Identifications and SEDs of the detected sources from the AKARI Deep Field South

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Abstract. In order to find counterparts of the detected objects in the AKARI Deep Field South (ADFS) in all available wavelengths, we searched public databases (NED, SIMBAD and others). Checking 500 sources brighter than 0.0482 Jy in the AKARI Wide-S band, we found 114 sources with possible counterparts, among which 78 were known galaxies. We present these sources as well as our first attempt to construct spectral energy distributions (SEDs) for the most secure and most interesting sources among them, taking into account all the known data together with the AKARI measurements in four bands.

1. Introduction

The AKARI Deep Field South (ADFS) is one of the deep fields close to the Ecliptic Pole. The unique property of the ADFS is that the cirrus emission density is the lowest in the whole sky, i.e., the field is the most ideal sky area for far-infrared (FIR) extragalactic observations. Very deep imaging data were obtained down to $\sim$ 20 mJy at 90 $\mu$m (for details, see Shirahata et al. 2009).

2. Catalog

We cross-correlated the ADFS point source catalog (based on 90 $\mu$m) with other known and publicly available databases, mainly the SIMBAD and NED. For 500 sources brighter than 0.0482 Jy, we searched for their counterparts in other wavelengths within the radius of 40\arcsec. In total, 110 counterparts for 114 ADFS sources were found. As shown in Figure 1, the angular distance between the ADFS source and its counterpart is in most cases smaller than 20\arcsec. It is plausible that the more distant identifications are caused by the contamination. In particular, all the three stars in the sample are most probably falsely identified because of the contamination (M. Fukagawa, private communication). Positional scatter map, shown in Figure 2, displays a small but systematic bias of $\sim$ 4\arcsec in declination of the ADFS positions with respect to counterparts.

We revealed that most of the detected bright sources are galaxies, and very few stars, quasars, or AGNs were found. As shown in Figure 3, most of the
identified objects are nearby galaxies at $z < 0.1$, a large part of them belonging to a cluster DC 0428-53 at $z \sim 0.04$. The statistics of identified ADFS sources is presented in Table 1.

Table 1. Statistics of identified ADFS sources

| Category                                      | Count |
|----------------------------------------------|-------|
| Galaxies                                     | 78    |
| Galaxy                                       | 37    |
| Galaxy in cluster of galaxies                | 33    |
| Pair or interacting galaxies                  | 4     |
| Low surface brightness galaxy                | 2     |
| Seyfert 1                                    | 1     |
| Starburst                                    | 1     |
| Star                                         | 3     |
| Quasar                                       | 1     |
| X-ray source                                 | 3     |
| IR sources                                   | 24    |
3. Spectral energy distributions

Spectral energy distributions (SEDs) give first important clue to the physics of radiation of the sources. The deep image at the AKARI filter bands has significantly improved our understanding of the nature of the FIR emission of various sources and allows us to update the models of interstellar dust emission.

Figure 4. Representative SEDs of galaxies in the ADFS with known redshifts; the data points from ADFS (full black circles) and public databases are fitted by four different models of dust and stellar emission.

We show six representative SEDs of galaxies with known redshifts in Figure 4. We tried to fit four models of dust emission with the SEDs. First we tried a modified black body ($\nu^\gamma B_\nu(T)$ with $\gamma = 1.5$) to the dust emission part, and a black body to the stellar emission part in the galaxy SEDs ($\nu = 10^{13} - 10^{14}$ Hz). Since these galaxies are evolved, a single black body gives a poor fit to the observed SEDs for some galaxies. Using a more sophisticated stellar population synthesis model with realistic star formation history will be our next step.

For dust emission, we then used models of Dale & Helou (2002) and Li & Draine (2001). These more refined models succeeded in reproducing the MIR part of the dust emission. By these fittings, we can calculate the mass and temperature of dust, as well as the PAH contribution to the total dust amount.
4. NGC 1705

One of the most interesting objects we found in the ADFS is a nearby dwarf starburst galaxy NGC 1705. This galaxy locates at a distance of $5.1 \pm 0.6$ Mpc. It has a relatively low metallicity of $0.35 Z_\odot$, and the star formation rate is estimated to be $0.3 M_\odot \text{yr}^{-1}$. This galaxy is known to harbor the richest super star cluster (SSC) ever found (Cannon et al. 2006, and references therein). The most striking feature of NGC 1705 is that it has completely hidden star formation only seen in the FIR, which does not correspond to the SSC observed at the optical. The AKARI data, as well as Spitzer and IRAS measurements enable more detailed studies on the dust emission, hidden star formation, ultraviolet radiation field strength and ISM physics of this galaxy.

Figure 5. The SED of a dwarf starburst galaxy NGC 1705; the ADFS (full black circles), Spitzer, IRAS and other known measurements are fitted by four different models of dust and stellar emission.

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