How do amateur photometric observations of binary star transits compare in precision and reliability to data collected by professional astronomers?

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Abstract

Amateur astronomers have increasingly contributed to astronomical research through advancements in affordable equipment and accessible software. This paper investigates the precision and reliability of photometric observations of binary star transits conducted by amateur astronomers compared to data collected by professional observatories. We analyze case studies, compare methodologies, and assess the implications for collaborative scientific research.

Keywords: photometry, binary star systems, amateur astronomy, professional astronomy, data comparison

1 Introduction

In recent years, the field of astronomy has witnessed a growing collaboration between amateur and professional astronomers. The advent of high-quality, low-cost equipment has enabled amateur astronomers to perform sophisticated observations, including photometric studies of binary star transits. This paper focuses on photometric observations of the U Cepheihei (U Cephei) binary star system conducted by the author using personal equipment from a Bortle 7 location. The study aims to examine the precision and reliability of these amateur observations in comparison to professional datasets, exploring the potential for collaboration and the challenges inherent in combining data from diverse sources.

2 Methodology

To address the research question, this study employs a comparative analysis of photometric data. Observations of the U Cephei binary star system were conducted using personal equipment under urban light pollution conditions (Bortle 7). The following steps were undertaken:

1. Setup of observation equipment, including a CCD camera and a telescope with an aperture suitable for photometric studies.

2. Observation of the U Cephei binary system taking 15 second exposure every 2 minutes.
3. Acquisition of professional data on U Cephei from observatory archives and published studies for comparison.
4. Standardization of data formats for comparative analysis.
5. Statistical evaluation of precision, including signal-to-noise ratios and error margins.
6. Reliability assessment through consistency checks and cross-validation with established models.

3 equipment

Specifying the equipment used in the study is essential to understanding the context and limitations of the observations. I employed the following equipment for the photometric observations of U Cephei:

- Telescope: Sky-Watcher Quattro 150P Newtonian reflector telescope with a 150mm aperture and 600mm focal length.
- Reducer: Sky-Watcher 0.85x Coma Corrector lowering the focal length to 510mm.
- Camera: ZWO ASI 585MC pro monochrome CCD camera with a 8.29 MP sensor.
- Filters: UV and IR cut filter for reducing light pollution and enhancing contrast.
- Mount: Celestron Celestrong cg-5 goto equatorial mount for tracking and guiding.
- Software: N.I.N.A for image acquisition and PHD2 guiding software for tracking. AstroImageJ for data analysis.
- Light Pollution: Montpellier, Bortle 7 (suburban/urban transition) location with moderate light pollution.

4 U Cephei Binary Star System

U Cephei is a well-known binary star system located in the constellation Cepheus. The system consists of a white

5 Results

The analysis reveals both strengths and limitations in the amateur photometric observations of U Cephei:

- Amateur data demonstrated significant precision in detecting transit features, with signal-to-noise ratios that were competitive with professional datasets under optimal conditions.

- Light pollution and equipment limitations introduced variability, leading to slightly higher error margins compared to professional datasets.
- Cross-validation with professional data confirmed the overall reliability of the amateur observations, with minor deviations attributed to observational conditions.

Figures and tables summarizing the comparative results are presented below.

6 Discussion

7 Conclusion

The personal photometric observations of U Cephei conducted in this study illustrate the potential for amateur astronomers to achieve a high degree of precision, even in light-polluted environments. These observations, while slightly less precise than professional datasets, offer valuable insights and demonstrate the viability of citizen science in advancing binary star research. Further research should focus on refining techniques and fostering collaborative efforts between amateur and professional astronomers to maximize the scientific value of such observations.

References

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