ROCKET EXPERIMENT TO SEARCH FOR THE NEAR-INFRARED EXTRAGALACTIC BACKGROUND LIGHT

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ABSTRACT. A rocket experiment was carried out to search for the extragalactic background light at 1-5 μm. After subtracting the foreground radiation, there still remains an appreciable amount of isotropic diffuse radiation with a complex spectral feature which is possibly attributed to extragalactic origin.

1. OBSERVATION

The photometer consisted of 2 parts both of which had 4° beam. One was a wide band photometric channel, covering the following standard filter bands : J(1.27 μm), K(2.16 μm), L(3.8 μm) and M(5.0 μm), each of which had a lens of 14 mm dia. Another was a narrow band photometric channel consisting of two 26 mm dia. lenses and a filter wheel which rotated intermittently and covered 1-5 μm region with 10% spectral resolution. A Ge detector for J band and InSb detectors for others were used. The zero signal level was confirmed by closing the cold shutter every 35 seconds. The whole system was cooled below 60 K by solid nitrogen for better performance. The instrument was installed at the top of the rocket body with the optical axis parallel to the rocket axis.

The sounding rocket, K-9M-77, was launched on 14 Jan. 1984 at 04:30 JST (19:30 UT, 13 Jan.) from the Kagoshima Space Center of Institute of Space and Astronautical Science. At 282 sec after launch, the rocket reached the apogee at an altitude of 316 km. The lid of the cryostat was opened at 80 sec after launch, and the survey started according to the precession of the rocket.

2. DATA ANALYSIS

During the flight, bright stars such as γLeo were observed, whose fluxes were consistent with those expected from the pre-flight calibration with 10% accuracy.

The contribution of the atmospheric emission and the contamination of the environmental emission due to the rocket engine fuel exhaust etc.

A. Hewitt et al. (eds.), Observational Cosmology, 69–72.

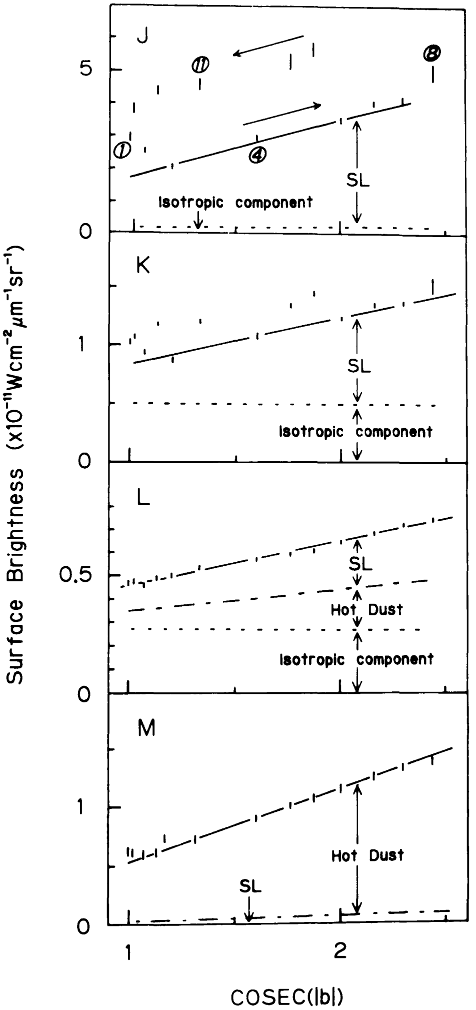

Fig.1. The observed surface brightnesses for the wide band channels are plotted versus cosec (b). The solid lines show the result of fittings. Breakdown of the observed surface brightness to the star light (SL), the isotropic radiation, and the new galactic component (Hot dust) is also shown.

was estimated from the altitude and temporal dependence of signals, and it was found to be negligible above 300 km altitude even for M band.

The earthshine was also observed at the longer wavelength bands when the optical axis approached to the earth limb. But the observed earth shine is consistent with off-axis response measured in the lab and can be neglected at the large elevation angle.

Stars brighter than 3 mag in K band were identified by the wide band channels and confirmed by reference to the IRC catalogue. The surface brightnesses for 13 regions where no such a bright star was observed are shown as functions of cosec (b) in Fig.1.

The J and K band data show a loop feature such that the sky at a higher ecliptic latitude has a lower surface brightness. This is attributed to the spatial distribution of the zodiacal light (ZL). We tried to look for the best fit combination for J and K which separates the observed brightness to three components, ZL, star light (SL) and isotropic radiation. Here, we assumed that color of ZL, (J-K), is constant and SL should be consistent with the model Galaxy[1,2,3]. The result indicates an upper limit for J but considerable amount of isotropic radiation for K.

A little different but a simple feature is seen at L and M. SL extrapolated from J and K can't explain observed galactic component and the new galactic component appeared (designated as "hot dust"). Again the isotropic component is clearly seen for L, but only upper limit was

https://doi.org/10.1017/S0074180900159042 Published online by Cambridge University Press

obtained for M. The break down to individual components is also indicated in Fig.1.

3. DISCUSSION

The spectrum observed at the galactic pole region is shown in Fig.2, where the systematic errors are included. The data of the narrow band channels are consistent with those of the wide band channels, and the component found at M can be represented by 310 ± 70 K blackbody. The isotropic component is also shown in Fig.2. The upper limit of EBL at the visible region[4] is also presented. In Fig.2 calculated EBL for two extreme cases is also shown[5]. Model 1 assumes no evolution for galaxies, while model 4 assumes that all He were synthesized in stars during early era of galaxy formation. The observed level is somewhat lower than model 4, but still considerably higher than model 1. Provided that the observed isotropic component is really extra-galactic origin, some activities at the early universe is required. Comparing our data with the recent observation of the smoothness of the sky at K[6], the fluctuation of EBL is so small that the observed isotropic radiation is hardly explained by the integrated light of the primeval galaxies. It may be worthy to mention that Carr et al.[7] predicted a similar line feature at the redshifted wavelengths for Lymann α due to the pregalactic pop. III objects.

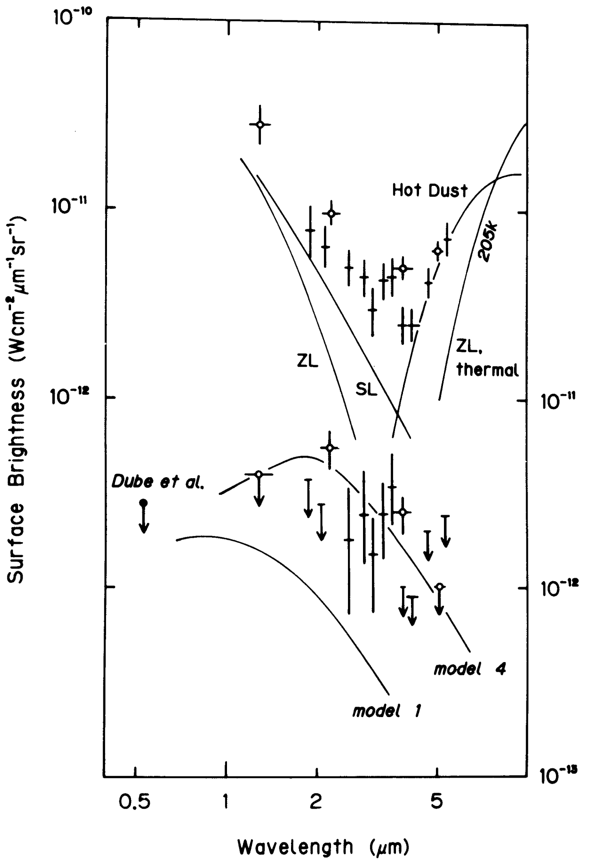

Fig.2. The spectrum of the observed surface brightness at the galactic pole region. Open circles and crosses are data of the wide and narrow band channels, respectively. The lower part shows the spectrum of the isotropic component. The unit of the surface brightness is indicated at the right side.

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