STELLAR PHOTOMETRY AT THE NORTH ECLIPTIC POLE: THE CONTRIBUTION TO BACKGROUND STARLIGHT

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ABSTRACT. We performed UBVRI photometry in a 4.7° field of diameter centered on the North Ecliptic Pole, covering all 94 SAO stars and one planetary nebula. This represents the first step of an attempt to improve the knowledge of integrated starlight in this important viewing direction. The contribution of these bright stars to the integrated starlight is considerable (30–40%) and quite unevenly distributed. Therefore, surface photometry with large fields of view should be individually corrected for this contribution.

A reasonably accurate knowledge of background starlight is of interest in discussing models of the Galaxy. Probably the most reliable measurements have been done from space by the *Pioneer 10* and *11* and *Helios 1* and *2* space probes. These measurements still include the diffuse galactic light and, particularly for *Helios*, the zodiacal light. Ground-based observations of stellar background light at specific points are still useful. If accurate enough (to about 2%) they allow one to deduce by subtraction the diffuse galactic light—perhaps even the extragalactic component—from the space observations. In particular, observations at the North Ecliptic Pole (b = 30°), where both space experiments mentioned above performed measurements near the Earth's orbit, will help to intercompare and interrelate these two important data sets. These observations will help to improve on the reliability of our knowledge both of the galactic background light and the zodiacal light.

A determination of background starlight is not trivial because of the large interval in brightness to be covered and because of the large number of objects involved. Existing star counts (Tanabe and Mori 1989, this volume) lack a direct photometric calibration, which adds some uncertainty. We suggest a different approach, divided into three steps:

1. Measuring individual photometry of bright stars in the field.
2. Measuring the fainter stars' contribution by chopping against areas free of stellar images on the Palomar Sky Survey prints.
3. Extrapolating the contribution of the stars too faint to be visible on the Palomar Sky Survey from models of galactic structure.

Here we present results for the first step based on photometry on the 1.2 m telescope on Calar Alto between 1983 and 1989 (Figure 1). We studied 17 one-square-degree fields arranged regularly around the North Ecliptic Pole and obtained UBVRI photometry for the 94 SAO stars plus the planetary nebula PK 96+29.1, contained in this area. The accuracy, judged from the fits to standard star measurements and repeated measurements of the same star on different nights, is 1–2%; between three and ten objects fall into one square-degree field. Not unexpectedly then, the brightness contribution varies considerably from field to field. However, the variation is even larger than expected, ranging from 1.0 to 27 S_{10} in U, from 2.8 to 31 S_{10} in B, and from 5.5 to 44 S_{10} in V. The maxima are about the same as the value found by

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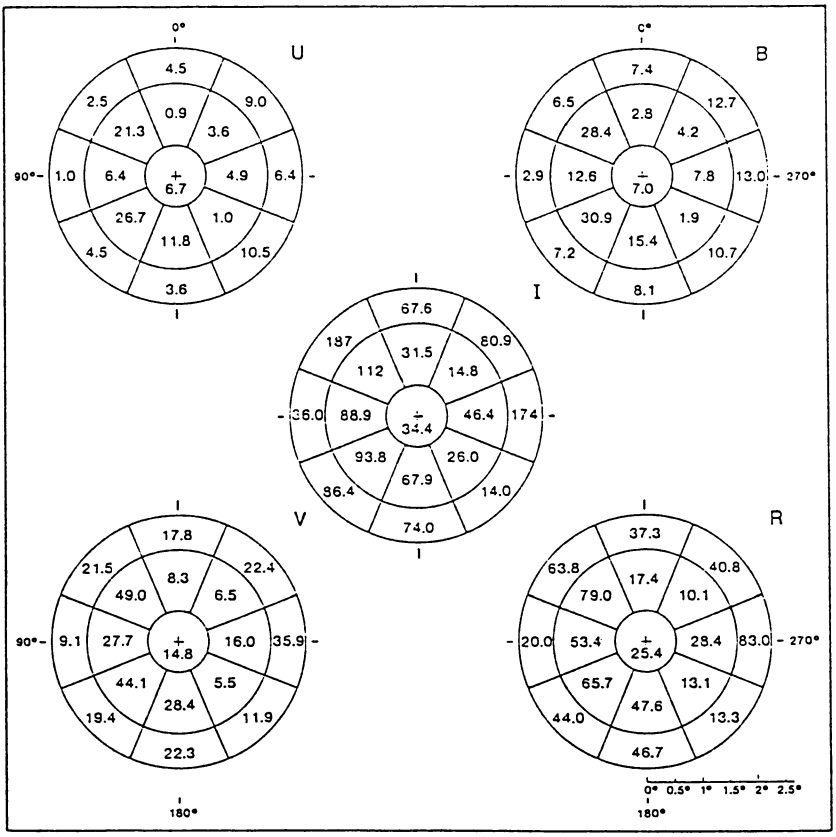

Figure 1. Integrated starlight contributed by SAO stars to 17 one-square-degree fields around the North Ecliptic Pole. The unit is S_{10} (equivalent stars of 10 mag per degree squared). At 550 nm, the unit corresponds to 1.2×10^{-8} W m^{-2} sr^{-1} μm^{-1}.

Tanabe and Mori (1989, this volume) for the total integrated starlight in a 3.5° × 3.5° field centered 1.2° east and 0.5° south of the North Ecliptic Pole. For quantitative work, the viewing direction "North Ecliptic Pole" therefore has to be defined accurately. This is particularly true for the two space experiments on *Pioneer 10* and *11* and *Helios 1* and *2* with their fields of view of several degrees. Here, a meaningful comparison is only possible if the individual locations of the fields of view are taken into account and bright stars are corrected individually. The present measurements make such a comparison feasible.

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REFERENCES

Tanabe, H. and Mori, K. 1989, in *Proceedings of IAU Symposium 139, Galactic and Extragalactic Background Radiation*, eds. S. Bowyer and Ch. Leinert, Kluwer Academic Publisher, Dordrecht, The Netherlands.