Rezekne Polish State Gymnasium

Perigee syzygy observation

Scientific research work in astronomy

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Abstract

The aim of this work was to observe and explore perigee syzygy natural phenomenon and its impact on the environment and people. It was important to find out the frequency of this phenomenon and perigee syzygy phase duration. In the experimental part pictures of this phenomenon were taken. They were compared to images from different parts of the world. The phenomenon impacts on the Earth's seismic activity were studied.

The conclusion was drawn that perigee syzygy is observed about once a year, but the cause of the adverse weather conditions often cannot be observed. During perigee syzygy earthquake activities are often seen in seismically active zones. When Perigee full Moon coincides with the phase of the Moon occurs about 12% higher than it is apogee Full Moon phase. Perigee period the Moon is 30% brighter than normal.

The work has been made in Latvia, Rezekne. The work was created in the period from 01/10/2016 to 28/11/2016.

Keywords: perigee syzygy, the Moon phase, SuperMoon, apogee. (1; 134), (5; 97)

Abbreviations

h hours

km kilometres

min minutes

SLR Single-Lens Reflex

Introduction

The Moon is familiar sight in our sky, brightening dark nights and reminding us of space exploration, past and present. It is the only Earth attendant. It has an effect on Earth processes, but more important is the Sun. The Moon is the second brightest celestial body after the Sun; it does not emit light itself, but reflects it from the Sun. The Moon's force of gravity causes the Earth's ocean ebb tides. The Earth turns around its axis, trying to rotate with its tidal waves. The Earth turns around its axis faster than the Moon around the Earth. There appears tidal friction that hinders the Earth's daily rotation and extends the Earth' day. The Moon also affects the human biological cycles and mental state. The Moon approaching the Earth can cause a variety of natural disasters. This natural phenomenon can cause earthquakes and volcanic activity all around the world. (3; 22-24)

The aim of the work: To observe and explore Perigee syzygy natural phenomenon and its impact.

To achieve the aim the following **tasks** were raised:

1. Explore scientific literature about Perigee syzygy phenomenon, cycles and patterns.
2. Observe Perigee syzygy phenomenon in Rezekne's region.
3. Get the information about the underground Perigee syzygy processes during the activity.
4. Make conclusions.

Work methods used: literature selection and analysis, photo fixation, modeling, comparison, observation, data processing and analysis.

Work structure: The work consists of a literature review, selected research methods, analysis of the results and used literature list, which includes 12 sources. The study included an introduction, abstract and 7 Annexes. In working visualization were added 11 pictures and 1 table.

Contents

1. LITERATURE REVIEW

1.1. Moon- Earth's natural satellite

The Moon is the Earth's only satellite. Distance from the Earth is 384400km. The Moon moves around the Earth, a little over an elliptical orbit. It orbits the Earth in 27 days, 7 hours and 43 minutes. The Moon is only 4 times smaller than the Earth, so the system Earth - Moon, also called doubleplanet. The Moon is the second brightest celestial body after the Sun, the only difference is that the Moon does not emit light itself. The Moon reflects the sunlight. This reflected light is highly visible in the night sky.

At times, the water level rises in the seas and the oceans, but sometimes decreases, because of the Moon. This phenomenon is called the ebb and flow. Many of us have probably already heard these two words somewhere. The Moon modifies its phase when the Sun illuminated and unilluminated parts of Moon change their directional to the Earth. (2; 59-63)

The Moon has the following phases: New Moon - the Moon is between the Sun and the Earth. Then the Earth facing side unlit and sun-lit part of the Moon is not visible; First Quarter – Moon phase, in which the sun-lit part of the Moon appears as a half circle to the right. In the coming days the Moon phase continues to grow, from New Moon to the full Moon phase Moon called growing; Full Moon - the Moon phase, the Moon is behind the Earth and the Sun fully illuminating the whole of the visible part of the Moon; Last Quarter - Moon phase, in which the sun-lit part of the Moon appears as a half circle with a curvature to the left. After this phase of relapse New Moon; waning Moon - the Full Moon phase to New Moon phase of the Moon is called a descending. (10)

1.2. Perigee syzygy- Moon nature phenomenon

Perigee syzygy is a phenomenon of the Moon with the maximum approach to the Earth. This can happen when the Moon is in a Full Moon or a New Moon phase. This can happen because the Moon is on this elliptical orbit. The Perigee syzygy time on the Earth is when the Moon is seen in the largest sizes. This phenomenon has a higher risk of events such as volcanic eruptions, earthquakes. The Perigee syzygy is the new concept, which has appeared relatively recently. (4; 62-63)

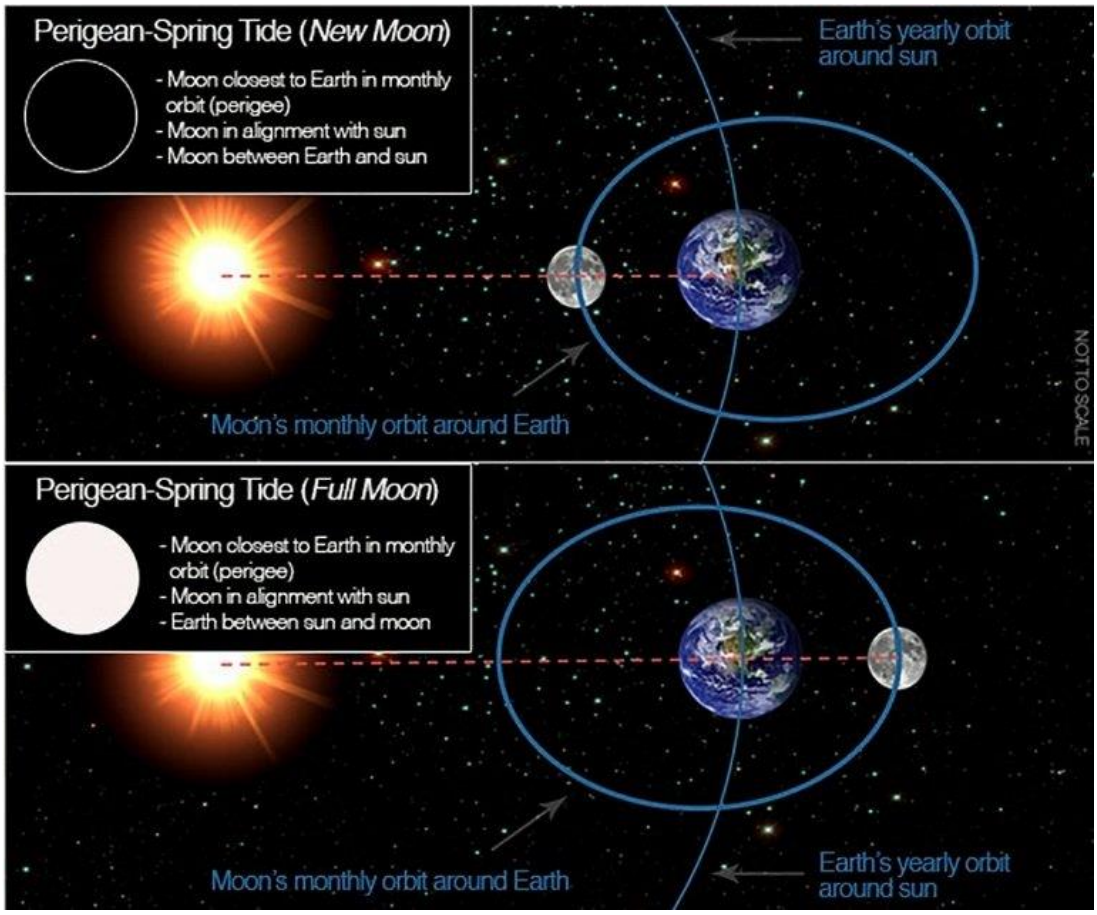

image 1 The Moon's motion trajectory (8).

Perigee syzygy phenomenon is divided into two categories –New Moon and Full Moon category. Perigee syzygy term first came into use in 1979. Richard Noll introduced this phenomenon. It is considered to be relatively rare. Another name for this phenomenon is perigee syzygy. It is an astronomical phenomenon, during which the Earth, the Moon and the Sun centers are located on a line.

Year	Date	Lenght	Moon phase
2011	March 19th	59 min	Super Full Moon
	November 26th	7 h 30 min	Super New Moon
2012	May 6th	2 min	Super Full Moon
	December 13th	9 h 28 min	Super New Moon
2013	June 23	23 min	Super Full Moon
	(invisible)	(invisible)	Super New Moon
2014	August 10th	26 min	Super Full Moon
	January 1st	9 h 46 min	Super New Moon
2015	September 28th	1 h 4 min	Super Full Moon
	February 19th	7 h 42 min	Super New Moon
2016	November 14th	2 h 29 min	Super Full Moon
	April 7th	6 h 11 min	Super New Moon
2017	(invisible)	(invisible)	Super Full Moon
	May 25th	5 h 39 min	Super New Moon
2018	January 2nd	4 h 30 min	Super Full Moon
	July 12th	5 h 40 min	Super New Moon

Table 1 Perigee syzygy cycles

The least period of time, this phenomenon was observed on May 6, 2012. At that time, the duration was 2 minutes. By contrast, for the longest time it was observated on January 1, 2014, the duration was 9 hours 46 minutes. The second longest Perigee syzygy was observed on December 13, 2012, when duration was 9 hours 28 minutes. Both Super Full Moon and Super New Moon occur only once a year - each in their own half. (9)

The Moon shows the Earth all the time the same surface. In 27.55 daysthe Moon also takes one turn around an axis, so the same the Moon’s part will always face the Earth. But comparing apogee and perigee pictures taken during the Full Moon it can be seen that the surface of the Moon rotation is both left and right, up and down. So, from the ground, we can see 59% of the Moon's surface.

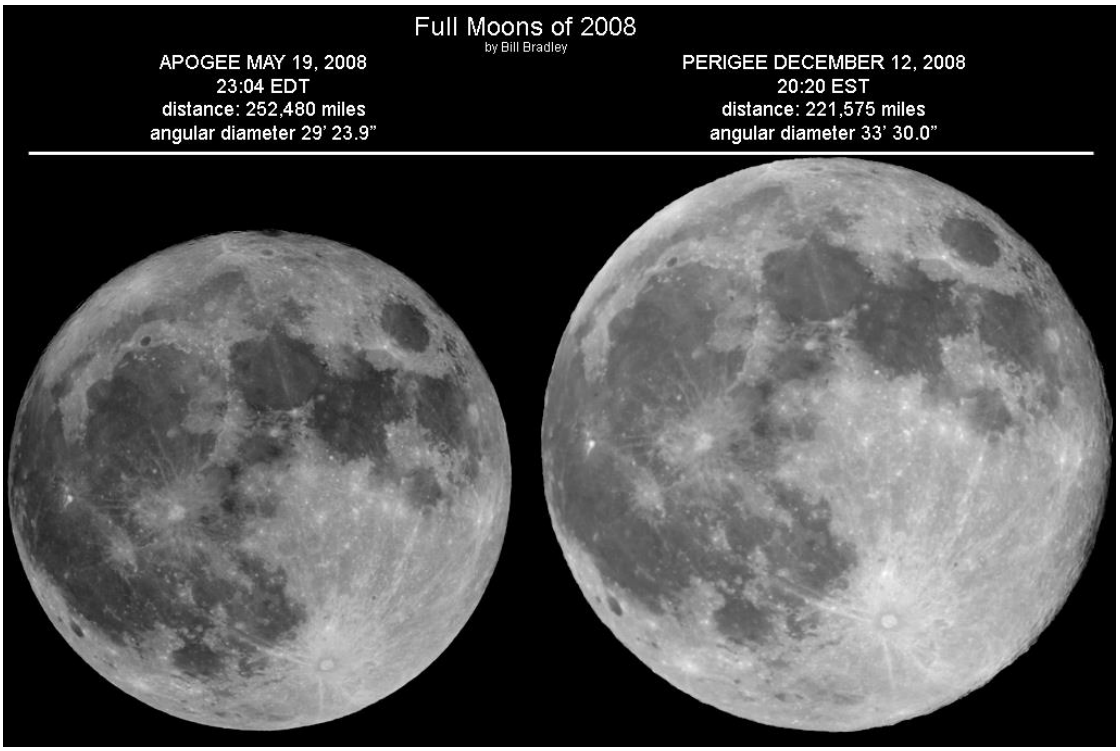

image 2 The Moon’s perigee and apogee (http://old.shqqaa.com/showthread.php?t=8649)

This is due to a phenomenon called libration (Latin. Libra scales). Libration arises for two reasons:

- First, the lunar equator is 7 ° to the lunar orbit. Therefore each time the Moon Orbital can look ≈7 ° over the North Pole, and the same - over the South Pole.
- Second, the Moon, circling around the orbit, slightly changing the speed of movement, but its speed of rotation around the axis is constant. As a result, the Moon turns around the axis of the moments ahead of the situation in orbit, but sometimes behind.

Closest perigee in the period from 1750 to 2125 was 356,375 on January 4, 1912, and the farthest apogee during the same period will be 406,720 km from the earth on February 3, 2125.

2. MATERIALS AND METHODS

2.1. Materials

For successful achievement of the project, were used variety materials which are used in everyday life.The Earth and the Moon cross-location module was created with those materials. In order to successfully carry, was used SLR camera. In order to facilitate the work were used Microsft Office Word 2013, Microsoft Excel 2013 programm. To reduce the image size was used Adobe Photoshop CS6.

2.1.1. Open-air observation

camera	Nikon D3300
camera stand	Digipod Tripod TR-472

2.1.2. Model constructing

- box
- gouache paint
- thread
- white bulb
- globus
- flashlight
- scotch tape
- camera
- calculator
- pen
- pencil
- paper

2.1.3. Used programmes

- Microsoft Office Word 2013
- Microsoft Office Excel 2013
- Adobe Photoshop CS6

2.2. Methods

1. The method of comparison

The method of the comparison was used to compare the visual distance of the Moon apogee perigee period. To compare the distances different criteria were set: the visual diameter of the Moon, lunar brightness, lunar terrain recognition.

2. The method of modeling

Modeling is a cognitive research of objects based on their models; real-world objects, processes or phenomena models, work and study in order to obtain explanations of this phenomenon. Models were used to develop visual aids. Development of models made it possible to show the Moon's and Earth's between locations more effectively.

2. Photo fixation

For this work photo fixation method was chosen to determine the existence of perigee syzygy phenomenon . Photo fixation was performed with SLR camera „Nikon". The images were takenon 14 November at 22:00 to 23:00 (see Annex 1, 2, 3).

3. RESULTS AND ANALYSIS

1. Perigee syzygy phenomenon comparison and description

The apogee and perigee distances are not constant, they tend to vary, but on average, during the apogee of the Moon is 406,697 km from the Earth and during perigee 356,410 km. Among them there is a difference 50 287 km. This difference is also visually discernible (see Annex 4). When Perigee full Moon coincides with the phase of the Moon occurs about 12% higher than it is apogee Full Moon phase (see Annex 5). Perigee period the Moon is 30% brighter than normal (see Annex 6). (6)

2. Project Modeling

For model creation were used materials that were described in part 2.1.2.. The aim of the module was achieved. This made it possible to explore and better understand the Moon location visually. This layout can be used for science and astronomy lessons, which is dedicated to the Moon and lunar phenomenon topics (see Annex 7, 8).

3. Photo fixation

Photo fixation with fixation phenomenon failed because it was cloudy. However, in the right side of the picture brighter sky spot is displayed. Therefore, we used the Internet hosted pictures (see Annex 9). (7)

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ANNEX

image 3 Brighter sky spot located on the right side (Picture taken by the author.)

image 4(Picture taken by the author.)

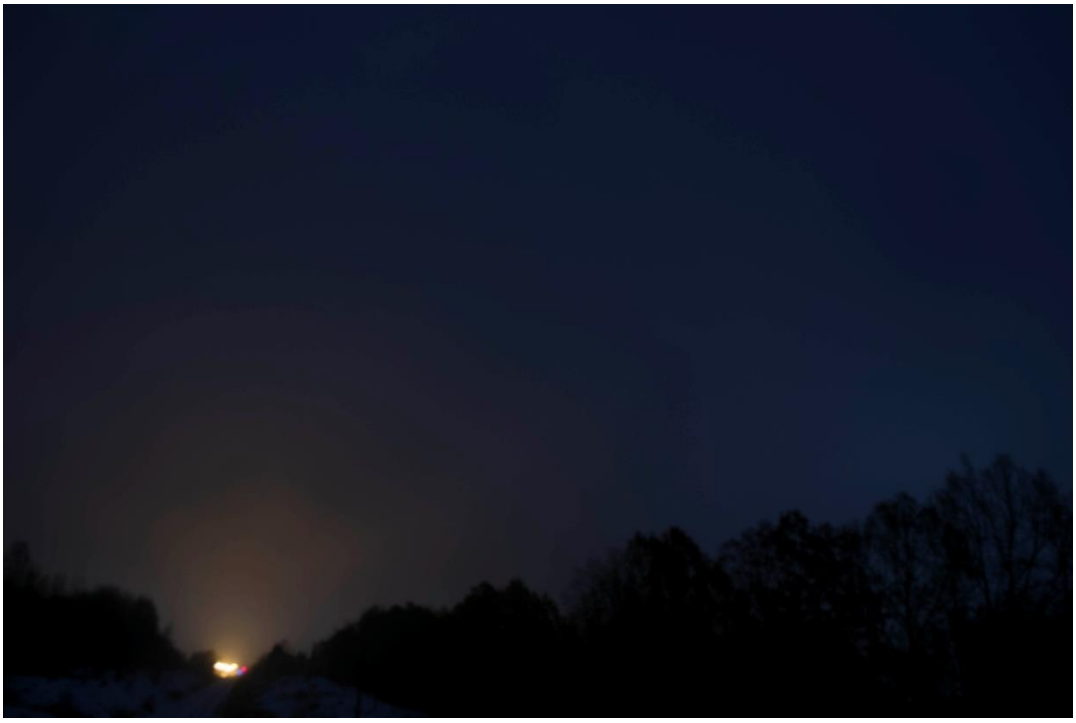

image 5 (Picture taken by the author.)

image 6 Our work team in the night of Perigee syzygy (Picture taken by the author.)

image 7 (Picture taken by the author.)

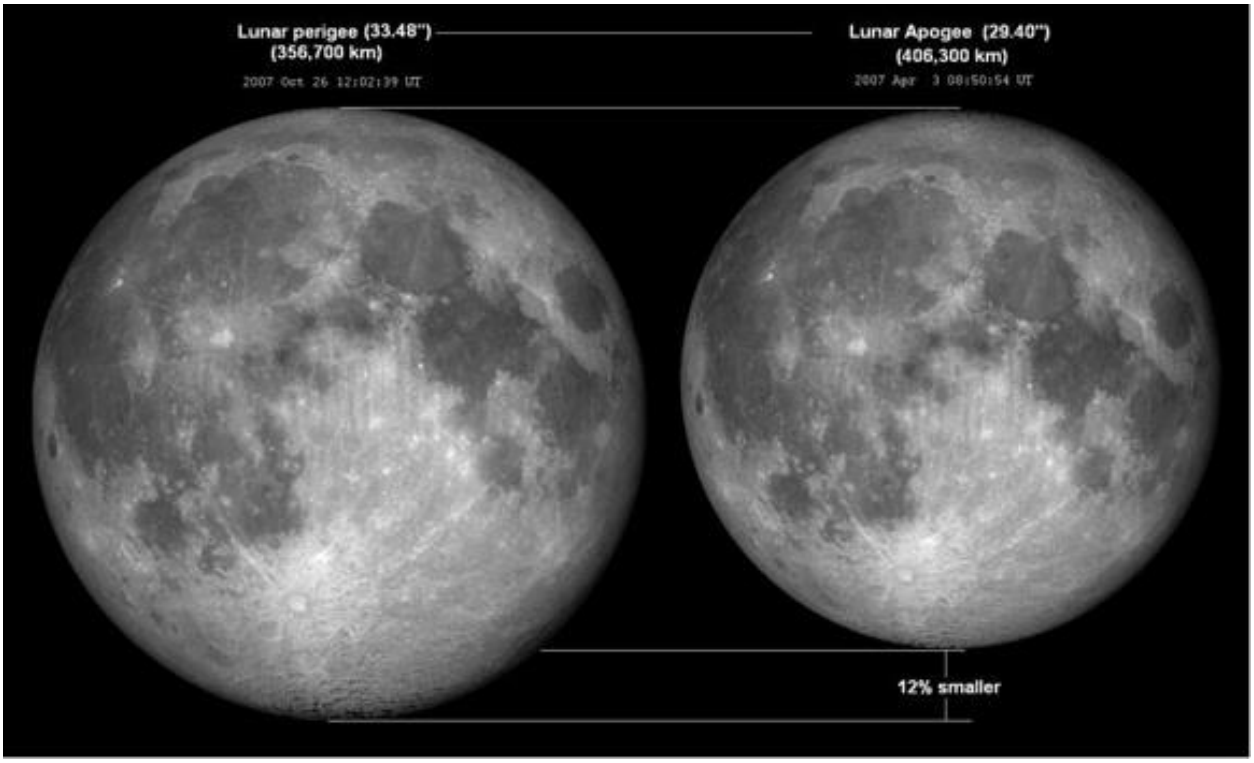

image 8 Lunar perigee and apogee in figures (http://earthsky.org/astronomy-essentials/close-and-far-Moons-in-2016)

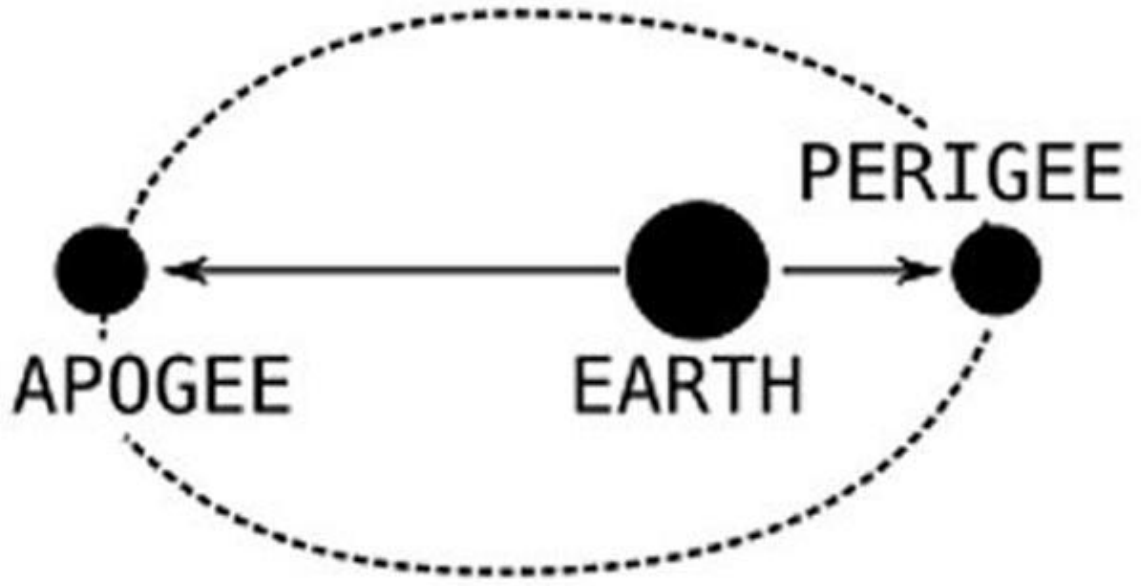

image 9 Perigee's and apogee's scheme
(http://www.wpclipart.com/space/diagrams/apogee_and_perigee.png.html)

image 10 Difference between Super Moon and Micro Moon (https://www.timeanddate.com/astronomy/Moon/lunar-perigee-apogee.html)

image 11 Model of Perigee syzygy (Picture taken by the author.)

image 12 Model of Apogee syzygy (Picture taken by the author.)

image 13 Working on our Model (Picture taken by the author.)

image 14 ,,Pasauli apbur valdzinošais supermēness.’’

(http://www.kasjauns.lv/lv/zinas/236178/pasauli-apbur-valdzinosais-supermeness-foto-video)

image 15 ‘’Supermēness visapkārt pasaulē’’

(http://spoki.tvnet.lv/foto-izlases/Supermeness-visapkart-pasaule/814202/1/2)