The cosmic infrared background (CIRB) is the integrated IR background, which arises from the extragalactic sources. The CIRB has been detected by COBE (Puget et al. 1996; Fixsen et al. 1998; Hauser et al. 1998). The 170-µm intensity at 140 µm reported by Hauser et al. (1998) is necessary to reproduce the very high CIRB intensity at 140 µm reported by Hauser et al. (1998). We note that an evolutionary factor larger than ten at high-z (z > 2) overpredicts the CIRB intensity at submillimeter wavelength regime. Basically the evolutionary factor increases by a factor of 30 up to z = 0.75 and decreases to, even at most, a factor of 10 toward z ~ 5, though many variants are allowed within these constraints. This evolution history also satisfies the constraints from the galaxy number counts obtained by IRAS, ISO and, roughly, SCUBA. The rapid evolution of the comoving IR luminosity density required from the CIRB well reproduces the very steep slope of galaxy number counts obtained by ISO. This result is also consistent with some recent results of multiwavelength surveys and follow-up observations of ISO extragalactic sources. We also estimate the cosmic star formation history (SFH) from the obtained FIR luminosity density, considering the effect of the metal enrichment in galaxies. The derived SFH increases steeply with redshift in 0 < z < 0.75, and becomes flat or even declines at z > 0.75. This is consistent with the SFH estimated from the reported ultraviolet luminosity density. In addition, we present the performance of the Japanese ASTRO-F FIR galaxy survey. We show the expected number counts in the survey. We also evaluate how large a sky area is necessary to derive a secure information of galaxy evolution up to z ~ 1 from the survey, and find that at least 50 – 300 deg² is required.


INTRODUCTION

The galaxy evolution has long been a strong driving force of the cosmological studies, and many problems have been still unsolved. Not only optical but also infrared (hereafter IR) and submillimeter (sub-mm) waveband observations of galaxies have a crucial importance for full understanding of their evolutionary status.

Recent infrared and sub-mm surveys revealed very steep slopes of galaxy number counts compared with that expected from the no-evolution model, and provided a new impetus to the related field (e.g. Kawara et al. 1998; Puget et al. 1999; Dole et al. 2000; Oliver et al. 2000a; Kawara et al. 2000; Okuda et al. 2000). The 170-µm slope proved to be d log N / d log S ~ 2.5 at S ~ 0.5 Jy in these new deep surveys, while the slope would be ~ 1.5 in the no evolution case. Such an excess of galaxy number count is generally understood as a consequence of a strong galaxy evolution, i.e. a rapid change of the star formation rate in galaxies.

Another important related issue is the cosmic infrared background (CIRB), which is the integrated IR light from galaxies, especially from those that are so faint that are unable to be resolved. Therefore the CIRB provides an important information on the past star formation history of galaxies including the inaccessible sources. The CIRB has been detected by COBE (Puget et al. 1996; Fixsen et al. 1998; Hauser et al. 1998). The reported CIRB intensity was surprisingly high (νLν = 25 ± 7 nW m⁻² sr⁻¹ at 140 µm and νLν = 14 ± 3 nW m⁻² sr⁻¹ at 240 µm: Hauser et al. 1998), and provided a profound problem awaiting to be solved.
Fig. 1. — The assumed galaxy spectral energy distribution in the near infrared to radio wavelengths, constructed from the color–luminosity evolution in IRAS galaxies and the tight correlation of the far-infrared (FIR) and radio fluxes. The prominent emission bands are PAH features. Vertical dotted lines represent the wavelengths of IRAS four bandpasses. The SEDs with the FIR luminosity of $10^8$, $10^9$, $10^{10}$, $10^{11}$, $10^{12}$, $10^{13}$, and $10^{14} L_\odot$ are shown from the bottom in this order.
\( \phi(L) \text{ [Mpc}^{-3} \text{ dex}^{-1}] \)

\( \nu L_\nu \text{ (60} \mu\text{m) [}\text{L}_\odot]\)