# Practical round. Problems to solve

## 6. The extinction in terrestrial atmosphere.

Extinction is a term used in astronomy to describe light attenuation due to its absorption and scattering.

A star was observed at different zenith distances during one night at the Engelgardt's Astronomical Observatory in the program of atmospheric extinction study at blue. Astronomers use parameter X, air mass, as an extinction characteristic. This parameter corresponds to relative length of the ray's way in the atmosphere. That means X = 1 for zenith, $X = 2/3^{1/2}$ for z = 30°; X = 2 for z = 60° and so on.

The determination of the star's brightness was performed with the method of photon counting. The 3rd column includes number n – the quantity of photons which were detected during one second. A luminescent source was used for calibration the data of observations. It produces a stable flow of photons N = 9900 ± 100 per second, which is equal to magnitude mb = 9.64$^m$ beyond the terrestrial atmosphere.

| z | X | n | Δmb |
|---|---|---|---|
| 39.7 | | 15135 | |
| 45.6 | | 13816 | |
| 49.5 | | 13180 | |
| 53.0 | | 12246 | |
| 54.9 | | 11800 | |
| 58.2 | | 10089 | |

**6.1.** Draw the table (similar to that you see right) in your answer book. Calculate the air mass for given zenith distances in 1st column, and write the result into the 2nd column.

**6.2.** Calculate relative magnitude of the star Δmb (blue), and write the result into the 4th column. Use the luminescent source as standard for the relative magnitudes.

**6.3.** Find functional relation between Δmb and X with a help of graphical method.

**6.4.** Determine the magnitude of this star as it was observed in zenith.

## 7. Variable star.

A variable star was explored at the RTT-150 Russian-Turkish telescope in 2003. The observations were performed during whole night at the first time, the 1st table. The brightness of the variable star was measured occasionally during the other nights, and moments of maximal values of brightness (15.59$^m$) were received on nights 2–5, the 2nd table. The time is in Julian days, and $m_V$ is the yellow spectral colour magnitude.

| JD | $m_V$ |
|---|---|
| 2452805.3543 | 16.67 |
| 2452805.3712 | 16.57 |
| 2452805.3869 | 16.03 |
| 2452805.4026 | 15.69 |
| 2452805.4161 | 15.59 |
| 2452805.4512 | 15.80 |
| 2452805.5152 | 16.14 |
| 2452805.5848 | 16.32 |
| 2452805.6676 | 16.58 |
| 2452805.7734 | 16.68 |
| 2452805.8421 | 16.63 |
| 2452805.8643 | 16.62 |
| 2452805.9068 | 16.73 |

| N | JDmax | $m_V$ |
|---|---|---|
| 1 | | 15.59 |
| 2 | 2452830.5089 | 15.59 |
| 3 | 2452831.5772 | 15.59 |
| 4 | 2452839.5858 | 15.59 |
| 5 | 2452854.5340 | 15.59 |

**7.1.** Plot the light curve (magnitude vs time function), determine the moment of maximum in the first night and write result (in Julian days) in form of «$T_0$ = …».

**7.2.** Calculate the period of the variable star using the data of *all 5* nights. Here period means the time between two closest maximums of the brightness. But actually astronomers usually do not know how many periods were passed between two observed maximums, because appropriate weather can not be same every day and a few periods can pass between two observed maximums.

**7.3.** What type of variable star is this – eclipsing binary or pulsating variable star. (Write in English: **Eclipsing** or **Pulsating** respectively.)

## Practical round. Problems to solve

**6. The extinction in terrestrial atmosphere.**

Extinction is a term used in astronomy to describe light attenuation due to its absorption and scattering.

A star was observed at different zenith distances during one night at the Engelgardt's Astronomical Observatory in the program of atmospheric extinction study at blue. Astronomers use parameter X, air mass, as an extinction characteristic. This parameter corresponds to relative length of the ray's way in the atmosphere. That means X = 1 for zenith, $X = 2/3^{1/2}$ for $z = 30^\circ$; X = 2 for $z = 60^\circ$ and so on.

The determination of the star's brightness was performed with the method of photon counting. The 3rd column includes number n – the quantity of photons which were detected during one second. A luminescent source was used for calibration the data of observations. It produces a stable flow of photons N = 9900 ± 100 per second, which is equal to magnitude $mb = 9.64^m$ beyond the terrestrial atmosphere.

| z | X | n | Δmb |
|---|---|---|---|
| 39.7 | | 15135 | |
| 45.6 | | 13816 | |
| 49.5 | | 13180 | |
| 53.0 | | 12246 | |
| 54.9 | | 11800 | |
| 58.2 | | 10089 | |

**6.1.** Draw the table (similar to that you see right) in your answer book. Calculate the air mass for given zenith distances in 1st column, and write the result into the 2nd column.

**6.2.** Calculate relative magnitude of the star Δmb (blue), and write the result into the 4th column. Use the luminescent source as standard for the relative magnitudes.

**6.3.** Find functional relation between Δmb and X with a help of graphical method.

**6.4.** Determine the magnitude of this star as it was observed in zenith.

## Practical round. Problems to solve

**7. Spectral observations.**

Astronomer performed spectral observations of a single star at the one and a half meter KFU telescope RTT-150 during a year. The spectrograms with marks of observation time are given to you for analysis (see separate sheet).

The abscissa is wavelength, the ordinate is intensity in arbitrary units. Spectra are shifted by Y-axis for better visibility. The same spectrum with laboratory wavelengths is drawn by the bold line.

It's recommended to measure at least two spectral lines for better accuracy.

| date | λ(measur) | Δλ | Vr |
|---|---|---|---|
| | | | |

**7.1.** Draw a table in form of the above example (columns 2, 3, 4 must be replicated as much, as many lines you measured). Calculate the radial velocity Vr of the star on each date, the results of measurements and write calculations into the table.

**7.2.** Plot the radial velocity curve, the graph of Vr vs time function.

**7.3.** Find equatorial coordinates of the star.

**7.4.** Indicate the accuracy of radial velocity in your measurements.

**Рис. к задаче 7.** **Fig. for problem 7.**