Z212b Statistical Quantification and Parametrization of Galaxies with SPICA

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Since the dimension of galaxy survey data is enormous nowadays, a classical approach would miss significant number of important features to represent the evolution of galaxies. In our previous work (X-0056-a), we have demonstrated a method to extract the evolutionary features of galaxies through unsupervised machine learning algorithm. We constructed a multidimensional space of twelve luminosities from FUV to K and redshift, based on the data of VIPERS project. We applied a Gaussian mixture model to these data and estimated parameters by the Fisher Expectation-Maximization algorithm. This method automatically reproduced important characteristics of galaxies such as the classical active/passive galaxy dichotomy, star-forming galaxy main sequence, etc. What we discovered was that the classified subgroups consist a one-dimensional continuous sequence in the multidimensional space, referred to as “the galaxy manifold”. It is then more reasonable to analyze this manifold as it is. This type of analysis is referred to as the nonlinear dimensionality reduction. We can expect to find a similar sequence when we add data from SPICA. The far-infrared (FIR) spectrum is known to trace more bursty star formation, and contains detailed information of the ISM. Then adding the FIR data will bring much more precise information to the structure of the galaxy manifold. This will be a new powerful tool to quantify and parametrize the evolution of galaxies and their ISM.