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# LIR onboard Venus Climate Orbiter

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LIR onboard the first Japanese Venus mission PLANET-C or Venus Climate Orbiter is an imager operating in the middle infrared region. LIR measures thermal radiation emitted from the cloud-top of the Venusian atmosphere. A horizontal wind vector field at the cloud-top height will be retrieved by means of a cloud tracking method. Absolute temperature will be also determined with an accuracy of 3K. Since solar irradiation scattered by the atmosphere is much weaker than the atmospheric radiation, LIR can continuously provide a hemispheric wind field independent of local time of the apocenter. Wind and temperature fields obtained by LIR will provide key parameters to solve climatological issues on the Venusian atmosphere.

LIR comprises a lens system including an optical band-pass filter, a hood, a mechanical shutter, an infrared focal plane array sensor, and a driving circuit. Use of an uncooled microbolometer array (UMBA) which needs no cryogenic apparatus contributes to reduction of power and weight. The UMBA is arranged as a 240×240 array of 37 $\mu$m square pixels. The instrumental field-of-view of 12° is equal to the angle subtended by Venus when observed from a nominal height of the apocenter of 10 Rv. The pixel field-of-view corresponds to a spatial resolution of 70 km. The sensitive spectral region is limited by a band-pass filter to 8 - 12 $\mu$m. The shutter functions not only as an optical shutter but also as a reference blackbody. Temperature stability of the sensor is especially important for reduction of background noise due to thermal radiation from the environment and precise sensitivity calibration. Temperature of the UMBA package is stabilized at 313± 0.1K with a Peltier cooler/heater. NETD of 0.3K, which is required for the scientific purpose, will be achieved. Radiation tolerance of the UMBA was evaluated by an experiment with a 100 MeV proton beam. It is confirmed that number of pixel defect unchanged after total dose of 30 kRad with fluence of 400 Rad/min.

A thermal infrared image is created by accumulation of 30 frames during 1 sec. Flat field images with the shutter closed are taken several seconds before and after exposure for a Venus image. After a Venus image is taken, LIR takes a cold calibration image of deep space. This measurement sequence is repeated every two hours while the spacecraft is in the apocenter part of the orbit. The depth of an image is 12 bits. Image data are transmitted down to the Earth after onboard calibration and data compression by a common digital electronics.

Keywords: Venus; Venusian Atmosphere, Venus Climate Orbiter, Thermal Infrared, Imaging, UMBA