

Observatoriumspraktikum Nordkuppel

KENN Michael, 8725258

11. März 2011

Zusammenfassung

In the context of the Observatoriumspraktikum SS2011 we took pictures with the telescope in the Nordkuppel of the Institute of Astronomy in Vienna. The first task of this practical was to evaluate positions and magnitudes of five stars in the open star cluster NGC956, using the exact positions and magnitudes of eight given stars. In the second part a 'pretty picture' of the Orion Nebular (M42, NGC1976) should be created by coloring different bands in different colors.

1 Star identification in NGC956

1.1 Picturing NGC956

With the telescope of the Nordkuppel of the Institute of Astronomy in Vienna, we took 15 science pictures of the open star cluster NGC956. The exposure time was always 20 seconds. For calibration we used 10 BIAS exposures, 29 DARK exposures with exposure times between 20 and 120 seconds and 10 doom flat exposures. Calibration was performed with the calibration wizard of Maxim DL Pro 5. After individually calibrating the 15 science pictures, an auto star-matching alignment was carried out to create the master science file. For stable results, all merging was performed by using medians.

1.2 Evaluation of star positions

In the following, \vec{p} will be the coordinates of a star in pixel and \vec{s} the star position in right ascension (RA) and declination (DEC). The exact pixel

positions of the eight stars with known coordinates and the five stars with coordinates to be evaluated are provided by Maxim DL Pro 5. One will guess, that minimizing the error of the affine mapping

$$\vec{s} = \mathbf{A}\vec{p} + \vec{b}$$

will yield a satisfactory result. However, it has to be considered, that RA and DEC are not following the same scale, so error minimization should be done in the pixel domain:

$$\sum_{\text{stars 1-8}} |\mathbf{A}^{-1}(\vec{s} - \vec{b}) - \vec{p}|^2 \rightarrow \min$$

with \mathbf{A} being a 2×2 -matrix and \vec{b} a 2-dimensional vector to be determined. Unfortunately, star #1 was not in the frame and had therefore been neglected. Anyway, the remaining seven stars were sufficient to calculate the six unknown parameters in \mathbf{A} and \vec{b} ¹

$$\mathbf{A} = \begin{pmatrix} 0.073 & 0.021 \\ -0.221 & 0.784 \end{pmatrix}, \quad \vec{b} = \begin{pmatrix} 02\ 31\ 11.02 \\ +44\ 27\ 50.2 \end{pmatrix}$$

with an average/maximum error of 1.9 resp. 4.1² pixel. This induces the following coordinates for the stars A to E:

star ID	calculated		Δ to literature		Δ in pixel
	RA	DEC	RA	DEC	
A	02 32 33.49	+44 37 16,4	0.11''	-1.8''	2.7
B	02 31 26.79	+44 35 04,1	-0.02''	-0.6''	0.7
C	02 33 01.08	+44 33 09,5	-0.05''	0.7''	1.1
D	02 31 52.89	+44 31 08,3	0.10''	-0.5''	1.5
E	02 32 45.04	+44 29 56,5	-0.06''	0.8''	1.2

Note, that the sky section had been considered as a flat plane with orthogonal coordinates to meet the requirements with an affine mapping.

¹The solution can be easily evaluated with e.g. Mathematica or Excel

²star #2

1.3 Evaluation of star magnitudes

This task was also done with the provided software Maxim DL Pro 5. Since the pictures were taken in V-band, we could only interpolate the corresponding V-magnitudes. Calibration using stars #2 to #8 and inclusion of the exposure time of 20 seconds gave an average background magnitude of 24.05 ± 0.12 mag.

star	calculated	literature
A	11.99 ± 0.12	11.91 ± 0.30
B	12.16 ± 0.12	12.35 ± 0.31
C	11.02 ± 0.12	11.13 ± 0.08
D	12.90 ± 0.12	12.84 ± 0.31
E	11.93 ± 0.12	12.14 ± 0.18

In summary it can be said, that the results match our expectations.

2 Pretty picture of the Orion Nebula

The second task of this practical was to choose an object for coloring. We took the Orion Nebular (M42, NGC1976). Unfortunately we could only use two filters. With the $H\alpha$ -filter we took 10 pictures (exposure time 20 seconds), with the V-filter 20 pictures (exposure time 5 seconds). Calibration we did again with 10 BIAS, 10 DARK and 10 FLAT exposures each, using the calibration wizard of Maxim DL Pro 5. For alignment, the star-matching option gave best results.

Now for the coloring: Since we had pictures from only two spectral bands, the TWO-option in the 'Combine Color' menu of Maxim DL Pro 5 lend itself to be chosen. The Red/Green/Blue ratio on the picture below is 2:1:0 for the $H\alpha$ -filter and 0:1:2 for the V-filter.

However, comparison with a professional exposure [1] proofed, that at least we hit the right object.

Literatur

- [1] Wikipedia - Orion Nebula
http://en.wikipedia.org/wiki/Orion_Nebula



Abbildung 1: The Orion Nebular, RGB ratio for $H\alpha$ is 2:1:0, for V 0:1:2