STUDYING THE MAIN ELEMENTS OF THE CELESTIAL SPHERE IN THE LABORATORY LESSONS OF THE ASTRONOMY COURSE

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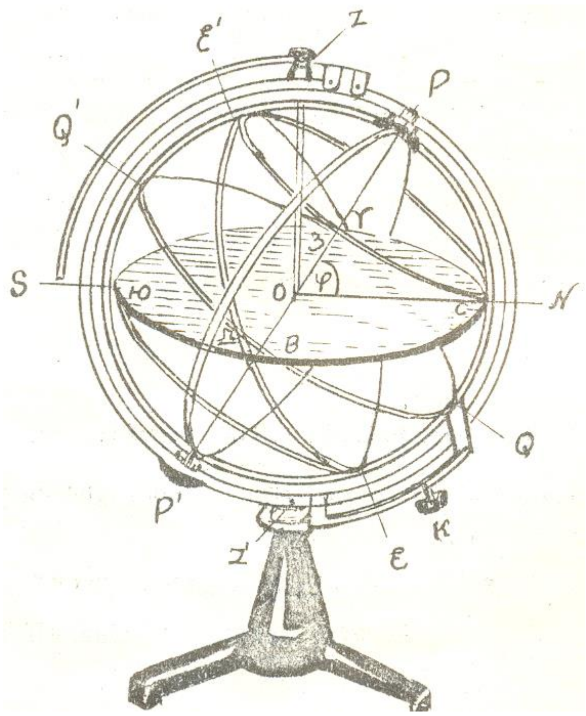
Abstract. *By studying the main elements of the celestial sphere in the laboratory classes of the astronomy course, students strengthen their theoretical knowledge of astronomy and learn to apply it in practice.*

Keywords: *celestial, equator, divides, celestial, convenient to study.*

It is very convenient to study the main elements of the celestial sphere with the help of a model of the celestial sphere and a moving map.

The observer is assumed to be at the point O = at the center of the celestial sphere model, $OZ -$a plane perpendicular to a vertical line is called a dream line, PP′ = a circle in the plane perpendicular to the axis of the universe (around which the celestial sphere apparently rotates) QQ′ = represents the celestial equator. The celestial equator divides the celestial sphere into the northern and southern hemispheres.

The points N, E, S, W on the mathematical horizon represent the north, east, south, and west points, respectively. Great circles passing through zenith Z and nadir - Z′ are called vertical circles. Vertical semicircles whose plane is perpendicular to the plane of the celestial meridian and passing through the east and west points are called the first verticals. Circles whose planes are parallel to the mathematical-horizon plane are called circles. $\varepsilon\varepsilon'$ the large circle represents the ecliptic, which is located at an angle of ε = 23°27′ relative to the equator. The ecliptic intersects the celestial equator at the vernal and autumnal equinoxes. Large semicircles passing through PP′ represent deviation circles. In astronomy, the declination circle is not a complete circle, but a semicircle passing from the P pole to the P′ pole. With the help of deviation circles, it is very convenient to demonstrate that the deviations of illuminants do not change during the day. At point Z, which represents the zenith in the model, there is a wire strip (equal to a great circle) attached to a movable ruler, which has an iron star stud. It is convenient for displaying the astronomical coordinates of iron bars and starlights. Circular metal wires, whose planes are parallel to the equator and are placed far from it $\pm 23^0 27'$, represent two diurnal parallels. They are very convenient in showing the daily path of the Sun at the points of solstice and the conditions for the luminaries not to rise or set. They are indicated by circles ε′



N and S ε. Here, ε represents the points of the summer solstice, and ε′ represents the points of the winter solstice. In the model, the yellow sphere attached to the deviation circle marks the Sun. It facilitates the study of the daily and annual movement of the Sun and the time systems related to the Sun.

The circle passing through the pole and the zenith represents the celestial meridian. Due to the apparent movement of the celestial sphere, each luminary crosses the celestial meridian twice a day. When the moving part of the model is rotated around the axis of the universe, when the star marking the illuminant crosses the meridian (R) south of the pole, the state where the lamp is at its peak, When it crosses (R) on the north side, it can be shown its position at the lower culmination. The distance of the illuminant from the zenith at the top culmination: $Z = \pm(\varphi - \delta)$ while at the lower culmination, $Z = 180^0 - (\delta + \varphi)$ is found with the expression.

By turning the K-screw at the bottom of the model, it is possible to change the angle of the universe axis with the mathematical horizon plane $(h_p = \varphi_{ни})$, that is, the model can be adapted to different geographical areas. After setting the model to the given geographic latitude, the K-screw is tightened. It is possible to adjust the model to different geographical latitudes and show how the appearance of the starry sky changes during the day.

TASKS

1. Find the universal axis, vertical line, meridian, mathematical horizon and equator circles, ecliptic, north, south, east and west points on the celestial sphere model. Adjust the model to the geographical latitude where you live, and determine the angles formed by the elements of the celestial sphere: the axis of the universe, the vertical line, the dream line, the mathematical horizon and the plane of the celestial equator.
2. At 21:00 on the date of performing this laboratory work, the main elements of the celestial sphere: the north pole of the universe, the vertical line, the axis of the universe, the celestial meridian, the mathematical horizon, the celestial equator, the approximate positions of the north, south, east, and west points in the sky. specify. Using the scroll map, determine the constellations located near the celestial meridian, the mathematical horizon, the equator of the universe.
3. In the model of the celestial sphere, roughly determine the equatorial coordinates of the poles of the universe - P, P′, the main points of the ecliptic E, E′.
4. Unscrew the K-screw of the model $\varphi = 90^0$, $\varphi = 66^0 33'$, $\varphi = 0^0$ adjust for extensions and geographic extension (φ)notice that the appearance of the celestial sphere and the mutual situations of the main directions and planes also change with the change. Find on the scrolling map which constellations do not set in the area where you live, and observe them in the evening sky.
5. Estimate the Z = zenith distances of the stars Shedar, Algol and Arcturus at the high culmination from the displacement map and, using the necessary formulas, calculate the exact values of Z - and estimate the position of these stars in the sky sphere model.

WORKSHOP REPORT

Expansion φ=

Elements of the celestial	The angle formed by the elements of the celestial sphere

sphere	With the mathematical horizon plane	With the plane of the celestial equator
The axis of the universe		
Vertical line		
Dream line		

constellations near the elements in the celestial sphere at 21 hours of the day when the laboratory worked:

Near the pole of the universe ...
Close to Zenith...
Near the mathematical horizon ...
Close to the celestial equator...
Outgoing...
Sinking ...
High climax ...

№	Points of the celestial sphere	α	δ
1	P		
2	P′		
3	γ		
4	Ω		
5	E		
6	E′		

	The occupied position of the element	$\varphi = 90^0$	$\varphi = 66^0 33'$	$\varphi = 0^0$
	Axis of the universe (relative to the vertical line)			
	Equator (relative to the horizon)			

$\varphi = 90^0$, $\varphi = 66^0 33'$, $\varphi = 0^0$ the view of the stars in the sky ...

Where you live. . . constellations do not set.

Stars at the top	δ	φ	Z	The position of the star in relation to the zenith		
				δ>φ	δ<φ	δ=φ
Shedar						
Algol						

Arktur						

$\delta\rangle\varphi$ and $\delta\langle\varphi$ formulas used to find the star's distance from the zenith.

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