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Development of a wide-band optical filter optimized for deep imaging of small solar-system bodies

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We developed a newly designed wide-band optical filter and evaluated its performance. It is optimized for deep imaging of small solar-system bodies. The new filter, which we denote as *Wi*, is designed to reduce contamination by light pollution from street lamps, especially strong mercury and sodium emission lines. For the reasons that (1) much of artificial light pollution concentrates in the *V* band, (2) the photon numbers peak at a wavelength of 6350 $\AA$ in the spectrum of sunlight, and (3) many asteroids have their peak/plateau reflectance at around 7000 $\AA$ in the optical range, the new filter's cut-on wavelength is set to 5880 $\AA$ by using an OG590 Schott color glass filter. On the other hand, the cut-off wavelength, which is achieved by a short-pass interference coating, is set to 9380 $\AA$ in consideration of worst of the OH night sky emission and the atmospheric water vapor absorption band at 9400 $\AA$.

Compared with the use of a commercially available long-wave cut wide-band filter (*W* filter, 4900-9100 $\AA$), the sky brightness is 10-20 % reduced by the *Wi* filter under bright-sky conditions by not only artificial light pollution but scattered moonlight. In the detection of asteroids, the detected total flux of an asteroid through the *Wi* filter has been 3% larger than that through the *W* filter, though the width of the *Wi* filter response function is 16% narrower than that of the *W* filter. By using the *Wi* filter, the S/N ratios in the detection of asteroids were improved by about 6%, on average, compared with the use of the *W* filter, and the improvements were slightly larger in a brighter sky. The use of the CCD with high sensitivity at longer wavelength, such as the back-illuminated, fully-depleted CCD, will show a larger improvement in the S/N ratio by using the *Wi* filter.

Reference:
Wide-Band Optical Filter Optimized for Deep Imaging of Small Solar-System Bodies,
Okumura *et al*. Publications of the Astronomical Society of Japan, **64**, 47 (2012)

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