R26b Reality and Reliability of the Evolution of the Galaxy Luminosity Function : Statistical Experiment

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The luminosity function (LF) of galaxies is an important tool in many fields of studies in observational cosmology. A variety of methods to estimate the LF has been proposed (e.g. Schmidt 1968; Lynden-Bell 1971; Turner 1979; Sandage et al. 1979; Marshall et al. 1983; Cołoniewski 1986; Efstathiou et al. 1988; Caditz & Petrosian 1990, 1993; Eales 1993; SubbaRao et al. 1996; Heyl et al. 1998). Power and robustness of the proposed estimators is different with each other as partially discussed by Willmer (1997), but detailed properties are still unknown and further examination is required.

Recent development of the photometric redshift technique provides us the redshift data of very distant, faint galaxies beyond the spectroscopic flux limits, and they have enabled us to construct the LF of galaxies at extremely high redshift ($z \sim 3-6$) directly. In this study, we investigated the properties of the LF at high redshift. We intensively examined the robustness of the LF estimators against various functional shapes by artificial mock catalog. For some estimators which have been designed for nearby Universe, we newly improved them to treat galaxies at cosmological distances and extended them to construct the redshift-dependent LF. Using the improved estimators, we determined I-band LF of galaxies in the Hubble Deep Field from the photometric redshift data newly provided by Fernández-Soto et al. (1999). We estimated the error from the data uncertainty by the bootstrap resampling analysis, which yielded a larger error than those claimed by previous authors. In spite of the large uncertainty, we detected a trend of the evolution in the shape of the LF at extremely high redshift, which is consistent with the result of Sawicki et al. (1997) in general.