphere has huge temperature variations from day to night. Its surface is full of impact craters, the biggest one being The Caloris Basin. A thick layer of sulphuric acid clouds and a dense atmosphere filled with carbon dioxide surround shining Venus, and, as such, the greenhouse effect make Venus the hottest planet in the Solar System. *Venera* Russian probes revealed the surface of the planet, showing that it has been transformed by an intense volcanic activity. *Magellan* American probe was the first space probe that managed to map the surface of planet Venus. *Venus Express* European probe studied in detail the atmosphere of planet Venus trying to find cues as to whether the surface of the planet is still experiencing volcanic activity or not. The rusty surface of Mars is arid and filled with sand dunes. At the poles of the planet ice caps can be observed. Sand storms roam the surface of the planet and its steep geographical landscape. The tallest volcano in the Solar System, Olympus Mons, can be found here. One of the largest canyons in the Solar System, Valles Marineris canyon can also be found here.

The giant Jupiter has an extended atmosphere with cloud strips that are moving in opposite directions thus creating huge hurricanes that last for hundreds of years. From the great number of Jupiter’s satellites the show presents Io where more active volcanos than on Earth were found and Europa, which contains an ocean of salty water under a thin layer of ice.

Saturn stands out through its rings, which are composed from billions of ice fragments remained from former satellites. From the great number of Saturn’s satellites, the biggest one is

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Titan, on which the *Cassini-Huygens* probe found methane lakes and seas.

Uranus stands out through its axis position, the planet being tilted at an angle of 98 degrees and thus tumbling on its orbit. Amongst its 27 satellites, Miranda has the most extreme topography with 20 kilometres tall ice faults.

The last of the planets, Neptune, has the most violent atmosphere in the Solar System. Its satellite, Triton, is geologically active and several nitrogen geysers have been identified on its surface.

The most well-known of the 5 dwarf planets is Pluto and the *New Horizon* probe discovered a very diverse topography on its surface.

There are millions of asteroids that orbit between Mars and Jupiter and beyond Neptune there are the Kuiper's Belt and the Oort's Cloud which represent the source of comets. But the Solar System is not alone in the Universe and until now thousands of extrasolar planets have been discovered in its close proximity. Who knows if some of them can sustain life or not.

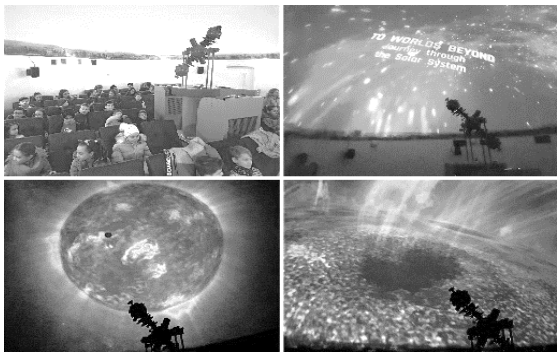

Fig. 1 – Watching the *Journey through the Solar System* planetarium show

The seminar included a practical activity as well within which each member of the club built their own 3D model of planet Earth.

Fig. 2 – Building the 3D model of planet Earth

During this activity, the club members had the opportunity to ask questions regarding the planets, and, at the same time, to test their practical abilities, and to improve their social skills by getting to interact with students from other schools in helping each other to create the 3D models.

Fig. 3 – 3D models of planet Earth done by the club members

The activity continued on the 16th of March with a seminar about the Universe. This started with the display of the sky and the constellations that are visible from the latitude of our country on a planisphere and it aimed to familiarize the club members with the notion of constellation and help them learn the most well-known and brightest constellations so that they can recognize them during the observing sessions. The theoretical part of this seminar continued with the multimedia presentation *The structure and the evolution of the Universe.*

The multimedia presentation *The structure and the evolution of the Universe* shows how the Universe was formed 13.8 billion years ago, presents all the stages of the Big Bang and describes how the early Universe looked like and how the first stars and galaxies formed. The star formation process from nebulas and how stars evolve according to their initial mass is shown. The source of stellar energy is also explained, and the stellar classification with examples for each category is presented. It is shown how stars are grouped within the Universe from double and multiple stars to star clusters, galaxies and galaxies clusters. The way in which galaxies interact within galaxies groups and clusters is also shown, as they often collide and merge which is a very important stage in their evolution. Finally, the structure of the Universe at the largest scale is

presented and the cosmic web is described as well as the way in which the Universe has evolved in the 13.8 billion years since its formation.

During this activity each of the club members has built a 3D model of the Kepler Space Telescope, the most important telescope dedicated to extrasolar planet discovery. During the activity, there have also been discussions about the most interesting exoplanets discovered in the proximity of the Solar System.

Fig. 4 – 3D models of the Kepler Space Telescope done by the club members

Cosmic Collisions within the Solar System seminar took place on the 13th of April and it started with a tour of the temporary exhibition *Astronautics in the 3rd millennium* which presents the most important space missions that are prepared by the largest space agencies, precisely missions with humans which are to be sent within the next two decades towards the Moon and Mars. The theoretical part of the seminar continued with the watching of *Cosmic Collisions within the Solar System* documentary.

Cosmic Collisions within the Solar System documentary speaks about the cosmic collisions that resulted in the formation of the celestial objects that compose the Solar System, as well as about the collisions that modelled the surfaces of these objects. It is shown how the Moon was formed as a result of planet Earth colliding with a planetoid the same size as Mars. The intense asteroid bombardment at the beginnings of the formation of the Solar System, which had a major contribution in modelling the surface of the Moon, is also shown. The way in which the atmosphere of a celestial object protects it against meteorite bombardments and the formation of impact craters are explained. It is shown how the numerous collisions that took place in the gas and dust disc remained around the Sun after its formation lead to the formation of the planets. Even though currently the probability for cosmic collisions inside the Solar System is very low, it is however possible that they take place. The possibility that they occur is real, and the documentary shows the collision between Shoemaker-Levy 9 comet and Jupiter that took place in 1994. It is explained that such collisions modified the planets' axis of rotation angle, and how a planet's tilted axis leads to the formation of seasons on that planet. It is also shown that there are cases of planets with an axial tilt higher than 90 degrees, which lead to them spinning around their own axis in the opposite direction compared to the other planets. The astronomers believe that the big altitude difference between the southern and northern hemisphere of planet Mars is the result of such a cosmic collision. Mars' northern hemisphere has a very low altitude and a relatively smooth surface while the southern hemisphere has mountains. It is possible that a gigantic impact between planet Mars and a planetoid produced this difference between the planet's two hemispheres, thus the low altitude area representing the largest impact crater in the Solar System. An impact at this scale occurred on planet Uranus that lead to the tilting of the planet to a 98-degree angle. Cosmic collisions between comets and Earth are what possibly represented the water source on our planet, this making life possible.

The practical part of the seminar consisted in the members of the club building their own 3D model of *Clementine* space probe which is one of the probes that orbits around the Moon to study its surface, which is littered with impact craters, the result of numerous cosmic collisions with meteorites, asteroids, and comets.

Fig. 5 – *The Universe seen through the children's eyes* drawings and 3D models exhibition

In May we organised for the members of the astronomy club a drawings and 3D models contest with astronomy and astronautics themes and with the best examples we created the *Universe seen through the children's eyes* exhibition which was displayed on the 3rd floor of *Victor Anestin* Astronomical Observatory, at the entrance of the planetarium dome. On the 18th of May we organised the exhibition opening as well as the awarding of the drawings and 3D models contest.

After the exhibition opening, at 11 o'clock, *The Polar Auroras and the Meteor Showers* seminar took place and it started with the planetarium show *Lucia – the Secret of the Shooting Stars.*

The planetarium show *Lucia – the Secret of the Shooting Stars* approaches the subject of polar auroras explaining their formation in detail. The show explains the way in which the solar wind interacts with Earth's magnetic field and with Earth's atmosphere thus creating the auroras. The characters of the show try to figure out the phenomenon behind the production of shooting stars. To see if there is a connection between the shooting stars that can be seen at night and the meteorites that hit the surface of Earth, the three characters start a space travel around the Solar System. They first visit the Moon and analyse its full of craters surface, arid and lifeless surface, with a black sky during day and night as a consequence of the lack of an atmosphere. After they witness the way in which a meteorite hits the surface of the Moon producing an impact crater they find out that this is the way in which the Moon's craters formed. To find out where meteorites come from the crew of the Polaris space ship leaves the Moon and heads towards the Asteroid Belt. Here they analize asteroids samples and the crew discovers that these have a similar composition with the meteorites found on Earth and Moon and conclude that meteorites come from the Asteroid Belt as a result of asteroids clashing against each other. The impact between an asteroid fragment and planet Jupiter is then presented. The impact leads to an explosion in the dense and extended atmosphere of this giant gas planet.

As the crew of the Polaris space ship continues its interplanetary travel, they meet the nucleus of a comet and they land on its surface where they observe that it is formed out of ice mixed together with dust and rock particles. On the face of the comet's nucleus that's lit by the Sun some of the ice starts to melt and boil off, along with particles of dust and they form the coma of the comet, the solar wind pushes the gas and the dust away from the coma forming the tail of the comet, which points away from the Sun. Polaris' crew then observes how planet Earth goes through the trail of dust and rock particles that was leftover from the comet and when the rock fragments enter Earth's atmosphere at high velocity they friction with the air and thus are set on fire, heating the air around them. This is how the phenomenon popularly called shooting star takes place. The same phenomenon is scientifically called meteor. The smaller fragments burn out in the atmosphere, while bigger fragments survive and hit the surface of the planet and are called meteorites. Thus the connection between meteorites and shooting stars that can at times be observed on Earth's night sky is revealed.

During the practical part of this seminar, the members of the astronomy club build the 3D model of the space probe SOHO, which is one of the most important space probes sent to study the Sun from its nucleus to the solar corona (the source of the solar wind, which produces the polar auroras).

On the 22nd of June we organized the *Road to Knowing the Universe* seminar which started with watching the planetarium show *The blind man with starry eyes.*

The planetarium show *The blind man with starry eyes* shows the story of a king that ruled its kingdom tyrannically. To find new ways to dominate the tyrant seeks advice from the wisest old man in his kingdom by asking him how to become more powerful. The old wise man advices the king to watch the sky and count the stars. The tyrant follows the advice of the old man hoping that he would find more ways to dominate and subjugate his people, but realises that this task overwhelms him so he orders his army to count the stars. The tyrant thus observes that the stars don't have a fixed position on the sky, but rising and setting to make space for other stars. The old wise man explains to the tyrant that this was because the Earth is spinning around its own axis. The tyrant then accuses the old wise man of challenging his authority and of wanting to convince the people that the king is not the ruler of Earth and imprisons the old man. But the tyrant keeps trying to find out whether what the old wise man had told him was true or not, and, in his search, slowly reaches the conclusion that the old wise man was right, that he wasn't the ruler of Earth, but belonged to Earth. And as the old wise man tells him that the Earth belongs to the Universe, the tyrant decides that he wants to own the entire Universe. The old wise man advices the tyrant to learn what the Universe is and then the Universe shall belong to him. In his attempt to follow the old man's advice the tyrant slowly discovers the secrets of the Universe: the explanation of the apparent movement of the night sky (the movement of the planet around its own axis), what the shooting stars are, what's the lifecycle of stars, what constellations are, etc. The contemplation of the sky and the discussions with the old man about the Universe slowly transformed the tyrant: he was thinking about war less and less and about studying the Universe more and more and the more he learnt the more he wanted to know more. Therefore, when the old wise man dies the

tyrant takes his clothes to take his place and studies the sky for the rest of his life.

After the planetarium show, the members of the astronomy club built the 3D model of a space rocket during a practical activity. They were told about the usefulness of space rockets: serving as vehicles that launch artificial satellites, automated space probes, or space ships with humans on board.

Fig. 6 – 3D models of a space rocket done by the club members

In between 25th and 27th of July, we organized *The Secrets of the Universe* Summer School for the members of the club. Each day started with a presentation of the constellations on the planisphere so that the members retain the shapes of the constellations to the best of their abilities and whenever they went to the planetarium they tried to recognize them on the planetarium dome.

Fig. 7 – presenting the constellations on the planisphere

On the 25th of July we continued with a tour of the *Solar System* exhibition and then with the watching of the planetarium show *Polaris.*

The planetarium show *Polaris* approaches the subject of polar nights and days and the two main characters of the show try to figure out which is the cause of the huge duration of 6 months of polar nights and days. The two characters wander if polar nights and days last as long on other planets and to find out the answer to this question they turn their telescope towards planets Mars and Saturn, but reach the conclusion that it isn't enough to just study the planets through the telescope to find out the answer. Instead, they need to travel with a space rocket and look at planet Earth from above and study it in as a whole and then to visit planets Mars and Saturn. Once they reach space, the two characters start orbiting around Earth and observe that the North Pole of the planet is in darkness so it's night. Regardless of the fact that the Earth is spinning around its own axis the North Pole remains in darkness as the polar night continues and this is because of the fact that Earth's axis of rotation is tilted and during the polar night the North Pole is tilted opposite to the Sun. The characters observe that the situation is reversed on the South Pole, which constantly has solar light and it's polar day time as because of the tilting of Earth's axis the South Pole is tilted towards the Sun. The characters realise that this situation changes throughout the year as the Earth orbits around the Sun according to Earth's position on the orbit and the position of the two hemispheres towards or against the Sun. Thus they decide to revisit Earth in a few months to analyse the situation and meanwhile go visit planets Mars and Saturn. On Mars' poles the characters observe ice caps and conclude that these must be formed as a result of long polar nights, the same way as on Earth. On Saturn's poles they notice there is no ice caps, but observe several thousand rings around the planet. They see that, unlike Mars, Saturn does not have a solid surface as it is made out of gas, and, as they approach the rings, they realised that they are made of billions of ice particles. As they return to Earth's orbit they observe that the situation is opposite compared to when they left: there's day on the North Pole and night on the South Pole. The axis of Earth preserves the direction of its tilt as it goes around the Sun, so the hemisphere that is at one point directed towards the Sun is going to be directed against the Sun in 6 months' time. If the North Pole is directed towards the Sun it means that here it's day and summer, while the South Pole is directed against the Sun in darkness experiencing winter and polar night. After 6 months the South Pole will be directed towards the Sun and the North Pole will be in darkness and the seasons will be reversed: 6 months of day and summer at the South Pole and night and winter at the North Pole. Thus, the cause of season formation on Earth is explained together with the explanation for the long polar nights and days. This leads to the conclusion that

any planet that has a tiled axis of rotation will experience seasons.

Fig. 8 – Solar observations

After the planetarium show we went to the Observatory's roof terrace to show the members of the astronomy club the ways in which the main optical instruments are used for astronomical purposes: the binocular, the refracting telescope and the reflecting telescope; and to make solar observations with the members.

The members of the club then built a 3D model of the Hayabusa 1 space probe, which is the first space probe that collected samples of an asteroid and brought them back to Earth.

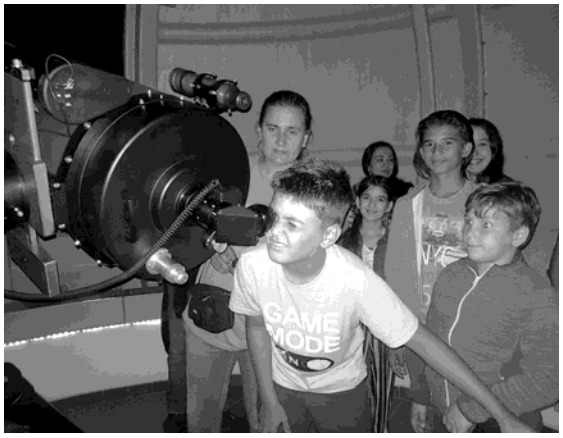

Fig. 9 – Astronomical observations through the reflecting telescope

The activities of the first day of the summer school ended in the night with astronomical observations of planets Jupiter and Saturn with a binocular, a refracting telescope and a reflecting telescope.

The second day of the summer school continued with a tour of *The grouping of stars* and *Stellar evolution* exhibitions and with watching the planetarium show *Constellations,* after the presentation of the constellations on the planisphere.

The planetarium show *Constellations* familiarises the students with the notion of constellation by presenting the constellations that can be seen on the sky in each astronomical season. The show presents both the mythology associated with the constellations and the celestial objects that are representative for each constellation, such as: star clusters, galaxies, or extrasolar planets.

It is explained how the astronomical seasons are delineated by equinoxes and solstices and how the duration of nights and days varies according to the astronomical season. The show presents the zodiacal constellations, and circumpolar constellations such as Small Dipper and Big Dipper, explaining how to use the latter to find the North Star, star which shows north and serving as a very good reference point. The brightest stars of each constellations are shown, and the different types of stars that exist in the Universe are presented and their characteristics are compared to those of the Sun.

The two categories of planets of the Solar System are showed: terrestrial planets and giant planets with an example from each category (the terrestrial planet Mars and the giant Saturn) and the main characteristics of each category of planets. Our galaxy, the Milky Way, is shown as it is seen from Earth and its full structure together with the types of celestial objects that comprise it. The show then presents the comets and how their remains form meteors. The strongest meteor showers are also presented.

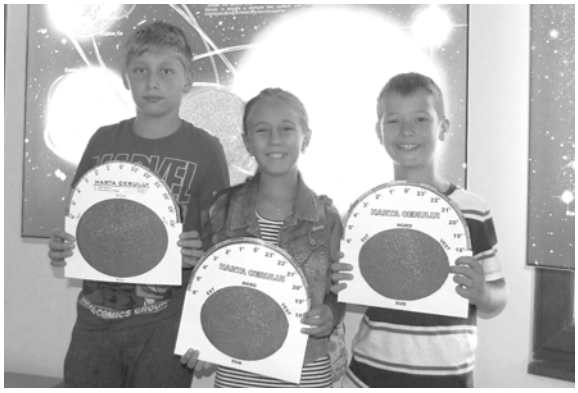

Fig. 10 – Planispheres built by the club members

During the practical part of the activity the members built a planisphere that would help them to orientate on the night sky.

The third day of the summer school was dedicated to the Apollo Program, as this year is the 50th anniversary since the first landing on Moon.

After the presentation of the constellations on the planisphere, the day continued with a tour through the astronautics exhibition and with the watching of the *Apollo 11* documentary.

The documentary presents the first space mission that brought humans to another celestial object, the Moon. The footage taken during all stages of the mission are presented: the launch of the spacecraft Apollo 11 with the rocket Saturn V, the activities of the astronauts during the Earth – Moon journey, the detachment of the lunar module from the Apollo 11 spacecraft, the landing on Moon, the activities of the astronauts on the surface of Moon, and their return to Earth.

The activities of the astronauts during their time outside of the Lunar Module are presented in detail: collecting Moon soil samples, planting the American flag on the Moon, installing of a set of scientific instruments on the surface of the Moon, photographing and filming the lunar landscape.

The documentary ends with the safe return of the three astrounauts on Earth, which marks the successful ending of the mission. The mission is considered to be the greatest achievement of the humankind regarding space exploration.

After watching the documentary, the day continued with a practical activity during witch the members of the club built a 3D model of the Apollo spacecraft. During this time it was shown to them on a 1/100 mock-up of the Saturn V rocket which are the stages of the rocket and how the rocket was launched into space.

Fig. 11 – Explaining how multistage rockets work

Fig. 12 – 3D models of the Apollo spacecratf done by the club members

In the end the members of the club were given participation certificates for taking part in the activities of *The Secrets of the Universe* Summer School. This also concluded the activity of ”Matei Alexescu” Astronomy Club in 2019. The activity is presented in the second edition of ”Matei Alexescu” Astronomy Club magazine.

Fig. 13 – Handing the participation certificates for the participation to the Astronomy Summer School.

Conclusions

Through all these activities ”Matei Alexescu” Astronomy Club aimed to increase the interest and motivation of the club members to study the Universe, to develop their ability to communicate using the scientific language specific to astronomy, and to offer the members the chance to discover the secrets of astronomy. During the activities the members of the club showed a real interest for astronomy, which, even though

represents one of the oldest sciences it is not taught in schools in Romania. As a result of the fact that astronomy is not being taught in schools the club members didn't know much about this subject when they first enrolled in the club. The non-formal education in this area of study done through astronomy clubs and astronomical associations is therefore extremely important as it replaces the formal education which is missing completely.

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