STAR FORMATION RATE IN MARKARIAN GALAXIES

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Study of current star formation rates in Markarian galaxies has been carried out. The tight correlation between the galaxy luminosity in the far infrared range and radio one (radiocontinuum at $\lambda = 21$ cm) has been revealed. The current star formation rates (averaged over the past 2×10^6 yr) have been derived both from the luminosity in the far infrared range ($SFR_{\rm FIR}$) and from the luminosity in the radio range ($SFR_{\rm 21cm}$). The Salpeter shape of the initial mass function (IMF) and a low-mass cut-off of 0.1 $M_\odot$ in IMF has been assumed for the $SFR_{\rm FIR}$ calculation. We derived the $SFR_{\rm 21cm}$ assuming that a radio free-free emission at $\lambda = 21$ cm is caused by the thermal gas ionized by massive stars radiation. The $SFR_{\rm 21cm}$ is about 3.3 and 5.0 times larger than $SFR_{\rm FIR}$ for starburst and Seyfert galaxies, respectively. $SFR_{\rm FIR}$ and $SFR_{\rm 21cm}$ can be considered as a lower and an upper limits, respectively of the genuine galaxy current star formation rate.

Star formation is one of the most fundamental processes in galaxies. Understanding of nature of this phenomenon is believed to contribute substantially to our insight into the subject of galaxies evolution. Star forming processes in galaxies are characterized by two parameters: an initial mass function (IMF) and a star formation rate (SFR). In the present paper we use the Salpeter IMF with a slope coefficient $\alpha = 2.35$. The low-mass cut-off of 0.1 $M_\odot$ in IMF and Hubble constant $H_0 = 75$ km s^{-1} Mpc^{-1} are taken as well. There are several methods to derive the star formation rate. Two most popular methods are based on the galaxy luminosities in the $\rm H_\alpha$ line and in the far infrared range [4, 2]. We use data from the First Byurakan Survey (FBS) and new NRAO VLA Sky Survey (NVSS) in the radiocontinuum at $\lambda = 21$ cm [1] to derive $SFR_{\rm FIR}$ following the technique described in [4], and $SFR_{\rm 21cm}$ in accordance with [3]. In Fig. 1a and 1b we show the radio-continuum luminosities $L_{\rm 21cm}$ *vs.* the far infrared luminosities $L_{\rm FIR}$ for subsamples of starburst and Seyfert galaxies, respectively. The tight correlation implies that emission in these wavelengths originates in star forming regions.

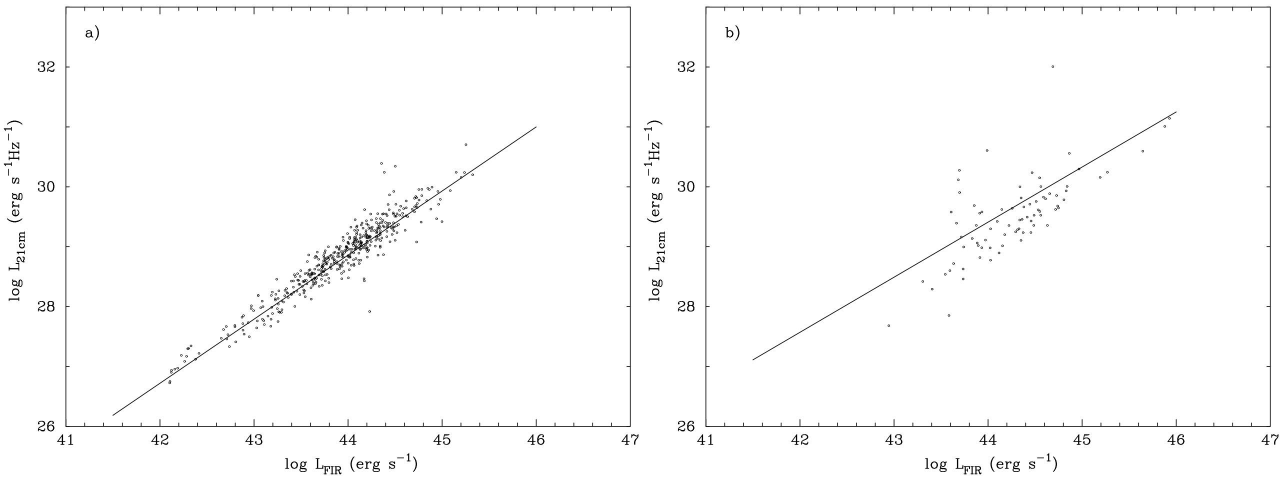

Figure 1: **a)**. log $L_{\rm 21cm}$ *vs.* $L_{\rm FIR}$ for starburst galaxies. **b)**. log $L_{\rm 21cm}$ *vs.* $L_{\rm FIR}$ for Seyfert galaxies

In Fig. 2a and 2b we show the differential distribution of ratios $SFR_{\rm 21cm}/SFR_{\rm FIR}$ for two subsamples. The tail in the distribution for Seyfert galaxies substantially affects the average values, hence the median value is more appropriate characteristic of the SFR ratios than an average. One can see from Table 1 that $SFR_{\rm 21cm}$ is about 3.3 and 5.0 times as large as $SFR_{\rm FIR}$ for starburst and Seyfert galaxies, respectively. The differences

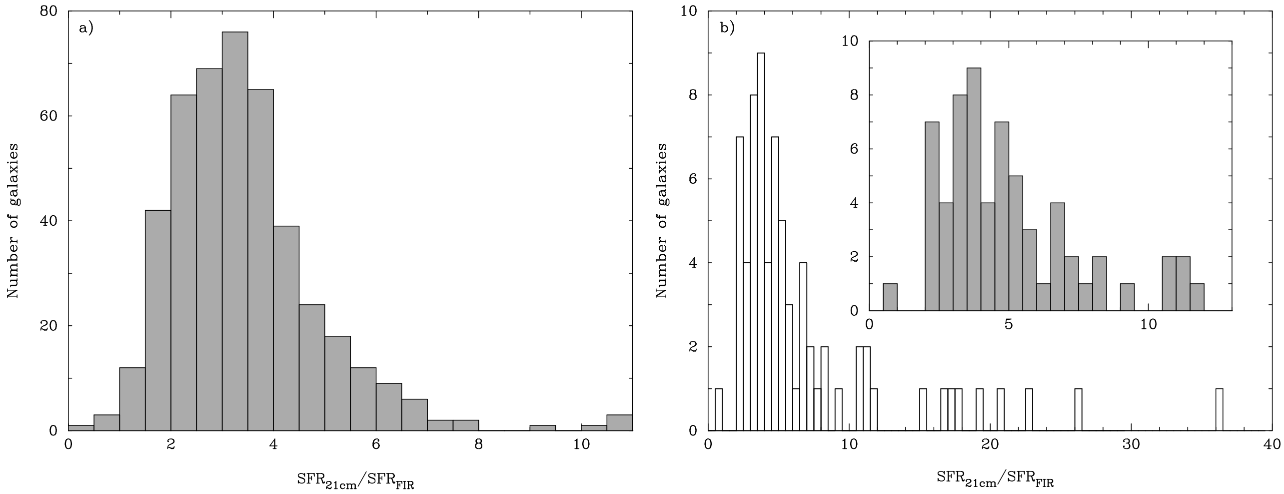

Figure 2: **a).** Distribution of ratios $SFR_{21\mathrm{cm}}/SFR_{\mathrm{FIR}}$ for starburst galaxies. **b).** Distribution of ratios $SFR_{21\mathrm{cm}}/SFR_{\mathrm{FIR}}$ for Seyfert galaxies. Part of the distribution for ratios $SFR_{21\mathrm{cm}}/SFR_{\mathrm{FIR}} < 12$ is shown separately

between median ratios could be caused by contribution of nonthermal radiation from Seyfert active nuclei. For the total sample of Markarian galaxies the ratio $SFR_{21\mathrm{cm}}/SFR_{\mathrm{FIR}}$ is about 3.4. The reasons of difference between SFR_{FIR} and $SFR_{21\mathrm{cm}}$ for blue compact dwarf galaxies, discussed in [3], could be valid for Markarian galaxies as well. SFR_{FIR} and $SFR_{21\mathrm{cm}}$ can be suggested as a lower and an upper limits respectively of the genuine galaxy current star formation rate.

Table 1: Some characteristics of starburst and Seyfert galaxies from FBS

	Starburst galaxies		Seyfert galaxies		Total sample	
	median	N	median	N	median	N
SFR_{FIR} ($M_{\odot}\mathrm{yr}^{-1}$)	16.1	442	34.8	77	16.3	519
$SFR_{21\mathrm{cm}}$ ($M_{\odot}\mathrm{yr}^{-1}$)	48.7	435	210.3	76	53.4	511
$SFR_{21\mathrm{cm}}/SFR_{\mathrm{FIR}}$	3.3	449	5.0	78	3.4	527

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