R05b Evolution of Far-Infrared–to–Optical Luminosity Ratio and Its Implication to the Cosmic Star Formation

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Nowadays redshifts of very distant galaxies have been available with the aid of large telescope facilities and photometric redshift techniques. These optical observations show various evidences of galaxy evolution. The evolution of the luminosity function (LF) of galaxies is important to derive the cosmic luminosity density. On the other hand, recent infrared and sub-mm (hereafter IR) surveys revealed a very steep slope of galaxy number count compared with that expected from no evolution model. Such excess of galaxy number count is generally understood as a consequence of strong galaxy evolution, i.e. rapid change of the star formation rate in galaxies. We, however, have not yet obtained a coherent picture of the cosmic star formation history, which successfully explains the above new results of both optical and infrared observations.

In order to derive the history of galaxy star formation, we estimated the LF from the photometric redshift catalog of galaxies in the Hubble Deep Field and obtained the integrated luminosity density at very high redshifts. We also constructed a model of IR galaxy number count and cosmic infrared background (CIRB), and obtained the history of the IR luminosity density. Comparison of these histories defined from the two independent observational datasets suggests that there must have been an IR-dominated epoch at $z \sim 1$. We examined the evolution of the IR-to-optical luminosity ratio by comparing the evolutionary model of a spiral galaxy, and estimated the contribution of starburst galaxies along with redshift. We found that the starburst galaxies must be quite abundant at $z > 1$, as previously suggested. But we should also note that there must not exist too many starbursts at very large redshift of $z > 2 - 3$, because of the constraint of the CIRB. We will show the contribution of the starburst population for the IR luminosity density.