

Far-Ultraviolet and Far-Infrared Bivariate Luminosity Function of Galaxies: Complex Relation between Stellar and Dust Emission

TSUTOM T. TAKEUCHI¹, AKANE SAKURAI¹, VÉRONIQUE BUAT², and DENIS BURGARELLA²

¹*Division of Particle and Astrophysical Science, Nagoya University, Japan*

²*Laboratoire d'Astrophysique de Marseille, OAMP, France*

Based on GALEX and IRAS/Spitzer datasets, we have found that both far-ultraviolet (FUV) and far-infrared (FIR) luminosity functions (LFs) show a strong evolution from $z = 0$ to $z = 1$, but the FIR LF evolves much stronger than the FUV one. Namely, the fraction of the star formation activity hidden by dust increases from $\sim 50\%$ ($z = 0$) to more than 80% at $z = 1$ (Takeuchi et al. 2005). Recent Herschel observation confirmed this evolution.

The FUV is dominantly radiated from newly formed short-lived OB stars, while the FIR is emitted by dust grains heated by the FUV radiation field. It is known that dust is always associated with star formation activity. Thus, both FUV and FIR are tightly related to the star formation in galaxies, but in a very complicated manner.

In order to disentangle the relation between FUV and FIR emissions, we estimate the FUV-FIR bivariate LF (BLF) of galaxies with GALEX and AKARI All-Sky Survey datasets (Takeuchi et al. 2010). There has been only ad-hoc or heuristic way to construct the BLF. However, recently we invented a new mathematical method to construct the BLF with given marginals and prescribed correlation coefficient (Takeuchi 2010). This method makes use of a tool from mathematical statistics, so called “copula”. The copula enables us to construct a bivariate distribution function from given marginal distributions with prescribed correlation and/or dependence structure.

With this new formulation and FUV and FIR univariate LFs, we analyze various FUV and FIR data with GALEX, Spitzer, and AKARI to estimate the UV-IR BLF. The obtained BLFs naturally explain the nonlinear complicated relation between FUV and FIR emission from star-forming galaxies. We also mention the evolution of the FUV-FIR BLF.

Keywords: dust; galaxies: formation; galaxies: evolution; stars: formation; infrared; ultraviolet.

References

- [1] T. T. Takeuchi, *MNRAS* **406**, 1830 (2010).
- [2] T. T. Takeuchi, V. Buat, S. Heinis, E. Giovannoli, F.-T. Yuan, J. Iglesias-Páramo, K. L. Murata, D. Burgarella, *A&A* **514**, A4 (2010).
- [3] T. T. Takeuchi, V. Buat, D. Burgarella, *A&A* **440**, L17 (2005).