

A VARIATION IN THE PRESENT STAR FORMATION ACTIVITY OF SPIRAL GALAXIES

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ABSTRACT

We show that the star formation activity of spiral galaxies has a great variety. The star formation variation in a time scale of 10^8 yr and the mechanism responsible for the variation are discussed.

Key Words : star formation, spiral galaxies

I. INTRODUCTION

The outline of the star formation history of spiral galaxies in a time scale of Gyr is established (e.g., Sandage 1986). The star formation rate (SFR) has been decreased continuously in an exponential way, and the time scale of the decrease depends on the Hubble type of morphology.

Many starburst and post-starburst galaxies exist in the Local Universe. It suggests that the SFR in a galaxy could vary greatly in a time scale of 10^8 yr, which is a quite different view of the history in a time scale of Gyr.

We investigate the statistics of the present star formation activity of spiral galaxies using available databases and study the star formation history in a time scale of 10^8 yr.

II. DATA

To pick up galaxies with various star formation activity, we took the optically-selected sample. We picked up 1208 galaxies with morphologies of S0a to Sc from RC3 catalog (de Vaucouleurs et al. 1991) by the following criteria: B_T^0 , $(B - V)_T^0$ photometries are given in RC3 and *IRAS* photometry can be assigned.

We used flux ratio of far-infrared (FIR) measured by *IRAS* and optical *B* band, f_{FIR}/f_B , as a measure of the present star formation activity in a whole galaxy.

III. RESULTS AND DISCUSSION

Figure 1 shows the $\log(f_{FIR}/f_B)$ vs $\log L_B$ diagram, where L_B indicates the *B*-band luminosity in the unit of L_\odot . Open circles indicate the galaxies with detected f_{FIR} , and crosses indicate the galaxies without the detection of f_{FIR} and show the upper-limit locations of $\log(f_{FIR}/f_B)$. f_{FIR}/f_B distributes in a range of two orders of magnitude without L_B -dependence.

Figure 2 shows the histogram of $\log(f_{FIR}/f_B)$ for each morphological type. We corrected the bias that only luminous galaxies are detectable in the far distance. Figure 2 shows two important results: (1) f_{FIR}/f_B distributes in a range of one to two orders

of magnitude even within one morphological type and (2) the shape of the histogram changes systematically along the Hubble sequence; the earlier-type sample has the flatter and wider histogram.

Result (1) suggests that the star formation activity of a galaxy varies in a range of orders of magnitude with a time scale of 10^8 yr, and result (2) suggests that the mechanism for the variation is an internal self-regulating one.

This study is reported in detail in Tomita, Tomita, Saitō (1996).

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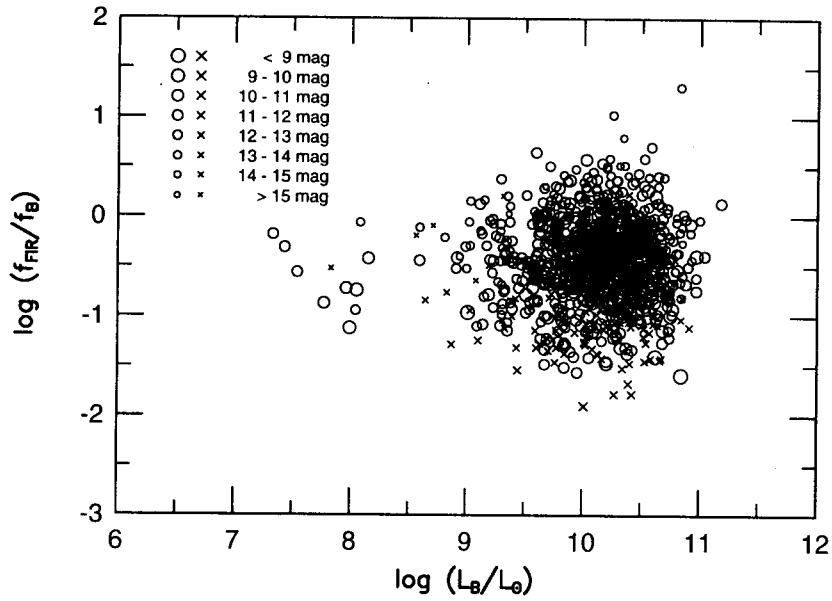


Figure 1. A $\log (f_{\text{FIR}}/f_B)$ versus $\log L_B$ diagram for the sample galaxies.

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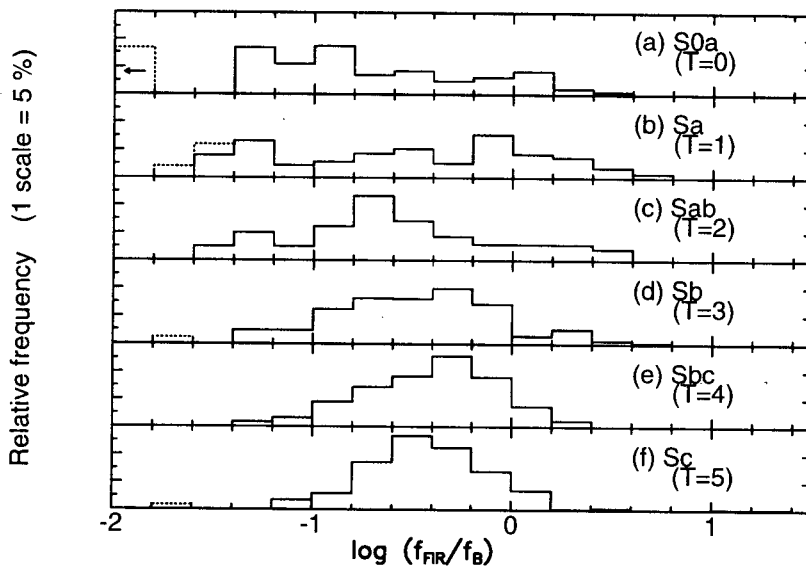


Figure 2. A universal histogram of $\log (f_{\text{FIR}}/f_B)$ for each morphological type.

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