Brightness and Fluctuation of the Mid-Infrared Sky from AKARI Observations towards the North Ecliptic Pole

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We present the smoothness of the mid-infrared sky from observations by the Japanese infrared astronomical satellite AKARI. AKARI monitored the north ecliptic pole (NEP) during its cold phase with nine wavebands covering from 2.4 to 24 micron, out of which six mid-infrared bands were used in this study. We applied power spectrum analysis to the images in order to search for the fluctuation of the sky brightness. Observed fluctuation is explained by fluctuation of photon noise, shot noise of faint sources, and Galactic cirrus. The fluctuations at a few arcminutes scales at short mid-infrared wavelengths (7, 9, and 11 micron) are largely caused by the diffuse Galactic light of the interstellar dust cirrus. At long mid-infrared wavelengths (15, 18, and 24 micron), photon noise is the dominant source of fluctuation over the scale from arcseconds to a few arcminutes. The residual fluctuation amplitude at 200 arcseconds after removing these contributions is at most 1.04 +/- 0.23 nW m^-2 sr^-1 or 0.05% of the brightness at 24 micron and at least 0.47 +/- 0.14 nW m^-2 sr^-1 or 0.02% at 18 micron. We conclude that the upper limit of the fluctuation in the zodiacal light towards the NEP is 0.03% of the sky brightness, taking 2{\sigma} error into account.

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