AKARI Far-Infrared Point Source Catalogues

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ABSTRACT

Two far-infrared point source catalogues from the *AKARI* All-Sky Survey are presented. The FIS Bright Source Catalogue ver.2 was released in April 2016 and publically available from the ISAS archive. It is the revised version of the initial release in March 2010, and have improvements in number of detections, completeness and reliability, and accuracy. The FIS Faint Source Catalogue is under evaluation and will be available in public soon. The catalogue contains fainter sources in the high-visibility region (high ecliptic-latitude regions). Two catalogues are expected to be used widely in future astronomical researches as standard data.

Keywords: infrared: space mission (AKARI) – survey: infrared – catalogs: infrared

1. INTRODUCTION

The Japanese infrared astronomical satellite *AKARI* was launched in February 2006 and carried out an all-sky survey in four far-IR wavelengths (65, 90, 140, & 160 μm) and two mid-IR wavelengths (9 & 18 μm) as well as thousands of pointed observations (Murakami et al. 2007, also Yamamura et al., this volume). A primary mission of *AKARI* All-Sky Survey is to produce All-Sky Point Source Catalogues for the 21-century astronomical researches. The first versions of the catalogues were released in March 2010. The FIS Bright Source Catalogue (Yamamura et al. 2010) provides position and fluxes of total 430 thousand sources while the IRC Point Source Catalogue (Ishihara et al. 2010) lists 870 thousand objects. Since the release of the first version, efforts to improve the far-IR catalogue to include more sources with better quality information is continued. In parallel, works to produce the FIS Faint Source Catalogue that contains fainter sources in frequently observed regions has been attempted (Yamamura et al. 2012). After almost eight years since the release of the first version, we finally report that the revised version of the FIS Bright Source Catalogue and the FIS Faint Source Catalogue are ready to publish.

2. THE FIS BRIGHT SOURCE CATALOGUE VERSION 2

The FIS Bright Source Catalogue version 2 (hereafter FISBSCv2) has been in public since April 2016. Although it is still in a private access area, anyone can request a password to get in there.

Figure 1 shows distribution of the sources confirmed at 90 μm band on the Galactic coordinate centred at the Galactic Centre. Table 1 lists number of confirmed sources and detection limits. Thanks to the revisions of processing softwares and tuning of detection threshold, FISBSCv2 contains 501 thousand sources. The condition for confirmation is the same as FISBSCv1; a source is regarded as real if it detected on two or more scans and equal or more than 3/4 of the total number of scans at the position. The new catalogue consists of two sub-catalogues distinguished by a new parameter "GRADE", which takes either 3 or 2; if a source is confirmed in two or more wavelength bands, or the source is detected in four or more scans in a band, GRADE is set to 3. Otherwise GRADE is 2. The *main* catalogue include GRADE=3 sources, while *supplemental* catalogue are for GRADE=2. The *main* catalogue is for variety analysis as a standalone data. The numbers in Table 1 are of the *main* catalogue, and are almost double compared to those of FISBSCv1 if "GRADE=3" condition is applied. The *supplemental* catalogue is less reliable and intended to provide far-IR information of known sources. Table 1 also show that the detection limits of FISBSCv2 are slightly improved from those of FISBSCv1. Figure 2 shows number count of 90 μm band confirmed sources (note that this plot is for *Normal* mode data acquisition only, so galactic plane regions are excluded. See Kawada et al. (2007)). It is clearly indicated that not only faint sources but also bright sources are additionally included in FISBSCv2.

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Table 2 describes information given in the catalogue. Most important column is FQUALxx where xx is the wavelength. If a source was confirmed and measurement was made properly, FQUALxx should be 3. It is recommended to use FQUALxx=3 for reliable analysis.

A few more new issues on source detection should be noted. In FISBSCv1, initial source detection was made on the most sensitive band, 90 μm, and then measurements were performed in other bands at the positions. In FISBSCv2, we attempt source detection in all four bands. As the result, sources that are too bright or too faint for 90 μm are additionally included. The wavelength in which a source is detected (in order of 90, 65, 140, 160 μm) is recorded in DETECTEDBAND column. We also record epoch of the observation in Julian day in EPOCH column. It is the average of all observation time over 1.6 years of All-Sky Survey, and is useful for comparison with other measurements in year timescale. Further, DISCSxx indicates standard deviation of fluxes measured on individual scans normalized by the catalogue flux.

Significant improvement in source position is realized in FISBSCv2. The position accuracy is $1\sigma = 2.3\times3.5$ arcsec with the major axis along the ecliptic meridian (c.f., 6 arcsec circular in FISBSCv1). This high accuracy enables cross-matching with other catalogues more reliable.

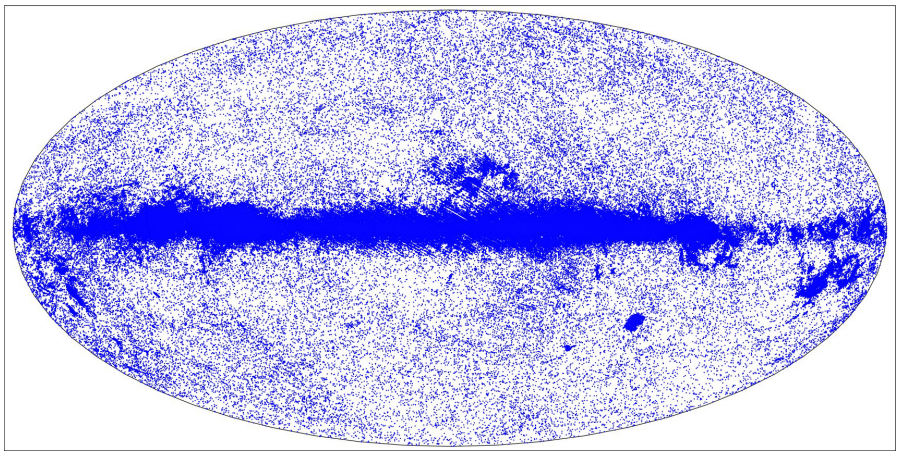

Figure 1. Distribution of the sources confirmed at 90 μm in the FIS-Bright Source Catalogue ver.2 *main* catalogue on the Galactic coordinate centred at the Galactic Centre.

Table 1. Number of sources and detection limits of AKARI-FIS catalogues.

	FISBSCv2(*main*)		FISBSCv1		FISFSCv1	
Wavelength (μm)	n_Source	$F_{\rm det}$ (Jy)	n_Source	$F_{\rm det}$ (Jy)	n_Source	$F_{\rm det}$ (Jy)
65	59,443	2.4	29,336	3.2	25,773	1.8
90	461,842	0.44	373,819	0.55	375,912	0.35
140	203,594	3.4	117,994	3.8	45,692	2.8
160	71,836	7.5	36,646	7.5	11,303	5.0
Total	501,444	—	427,071	—	401,157	—

Note—n_Source: Number of confirmed (FQUAL=3) sources.
$F_{\rm det}$: Approximate detection limit estimated from number count.

3. THE FIS FAINT SOURCE CATALOGUE VERSION 1

The FIS Bright Source Catalogue is constructed to provide uniform detection limits corresponding to a single scan sensitivity over the entire sky. Visibility would affect to reliability of the detection and accuracy of the measurement. It is possible on the other hand to produce a catalogue in which high visibility is used to improve detection limit. The FIS-Faint Source Catalogue (FISFSCv1) is processed by the same software used for FISBSCv2 but with different confirmation algorithm. Scan data over an area of the sky are divided into three groups and coadded. A source is confirmed as real if it is detected in all three groups. The catalogue contents given in Table 2 is in principle common with FISBSCv2. Identical sources with FISBSCv2 should have the same information (position, flux, etc.), because the measurement process is common for two catalogues. Figure 3 plots the number count of FISFSCv1 for different number of scans. Obviously,

Table 2. Data Format of *AKARI* FISBSCv2 and FISFSCv1

FITS	Text	Unit	Description
OBJID	objID		Object ID (mainly internal purpose)
OBJNAME	objName		Object Identifier (HHMMSSs−DDMMSS)
RA	RAdeg	deg	Right Ascension (J2000)
DEC	DECdeg	deg	Declination (J2000)
POSERRMJ	errMaj	arcsec	Position error major axis
POSERRMI	errMin	arcsec	Position error minor axis
POSERRPA	errPA	deg	Position Angle
EPOCH	Epoch		Observation epoch in Julian day*
GRADE	Grade		Band confirmation result*
FLUXxx	Sxx	Jy	Flux density (per band)
FERRxx	e_Sxx	Jy	Flux uncertainty (per band)
FQUALxx	q_Sxx		Quality flag (per band)
FLAGSxx	f_Sxx		Bit flags (per band)
NSCANCxx	Ncxx		Number of scans in which the source is detected (per band)
NSCANPxx	Npxx		Number of scans over the source position (per band)
MCONFxx	Mxx		Month confirmation flag (per band)
BGxx	Bgxx	ADU	Background level [ADU] (per band)
DISCSxx	s_Sxx		Standard Deviation of the fluxes measured on single scans (per band)*
DETECTEDBAND	detBand		Source detected wavelength (see text)*
NDENS	Ndens		Number of sources with 5 arcmin of the source

Note—'FITS' and 'Text' indicate column name in the FITS or Text format, respectively.
"xx" indicates wavelengths bands (65, 90, 140 or 160).
*Newly introduced in FISBSCv2 and FISFSCv1.

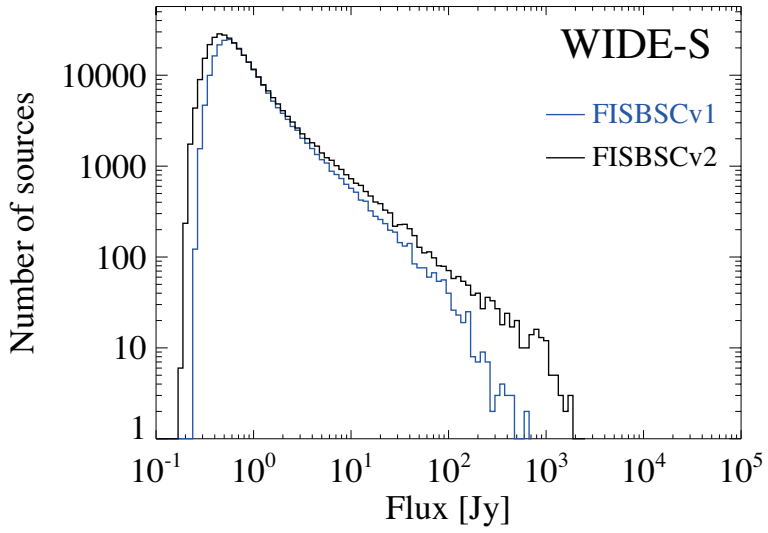

Figure 2. Source number count of FISBSCv2 and FISBSCv1 for WIDE-S (90 μm) band. FISBSCv2 adds not only faint sources but also bright sources. in the Galactic coordinate centred at the Galactic Centre.

we see that the detection limit gets lower as number of scans increases. Naturally, the catalogue should not contain sources of $n_{scan} < 3$. One would think that the FISFSC may exclude low-visibility regions because effects of adding-up scans is not efficient. However, change of confirmation policy also affect to the low-visibility region and some portion of detected

sources are different from FISBSCv2. So, we decide that FISFSCv1 also covers the entire sky. More details of the catalogue will be explained in Yamamura et al. (in prep.).

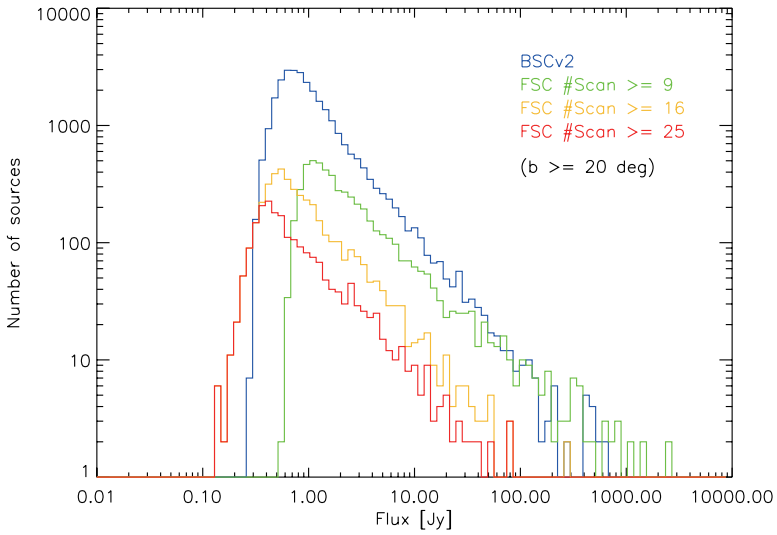

Figure 3. Source number count of FISFSCv1 for regions of different number of scans (WIDE-S; 90 μm). Fainter sources are detcted as the number of scans increases.

4. SUMMARY AND FUTURE

FISBSCv2 increases the number of far-IR sources with better quality measurements from the last release. Additional information such as EPOCH will be useful for data analysis. FISFSCv1 extends the population to the fainter side. Flux calibration is common for both catalogues, and in principle based on the same procedures for FISBSCv1. Improvement on signal measurement slightly decreases relative error. Updates on calibration reference data is under discussion and if realized, minor update of the catalogues would appear. FISBSCv2 is already available for any users. FISFSCv1 is under validation and to be released in the same manner in near future. Both catalogues will be fully in public as soon as the explanatory document (Yamamura et al. in prep.) will be published. We hope that the catalogues will be used broadly in the scientific research.

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