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「あかつき」搭載中間赤外カメラ

Longwave Infrared Camera onboard the Akatsuki spacecraft

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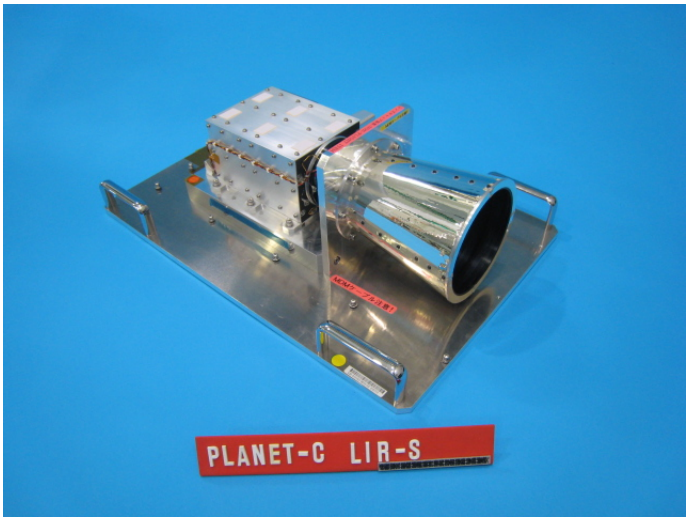

The Longwave Infrared Camera (LIR) is one of a suite of cameras onboard Akatsuki or the Venus Climate Orbiter, taking an image of thermal radiation emitted from the sulfuric acid cloud tops of the Venusian atmosphere with a single bandpass filter of 8-12 micrometer [1]. A horizontal wind vector field at the cloud-top height will be retrieved by means of a cloud tracking method. In addition, absolute temperature will be determined with an accuracy of 3 K. Since solar irradiation scattered by the atmosphere is much weaker than the atmospheric thermal radiation, LIR can continuously monitor a hemispheric wind field independent of the local time of the apocenter throughout the mission life of two years. Wind and temperature fields obtained by LIR together with data obtained by the other instruments will provide key parameters to solve the mechanisms of super rotation and meridional circulation. LIR will also depict variations of the polar dipole and collar which are characteristic temperature fields in the Venusian atmosphere. Origins of streaks, wave trains and cell-like structures found in the clouds will be investigated using a sequence of close-up images taken at the distance of 4-6 R_v.

The use of an uncooled micro-bolometer array (UMBA), which requires no cryogenic apparatus, as an image sensor contributes to the reduction of power consumption and the weight of the LIR imager. An instrumental field-of-view of 12 degrees is equal to the angle subtended by Venus when observed from a height of 9.5 R_v. The pixel field-of-view corresponds to a spatial resolution of 70 km viewed from the apocenter. A mechanical shutter functions not only as an optical shutter but also as a reference blackbody.

The temperature stability of the sensor is especially important, because fluctuation of thermal radiation from the internal environment of the sensor itself causes background noise. Temperature dependence of the output image counts has been evaluated for the flight model of LIR. The temperatures of the UMBA package and the shutter are stabilized at 313+/-0.1 K and 300+/-1 K to achieve the NETD of 0.3 K for the target temperature of 233 K, which is required for this infrared imager. It is confirmed that LIR can map the coldest region of Venusian cloud top of which brightness temperature is as low as 203 K. Flat field images are taken with the shutter closed several seconds before and after 1 s exposure for a Venus thermal image. 32 raw images are stacked in order to improve the signal-to-noise ratio. This measurement sequence is repeated nominally every two hours. Image data are transmitted down to the Earth after onboard calibration and reversible data compression by the common digital electronics. We will get a first infrared image of Venus taken by LIR in early 2011, when LIR will be a milestone of the planetary infrared imagery.

[1] Taguchi, et al., Adv. Space Res., doi:10.1016/j.asr.2007.05.085, 2007.