# A Comparative Study of Star Formation Rate in Galaxies of Different Morphological Types

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## Abstract

We study the star formation rate (SFR) of 3,079 galaxies at $z < 1.468$ drawn from the Sloan Digital Sky Survey (SDSS) DR6 sample. We visually classify the sample into different morphological types and measure the SFR along the Hubble sequence by using the SFR calibrations of Kennicutt (1998). We compare results from the each SFR calibration and discuss the difference of SFR in each type of galaxies.

## Introduction

Star formation rate (SFR) varies widely in each type of galaxies across the Hubble Sequence. Red galaxies mainly contain passively evolving stars while blue galaxies contain young stellar population and still forming stars. The Sloan Digital Sky Survey (SDSS) database, which contain both the spectra and images of galaxies (Fig. 1), allows us to study the of star formation rate from spectral emission lines while classifying the morphological type of galaxies from the image.

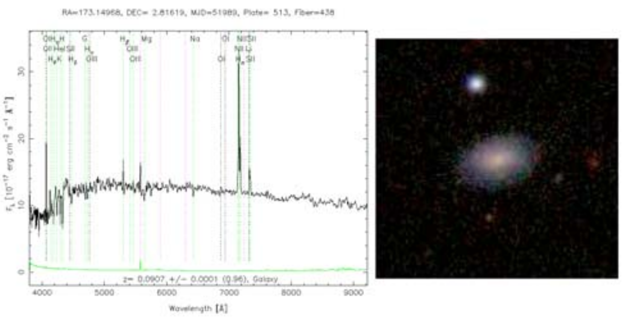



**Fig. 1.** A typical spectra and image of a SDSS galaxy

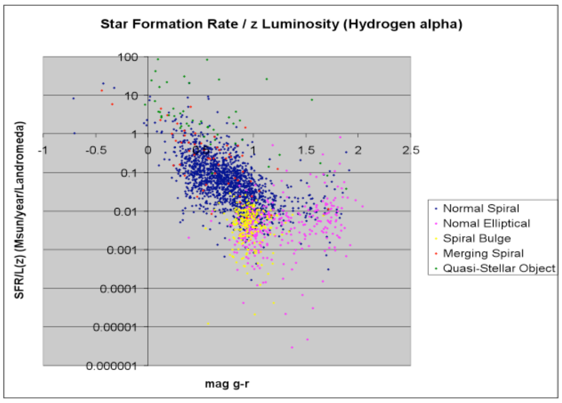
For this work, we selected galaxies and quasars from the SDSS DR6 at $z < 1.468$ (the average $z$ is about 0.15) and determine their SFR using the indicators given by Kennicutt (1998) relying on the H$\alpha$ recombination line and [OII] forbidden line at z > 0.402 where H$\alpha$ redshifts out of the SDSS spectral range.

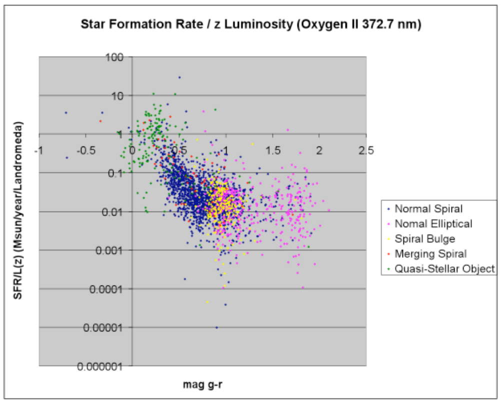
$$\mathrm{SFR}\ (M_{sun}/yr) = (7.9 \times 10^{-42})\ L\ (H\alpha)\ (erg/s)$$
$$\mathrm{SFR}\ (M_{sun}/yr) = (1.4 \times 10^{-41})\ L\ [O\ II]\ 3727\ (erg/s)$$

We visually classify our initial sample of 3,840 galaxies into six morphological types, including the spiral (1736, 45%); elliptical (749, 20%); spiral bulge (301, 8%); interacting galaxies (55, 1%); quasar (238, 6%). Stars and unclassifiable objects comprise of the rest 761 objects (20%). We obtain the integrated line fluxes of H$\alpha$ and [OII] from the SDSS database and estimate the SFR for each galaxy per unit luminosity of the

Andromeda galaxy (M31), which is an approximate way to estimate the star formation rate per unit luminosity.

Fig. 2 and Fig. 3 show the SFR as a function of the SDSS $g - r$ color index for each morphological type derived from H$\alpha$ and [OII] SFR indicator, respectively.




The SFR per unit luminosity as a function of the SDSS $g - r$ color index based on H$\alpha$ (left, Fig. 2) and [OII] SFR indicators (right, Fig. 3)

**SUMMARY AND DISCUSSION**

We determine star formation rates (SFRs) in 3,079 galaxies (with z < 1.468) by using the calibrations of Kennicutt (1998). From the H$\alpha$ indicator, we found that the trends of SFRs per unit luminosity of normal spiral galaxies corresponds to a range of 0.1-1 $M_{\rm sun}$ year$^{-1}$ for an $L^*$ galaxy (roughly comparable in luminosity to the M31). We observed higher SFRs in interacting spiral galaxies, corresponding to a range of 0.1-10 $M_{\rm sun}$ year $^{-1}$ for an $L^*$ galaxy. On the other hand, SFR for elliptical galaxies and spiral bulges are lower, which agrees with their redder color. We found SFR of quasars per unit luminosity to be the largest. However, the line flux measurement could be affected by the broadening of quasar emission lines and also the contaminating emission from the active nucleus itself, therefore this result requires a further investigation.

We note that the SFR derived from [OII] are slightly lower than the SFR derived from H$\alpha$ , which could be due to the environment of the galaxy (such as the metallicity), the dust extinction in the target galaxy, or unknown issues with the SFR calibrations.

**REFERENCE**

Kennicutt, R. C., 1998, ARA&A, 36, 189