Small-JASMINE: Current Status

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We have been investigating the validity of satellite system of Small-JASMINE. There is no fatal problem in the system at this present stage. We have changed the observational wave-length from K-band to H-band in 2010 in order to remove the refrigerator because it is too expensive. Accordingly we now investigate mainly the following points for the system.

◦ Cooling system using Peltier device
◦ Attitude of the satellite
◦ Baffle of the telescope

In addition to the above issues, we have picked up the following three important issues in order to achieve the aim of Small-JASMINE project[1]. (A) Small-JASMINE is required to measure the positions of stars with high accuracy from the huge amount of data during the observational period. (B) The high stabilization of the thermal environment in the telescope is required. (C) The attitude-pointing stability of these satellites with subpixel accuracy is also required. Here we concentrate on these three issues.

1 Measuring the positions of stars with high accuracy

Determination of positions of star images on a detector with high precision is very important. We will show the laboratory experiment that we can determine the positions of star images on the detector with high precision.

In order to accomplish such a precision, we take the following two procedures. (1) We determine the positions of star images on the detector with the precision of about 0.01 pixel for one measurement, using an algorithm for estimating them from photon weighted means of the star images. (2) We determine the positions of star images with the precision of about 0.0001–0.00001 pixel, which corresponds to that of 10 micro-arcsec, using a large amount of data over 100000 measurements. We have already shown the validity of the procedure (1). For the procedure (2), we have shown the expected accuracy of positions of stars using 100000 data by now.

2 The high stabilization of the thermal environment

Image on a detector is distorted if the telescope expands or shrinks by the variation of the thermal environment.

In order to accomplish a measurement of positions of stars with high accuracy, we must make a model of the distortion of the image on the focal plane with the accuracy of less than 0.1nm. We have investigated numerically that the above requirement is achieved if the thermal variation is within about 1 K /0.75h. We have investigated the validity of the following algorithm in order to determine the positions of stars.

◦ Distortions of the image of the first and second order are solved from the observational data of adjacent images.
◦ The displacement of higher order (higher than third order) is small enough to neglect.

We examine the thermal structure analysis and obtain the distortion of images on the focal plane. Then we calculate the displacement of each order.

We have ascertained that more than third order displacement is less than the required value of 0.1 nm. Then, our algorithm will work well.

3 The attitude-pointing stability of the satellite

We need high precision attitude-pointing stability with sub-pixel accuracy. Then, we develop a Tip-tilt mirror (TTM) servo system in order to achieve a pointing stability with an accuracy of 190 mas/7 sec. We use star images for correction of pointing error. Now we prepare for experiment of TTM servo system.

Reference

[1] Yano, T., et al.: 2011, *EAS Publications Series*, **45**, 449-452.