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MIR LUMINOSITY FUNCTION OF GALAXIES IN THE NEP-WIDE FIELD

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ABSTRACT

We present the mid-infrared (MIR) luminosity function (LF) of local (z < 0.3) star-forming (SF) galaxies in the North Ecliptic Pole (NEP) field. This work is based on the NEP-Wide point source catalogue and the spectroscopic redshift (z) data for ∼ 1700 galaxies obtained by the optical follow-up survey with MMT/Hectospec and WIYN/Hydra. The AKARI's continuous 2 – 24 μm coverage and the spectroscopic redshifts enable us to determine the spectral energy distribution (SED) in the mid-infrared and derive the luminosity functions of galaxies. Our 8 μm LF finds good agreements with the results from SWIRE field over the wide luminosity range, while showing significant difference from the NOAO deep data in the faint end. The comparison with higher-z sample shows significant luminosity evolution from z > 0.3 to local universe. 12 μm LF also shows a clear indication of luminosity evolution.

Key words: infrared: galaxies – galaxies: luminosity function

1. THE NEP-WIDE DATA

The NEP-Wide Survey covered a wide (5.4 deg^2) field and provides a huge number of extragalactic sources in the redshifts below z ∼ 1 (Matsuhara et al., 2006; Lee et al., 2009; Kim et al., 2012). Supplementary optical and ground-based near-IR data covering this NEP-Wide field (Hwang et al., 2007; Jeon et al., 2010) as well as the spectroscopic redshifts (spec-z) information (Shim et al., 2013) enable us to figure out spectral energy distributions (SEDs) and spatial distribution of various types of galaxies.

Mid-IR luminosities are known to be sensitive to the star-forming activity because significant amount of luminosity generated by young stars can be reemitted in the infrared by heated dust and this reprocessed emission accounts for most of the mid-IR luminosity (Lagache et al., 1999; Puget et al., 1996; Frenceschini et al., 2008). Here, we present the recent determination of mid-IR (8 μm and 12 μm) luminosity functions for local (z < 0.3) galaxies based on the multi-band data from the NEP-Wide point source catalogue covering from optical u* band to AKARI 24 μm band together with spectroscopic redshift data for selected sample. This work complements the results from the NEP-Deep Survey (Goto et al., 2010), which derived LFs for more distant universe (z > 0.3).

2. ANALYSIS AND METHODS

Among the infrared sources in the NEP-Wide Survey data (Kim et al., 2012), we used the spectroscopic sample classified as 'galaxy' based on the analysis of emission lines obtained by optical follow-up survey with MMT/Hectospec and WIYN/Hydra (Shim et al., 2013).

To find the best-fit model for these selected sample, we performed SED fitting over all the available photometric data with spectroscopic redshifts. For this, we used the models from Polletta et al. (2007). AKARI's continuous filter coverage in the mid-IR part and the redshifts determined by spectroscopic observations al-

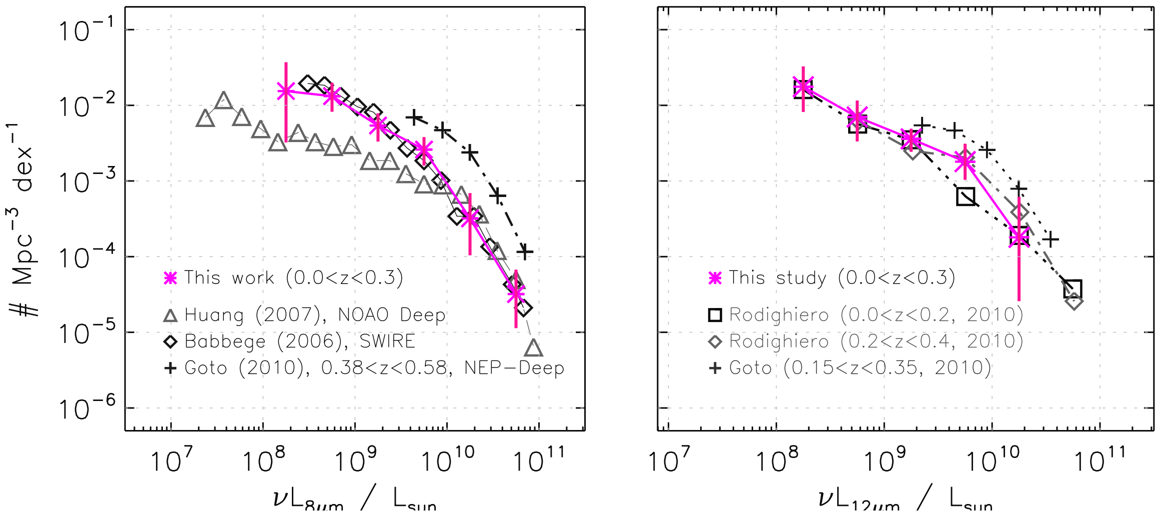

Figure 1. Left panel: 8 μm LFs of SF galaxies. The asterisk represents the LF of local ($z < 0.3$) galaxy sample in the NEP-Wide survey field (this work). Diamonds show the results from Babbege et al. (2006) based on the SWIRE data, the triangles from Huang et al. (2007, NOAO deep). The cross shows the LF for galaxies at higher z from NEP-Deep survey (Goto et al., 2010). Right panel: 12 μm luminosity functions of SF galaxies.

low us to avoid large uncertainties when we calculate K-corrections and luminosities.

After we computed the maximum redshift (z_{max}), where a source could be observed with the detection limits, we determined corresponding comoving volume V_{max} for each source. We collected the sources having the same luminosity ranges (ΔL). Then, luminosity functions (Φ) were calculated using $1/V_{max}$ method,

$$\Phi(L) = \frac{1}{\Delta L} \sum_i \frac{1}{V_{max,i}} s_i \qquad (1)$$

where s_i is correction factor for bias and incompleteness. The merit of this method is that it is relatively insensitive to the incompleteness of sample and unsusceptible to the parametric dependence.

3. RESULTS

In Figure 1, we show 8 μm and 12 μm LFs for local (z < 0.3) star forming (SF) galaxies based on the NEP-Wide survey data. In this figure, we show comparisons of our work with previous results from various literatures. Here, our results are presented by asterisk in magenta. Left panel shows 8 μm LFs. Diamond indicates LF of local ($z < 0.25$) galaxies in the SWIRE field (Babbege et al. 2006), and the triangle represents LF of galaxies ($z < 0.3$) in the NOAO deep field surveyed by *Spitzer* (Huang et al., 2007). We also overplotted a part of the work by Goto et al. (2010), which gives LF for a different redshift range (z > 0.3) based on the AKARI NEP-Deep survey data (Wada et al., 2008) with photometric redshfits. 12 μm LF is shown in the right panel. Our LF is compared with other results based on the *Spitzer* data and the results from higher redshift range (Rodighiero et al., 2010; Goto et al., 2010).

The Mid-IR LFs based on the NEP-Wide survey data show a fairly good agreement with other studies based on the *Spitzer* observation on various fields except for the 8 μm results from Huang et al. (2007). The comparison of our LFs with higher-z sample from the NEP-Deep Survey shows clear indication of luminosity evolution from z > 0.3 to local universe.

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