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Software-Based Astronomy Education Improvement Of The Methodology

Avezmuratova Zebo Allayarovna,
UrDPI, "Physics, mathematics and technological educational sciences"
Associate Professor of the Department of Medical Sciences

Abstract: STELLARIUM measured the results on June 22 and December 21-22 using a protractor or theodolite in the open sky for 24 hours. Of course, the results of practical measurements of students, schoolchildren and young astronomers leave a deep memory in them.
Key words: Observatory, meridian, Moon, Sun, astrolabe, "Zizhi Coragona", "Ziz"i, geocentric, heliocentric, Ecliptic, STELLARIUM.

Since the earliest times (1000 BC), people have been interested in measuring the distance of the Ecliptic to the Equator. It will be very interesting to measure this issue with students and students in the teaching of astronomy. Here are some simple methods.

It is known that all the luminaries in the sky are constantly rotating from East to West around the PP axis, as if fixed in a sphere called the celestial sphere (Fig.1).

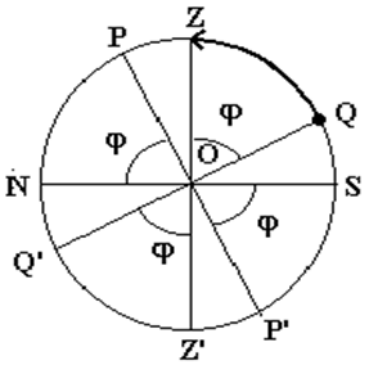

Figure 1.

Figure 1A. The celestial sphere main points, axes and planes

Figure 1. It is called PP' axis (universal axis). A large plane perpendicular to it is called the celestial equator. The plane of the celestial equator divides the celestial sphere into two hemispheres (Northern and Southern).

The plane on which the observer stands is called the horizon plane (NS). This plane is perpendicular to the observer's position on the Earth and is always in the center of the Celestial sphere. The horizon plane has 4 cardinal points. E-East, S-South, W-West, N-North.

The crossing of the meridian by the luminaries is called the culmination. The passage of the sun through the culmination is called twilight for this place. So, all lights cross the meridian during one day. This culminating situation is of great importance. At the time of culmination, the height of the luminaries above the horizon is measured and provides solutions to many astronomical calculations. That is why the arc of the device of the Mirzo Ulugbek observatory with a radius of 40.2 m is located on the meridian plane. Based on this device, the distance of the ecliptic to the celestial equator was accurately measured by Ulugbek for his time.[1].

The circular path showing the annual movement of the Sun in the celestial sphere is called the ecliptic. The difference between the plane of the ecliptic and the plane of the equator is currently 230 27I. Over the years, this pattern has changed. Scientists have been interested in this mass for a long time and have been measuring it. For example, the Chinese astronomer Chu Kong measured 1100 BC. Often, this angle of inclination is denoted by the Greek letter Ɛ (epsilon). We present the Ɛ value of ogma determined by astronomers who lived in different eras.

Eratosthenes, 230 BC 23° 51/ 20// error + 7/ 55

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Hipparchus 130 BC	23° 51/ 20// xato +8/ 23//
Ptolemy 140 AD	23° 51/ 20// xato +10/ 10//
Al Battani 880 AD	23° 35/ 00// xato - 0/ 17//
As Sufi 965 AD	23° 33/ 45// xato -0/ 50//
Abul Wafa 987 AD	23° 35/ 00// xato +0/ 35//
Al Kuhi 988 AD	23° 51/ 01// xato +16/ 36//
Ibn Yunus 1001 AD	23° 34/ 52// xato +0/ 33//
Nasriddin Tusi 1270 AD	23° 30/ 00// xato -2/ 09//
Ulugbek in 1437 AD	23° 30/ 17// xato -0/ 32//

It can be seen from these data that Mirzo Ulugbek's measurement had the least error or the highest accuracy.[2]

Everyone can measure obesity in different ways. According to the theory from Fig. 2, the height of the north pole relative to the horizon for an observer at the northern latitude of the Earth $h_p=\varphi$ can be used under the condition of equality of the geographical latitude of this place.

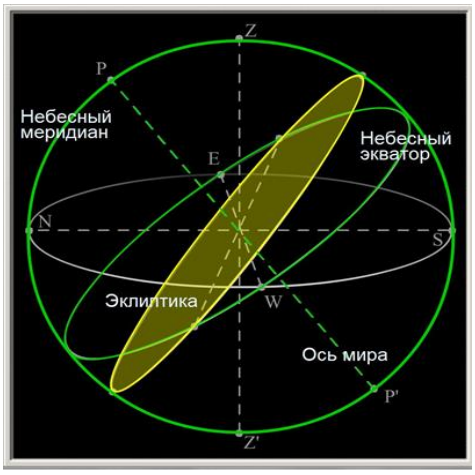

Figure 2

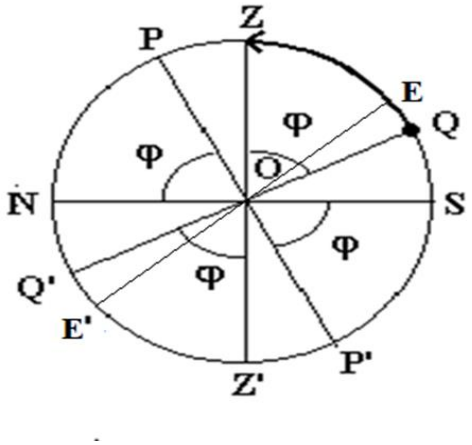

Figure 2A

Figures 2 and 2A show the celestial meridian (green solid circle) PZSPIZIN, the celestial equator (green oval circle) and the ecliptic plane (yellow plane).

The density (Ɛ) can be measured in a simple way using the Stellarium program [3]. Depending on the conditions of the school or academic lyceum, it is possible to conduct measurements with pupils and students. Al-Khwarizmi also used such a simple method. They determined the kilmination of the Sun by measuring the height of the summer and winter solstice.

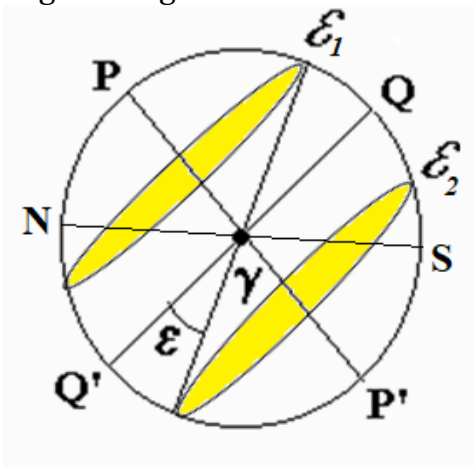

Figure 3

It is known from Figure 3 that on June 22, the Sun deviates from the equator at its maximum Ɛ1 and reaches its maximum height at the culmination relative to the horizon where the observer is standing. Al-Khorazmi measured the height of the Sun above the horizon on such a day and determined the geographic width of the place.

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On December 21-22, the winter solstice, the Sun deviates minimally from the equator and reaches a minimal height at the culmination relative to the horizon. On June 22, the Sun moves along the Ɛ1 -day parallel (Figure 3). On December 21, the Sun moves along the Ɛ2-day parallel. Both of these Ɛ1 and Ɛ2 figure 3 are symmetrical parallel to the celestial equator and lie at the same arc distance.

That is, it can be seen that Ɛ1Q͡=Q͡Ɛ2=Ɛ. Ɛ1Q͡+Q͡Ɛ2=2Ɛ. in which Ɛ1Q͡=Q͡Ɛ2 is measured by the arcs of the circle. It can be seen that if the summer solstice height of the Sun measures 2 - and the winter solstice height of the Sun on December 22 measures

hyoz - hqish= Ɛ1Q͡+Q͡Ɛ2=2Ɛ

it can be seen.

Considering that this work is an ancient issue, it arouses interest among readers and students. Now we live in the era of advanced information technologies. This work can be done on the basis of the STELLARIUM program. If we enter the STELLARIUM program at any time of the year without waiting for June 22 or December 21, set the time to June 22, and observe that the center of the Sun crosses the meridian line, the Sun will appear in the upper left corner of the screen in relation to the horizon during the culmination. shows azimuth and height h. Below are two such pictures.

Figure 4 shows the culmination of the Sun for the city of Urganch on 06/22/2024 at 12 hours, 57 minutes, 33 seconds, when the culmination of the Sun crosses the meridian. The parameters are shown on the upper left side of the image. According to it, the height of the Sun is hyoz =71052/43//.

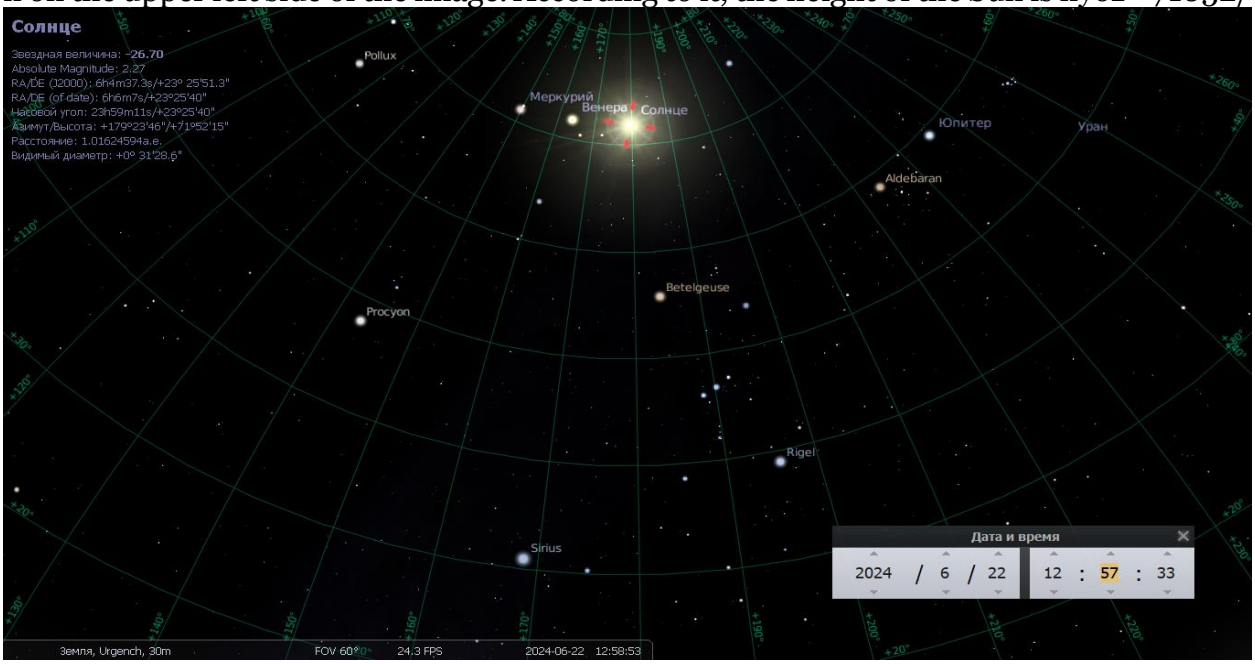

Figure 4. Summer solstice on June 22, 2024

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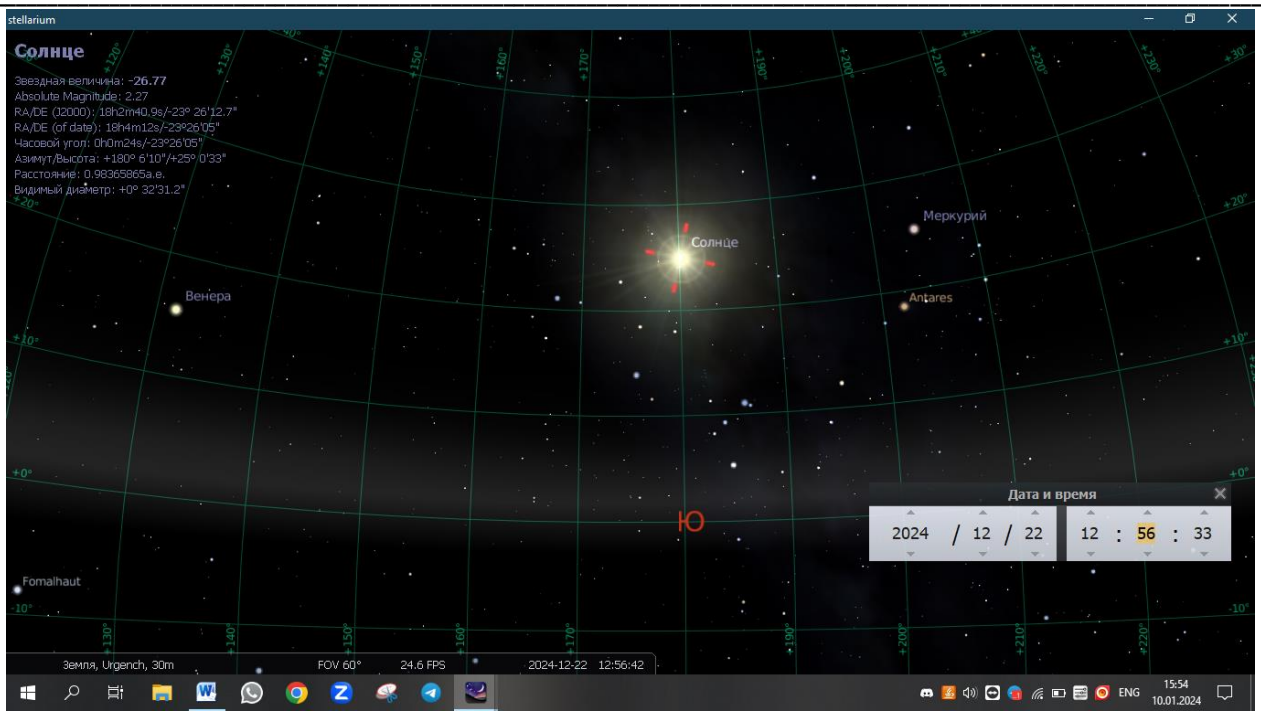

Figure 5. Winter solstice on 12.22.2024

This image from the STELLARIUM program shows the time when the Sun's culmination crosses the meridian at 12 hours, 56 minutes, 33 seconds Tashkent time for the city of Urganch on December 22, 2024. The parameters of the Sun are given in the upper left part of the picture. According to it, the height of the Sun relative to the horizon at the winter solstice is hqish =25000/34// according to the above formula, we replace hyoz-hqish =2 Ɛ [3].

$2Ɛ=71^{0}52/-25^{0}00$ $2Ɛ=46^{0}52/$ $Ɛ=23^{0}26/$

So, the value we calculated using the STELLARIUM program turned out to be the difference between the ecliptic plane and the equatorial plane Ɛ=23026/. In the literature, Ɛ=23027/ is indicated, the error is 1 minute. Such monitoring can be done for the desired city or region. Of course, there are measurement errors. Later, the results measured using the STELLARIUM program can be carried out on June 22 and December 21-22 using a protractor or theodolite in the open sky, during the day. Of course, the results of practical measurements of students, pupils and young astronomers leave a deep memory in them. Students' interest in astronomy will increase. Currently, Uzbekistan's astronomy is recognized by world scientists. It will contribute to the development of strong astronomers in Uzbekistan in the future.

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