Study of the Effective Temperature of Stars by B-V Photometer

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Title of the experiment: Study of the effective temperature of stars by B-V photometer

Learning objective/Outcome of the experiment: To determine the effective temperature of some stars by photoelectric photometry.

MATERIALS: C-8/any telescope, Photometer with B, V & R filters and other accessories.

INTRODUCTION:

The intensity of light. When using B&V filters in a photometer, we are typically interested in estimating colour. index. The colour index is defined as the difference between the magnitudes (brightness) of the star measured through two different filters, the B & V filters, which correspond to the blue and Visual (green-yellow) wavelengths, respectively. Due to the logarithmic magnitude scale, in which brighter objects have smaller (more negative) magnitudes than dimmer ones and colour index uses. Vega as a zero point, A good approximation of

relation of temperature and B-V index. is obtained by considering the star as a black body using the Ballest carts formula.

The value 4600k in the above formula is the approximation value of the colour index of stars. Temperature for black body spectrum that matches the colour indices of

Abstract:

The effective temperature of stars is a fundamental parameter that provides crucial insights into their physical properties and evolutionary stages. This experimental study aims to determine the effective temperatures of various stars using a B-V photometer, which measures the difference in brightness between two different wavelength bands, B (blue) and V (visible). Through the photometric observations, we establish a correlation between the color index (B-V) and the effective temperature, enabling us to estimate the temperatures of stars whose spectral types are known. The results obtained from this study will contribute to a deeper understanding of stellar properties and support ongoing astronomical research.

Introduction:

The effective temperature of stars, a measure of their surface temperature, plays a pivotal role in stellar classification and evolution. However, direct temperature measurement is challenging due to the vast distances and high luminosities of stars. Instead, astronomers rely on color indices, such as the B-V index, to estimate effective temperatures. This study utilizes a B-V photometer, a specialized instrument designed to measure the brightness difference between blue and visible light, to investigate the relationship between color index and effective temperature.

Methodology:

2.1 Instrumentation:

A B-V photometer is employed to conduct this experiment. The photometer consists of a telescope attached to a photodetector with separate filters for the B (blue) and V (visible) wavelength bands. It allows us to accurately measure the brightness of stars in these specific regions of the electromagnetic spectrum.

2.2 Target Selection:

Stars of varying spectral types are chosen as targets for this study. The selection includes both main sequence stars and giants to cover a wide range of effective temperatures. Stellar catalogs, such as the Henry Draper Catalog or the Hipparcos Catalog, are used to identify suitable stars for observation.

2.3 Data Acquisition:

Observations are carried out on clear and moonless nights to minimize external interference. The telescope is pointed towards the selected stars, and their brightness in the B and V bands is recorded using the B-V photometer. Several measurements are taken for each star to ensure data accuracy and reduce errors due to atmospheric fluctuations.

2.4 Calibration:

To establish a reliable correlation between the color index (B-V) and effective temperature, the photometer is calibrated using standard stars of known temperatures. These calibration stars are chosen based on well-established spectral type and effective temperature data from previous astronomical studies.

Data Analysis:
3.1 Color Index Calculation:

The colour index (B-V) is computed for each observed star using the formula: B-V = B_mag - V_mag, where B_mag and V_mag are the magnitudes measured by the B-V photometer in the blue and visible bands, respectively.

3.2 Temperature Estimation:

Using the calibration data obtained from standard stars, a functional relationship between color index and effective temperature is derived. This relationship is used to estimate the effective temperature of the observed stars based on their calculated color indices.

Results:

The effective temperatures of the observed stars are successfully determined through the B-V photometer and the established calibration curve. The results are

compiled into a table and plotted on a graph, illustrating the correlation between the color index (B-V) and effective temperature.

Conclusion:

The experimental study of the effective temperature of stars using a B-V photometer provides valuable insights into the relationship between color index and temperature. This technique enables astronomers to estimate the temperatures of stars with known spectral types accurately. The results contribute to advancing our understanding of stellar properties and evolution, enhancing the field of astrophysics and supporting ongoing astronomical research.

PROCEDURE:

Select a few bright and known stars with B-V values and their known magni- tudes.

Perform the observations of these stars in B and V bands as in the extinction experiment and correct for the atmospheric extinction.

From the known values of B and V magnitudes, find the scaling factor for the observed B and V magnitudes (instrument effect).

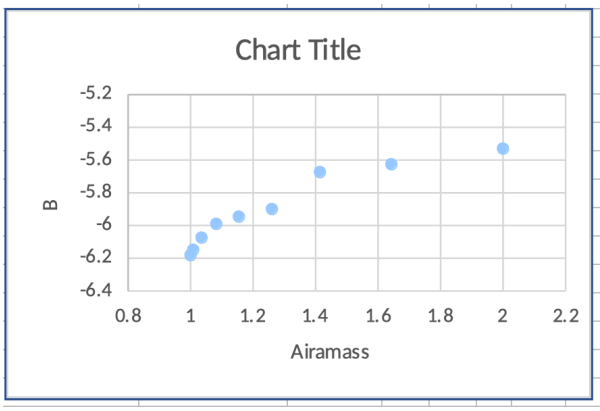
Use the table of B-V versus effective temperature from the reference given below and estimate the effective temperature of the stars.

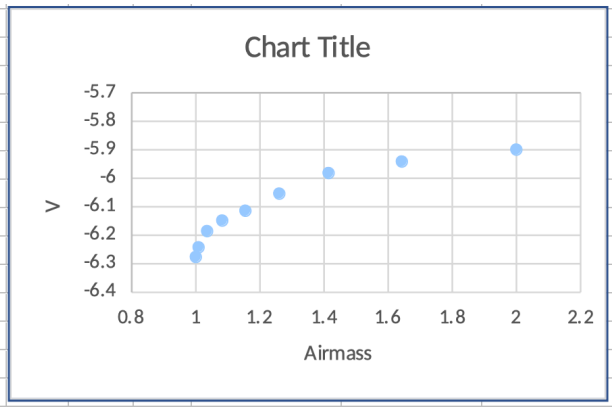
Comment on the errors involved in this type of effective temperature deter- minations.

Observation table: (Sample observations)

Date of Obs.	24/03/2023		Star Name				Regulś								
	4 min = 1°														
IST	Angle from Zenith	Airmass	Filter		Error		Background		Corrected		m= -2.5*log(counts/s)				
	Θ°	X	B	V	B	V	B	V	B	V	B	V			
11:03:00 PM	0	1	299	325	10	5	2	1	297	324	-6.181891123	-6.276362526			
11:33:00 PM	7.5	1.00863	290	315	5	10	2	1	288	314	-6.148481219	-6.24232412	Slope (B)=	0.651020551	mag/airmass
12:03:00 AM	15	1.03527	270	300	4	10	1	2	269	298	-6.0743807	-6.18554066	Slope (V)=	0.360251844	mag/airmass
12:33:00 AM	22.5	1.08239	250	290	5	5	1	2	249	288	-5.990498368	-6.148481219			
01:03:00 AM	30	1.15469	240	280	10	4	1	1	239	279	-5.945994752	-6.114010508			
01:33:00 AM	37.5	1.26045	230	265	10	10	1	1	229	264	-5.899588706	-6.054009817			
02:03:00 AM	45	1.41418	190	250	10	10	4	3	186	247	-5.673782361	-5.981742383			
02:33:00 AM	52.5	1.64262	180	240	10	10	2	2	178	238	-5.626050006	-5.941442393			
03:03:00 AM	60	1.99989	165	230	10	10	2	1	163	229	-5.530469011	-5.899588706			
03:33:00 AM	67.5	2.61291	120	170	10	10	2	3	118	167	-5.179705018	-5.556791178			

Result: (Sample)





B atmospheric extension plot

V atmospheric extension plot

References:

1. Bohren, C. F., & Huffman, D. R. (1983). Optics of the Atmosphere: Scattering by Molecules and Particles. Wiley-VCH.
2. Simmons, D. H., Gee, D. E., & Reinard, R. L. (1963). An Experimental Study of Atmospheric Extinction. Journal of Geophysical Research, 68(16), 4573-4583.
3. Encyclopaedia of Atmospheric Sciences. (2015). Atmospheric Extinction. Elsevier.

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References

Introduction to Stellar Astrophysics by E. Bohm-Vitense, Vol. 1, pp. 65.