Available online at www.sciencedirect.com
ScienceDirect
ELSEVIER
Advances in Space Research 40 (2007) 595–599
ADVANCES IN SPACE RESEARCH
(a COSPAR publication)
www.elsevier.com/locate/asr

AKARI (ASTRO-F): Flight performance and preliminary results

Hiroshi Shibai *

Graduate School of Science, Nagoya University, Furo-Cho, Chikusa-Ku, Nagoya 464-8602, Japan

Received 4 December 2006; received in revised form 25 March 2007; accepted 29 March 2007

Abstract

ASTRO-F, which is the first Japanese satellite mission dedicated to the infrared wavelength region, was successfully launched on February 21, 2006 (UT), and was named "AKARI". The telescope has a 69 cm aperture, and is cooled to 6 K with super-fluid helium and mechanical coolers. AKARI is designed for the most advanced all-sky survey in the mid- and far-infrared wavelength region since the Infrared Astronomical Satellite (IRAS). We performed test observations using the performance verification period after the launch, and demonstrated that the instruments are mostly working well. The survey is on-going with six photometric bands including the first all-sky point source survey at 140 and 160 μm. In addition to the all-sky survey, deep imaging and spectroscopic surveys with pointed observations are being carried out in 13 wavelength bands from 2 to 160 μm for various scientific objectives.

Keywords: Infrared radiation; Infrared astronomy; Astronomical satellite; All-sky survey

1. Launch and operation

A full description of the AKARI project was given by Shibai (2004). The launch was executed at 21:25 on February 21, 2006 (UT) with the M-V-8 vehicle. The spacecraft was thrown into an initial orbit of 304 × 733 km with an inclination of 98.2°. After adjustment operations lasting over 1 month, it was finally fixed as a 700 km circular, sun-synchronous orbit along the day–night border. Fig. 1 shows the major events of AKARI operation.

The aperture lid was originally planned to be ejected 2 weeks after the launch. However, due to a malfunction of part of the attitude control system, the onboard software had to be revised to operate properly using only the remaining working components. Consequently, the ejection of the lid was delayed by 5 weeks, and was executed on April 13. As a result of this delay, the payload verification (PV) period was shortened from 6 weeks to 3.5 weeks after the ejection of the lid. Finally, scientific observations started on May 8, 2006.

The other significant effect of this delay of the ejection of the lid was excess loss of cryogen. During the lid in closed position, the evaporation rate of cryogen was several times higher than that during the period without the lid. This meant that the total available observation time with cryogen was expected to be reduced by 6 months, which would have given a final cryogenic operation period of only 10 months. However, the measured evaporation rate of cryogen in orbit was remarkably lower than the design value. Including this effect, the expected observation period was increased to at least 12 months, without the PV period. Therefore, it will be possible to view every part of the sky twice during the mission lifetime.

2. Optics and detector performance

The in-orbit performance of instruments was found to be satisfactory. Most functions, including moving parts such as filter wheels, shutters, and a Fourier transform spectrometer, worked as expected. It was found from the PV phase test observations that the focus of the telescope was not at the best position. We determined the best position for the secondary mirror (at 65 μm from the original

* Tel.: +81 52 788 6190; fax: +81 52 789 2919.
E-mail address: shibai@nagoya-u.jp.

0273-1177/$30 © 2007 COSPAR. Published by Elsevier Ltd. All rights reserved.
doi:10.1016/j.asr.2007.03.073

Feb. 21	Launch	
|		(7 Weeks)
Apr. 13	Aperture Lid Ejected	
|		PV Period (3.5 Weeks)
May 8	Observation Start	
|		Phase 1: Mostly Survey Observations
Nov. 8		
|		Phase 2: Pointing Observations + Supplementary Surveys
May 2007	Liq. He Run Out	
| (or later)		Phase 3: NIR Observation Only

Fig. 1. Operation schedule.

position) by performing several adjustment operations. The final Strehl ratio focus for a 8 μm wave was 0.8.

The point source sensitivity of AKARI is shown in Fig. 2 compared with those of other missions. The near- and mid-infrared camera (IRC) works well, and almost all instrument performance value measured in space are consistent with pre-flight expectations.

In contrast, the far-infrared survey instrument (FIS) has two problems. We anticipated that the responsivity of far-infrared detectors would be higher than that on the ground due to high-energy irradiation as this phenomenon has

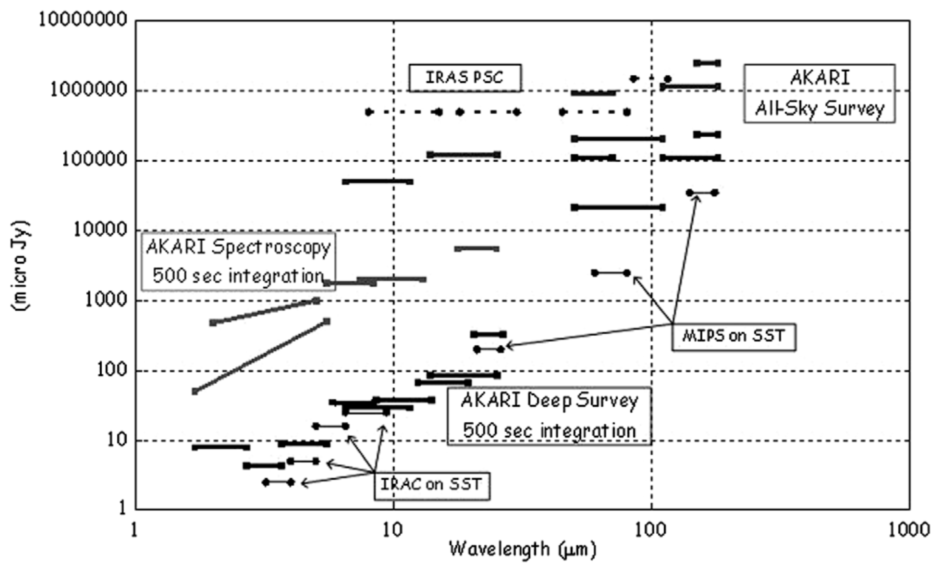

Fig. 2. Point source sensitivities of AKARI (5σ) compared with IRAS PSC limits (Neugebauer et al., 1984) and SST (5σ, 200 s integration) (Werner et al., 2004).

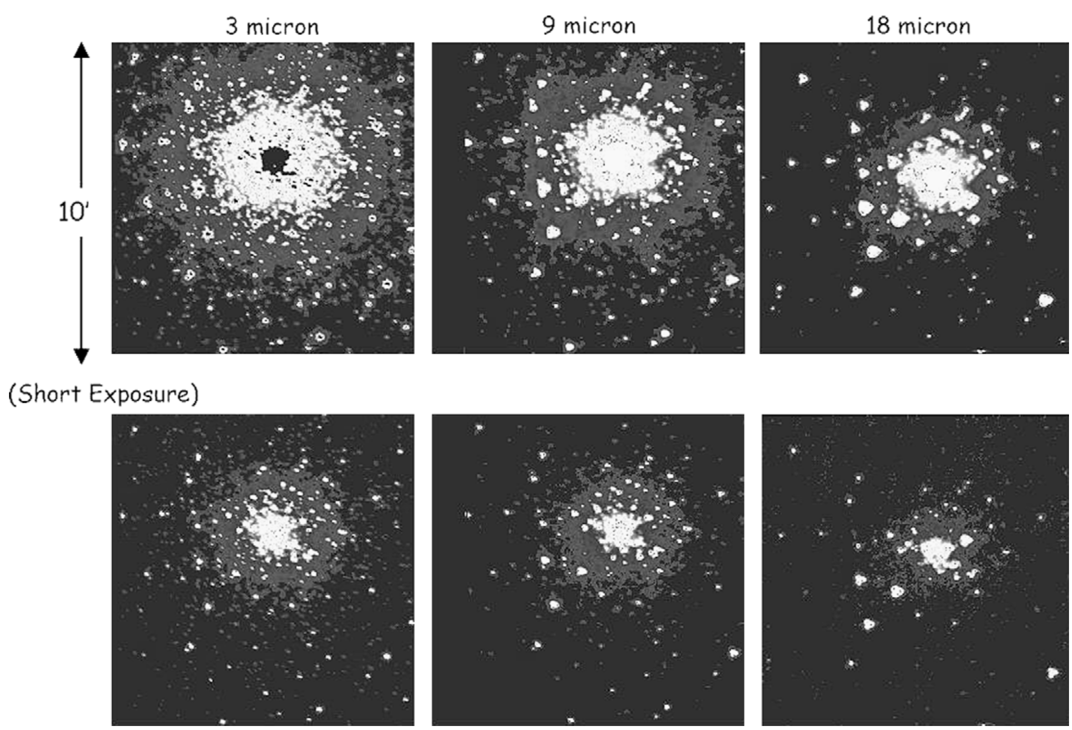

Fig. 3. Near- and mid-infrared test images of a globular cluster (NGC 104 = 47 Tuc). The lower panels are shorter exposure images in order to avoid saturation.