



## Practical round. Problems to solve

### 7. Distance to the galaxy NGC 4214

The usage of novae in outbursts as distance indicators is based on the correlation of their absolute magnitudes at maximum brightness with their rates of decline. The simplified relationship between the absolute magnitude at maximum of a nova and its rate of decline may be expressed through the linear expression:

$$M_{Vmax} = a + b \log t_2, \quad (1)$$

where  $a$  and  $b$  are constants to be determined using observational data of a certain number of galactic novae with spatially resolved shells,  $t_2$  is the rate of decline, i.e. the time (expressed in days) that it takes the nova to drop by 2 magnitudes below its light maximum.  $t_2$  should be evaluated from the graph of the light curve of a nova.

**7.1.** Using data of Table 1 determine the constants  $a$  and  $b$  in the expression (1). The results of the calculations should be written in Table 1a. A graph template (Fig. 1a) should be used for determination of constants  $a$  and  $b$ .

**7.2.** Using the obtained expression and photometric data of a nova, which erupted in the galaxy NGC 4214, calculate the distance to this galaxy. Photometric data of this nova are given in Table 2. A graph template (Fig. 2a) should be used for the plot of the light curve of the nova.

*Data of Table 1:*

- 1<sup>st</sup> column is the number of the nova;
- 2<sup>nd</sup> – the time of the maximum brightness of the nova,  $T_0$ , in Julian Days (JD);
- 3<sup>rd</sup> – the apparent magnitude of the nova at maximum brightness,  $m_{Vmax}$ ;
- 4<sup>th</sup> – the rate of decline, i.e. the time that it takes the nova to drop by 2 magnitudes below maximum,  $t_2$ , in days (d);
- 5<sup>th</sup> – the angular radius of the expanding shell of the nova,  $\theta$  (in arcsec);
- 6<sup>th</sup> – the time of the measurement of the radius of the nova shell,  $T$ , in Julian Days (JD);
- 7<sup>th</sup> – the rate of expansion of the shell of the nova,  $v$ , in km/s;
- 8<sup>th</sup> – the interstellar extinction in the direction of the nova,  $A_V$ .

*Data of Table 2:*

- 1<sup>st</sup> column is the time of observation in Julian Days (JD);
- 2<sup>nd</sup> – the apparent magnitude of the nova.

Table 1. Data of the galactic novae for determination of the constants  $a$  and  $b$ ;

Table 2. Observations of the nova in NGC 4214;

Table 1a. Results of calculations of the parameters of the galactic novae;

Fig. 1a. Graph template for determination of the constants in the expression (1);

Fig. 2a. Graph template for the plot of the light curve of the nova NGC 4214.