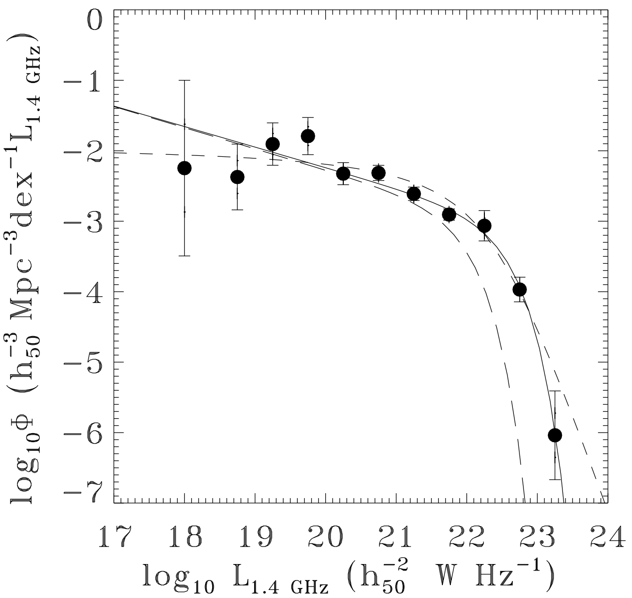

Figure 1. Local 1.4 GHz radio luminosity function of Revised Shapley-Ames spiral galaxies, with known AGN from Véron-Cetty & Véron (1993) catalogue excluded. Errors are the $\Sigma 1/V_{\mathrm{max}} \pm \sqrt{\Sigma 1/V^2_{\mathrm{max}}}$ range in the case of > 1 galaxy in the bin; for bins with a single galaxy the errors represent $\pm 1\sigma$ limits on the appropriate Poisson distribution. The full line shows the Schechter function fit described in the text, and the short dashed line shows the original Condon (1989) luminosity function. The long dashed line shows the best-fit Hα luminosity function of Gallego et al. (1995), scaled using equations 2 and 3.

atically higher star formation rates than inferred at $z \sim 0.5 - 1$ in the optical; the Hα luminosity density in the CFRS (Tresse & Maddox 1998) implies a $z \sim 0.3$ star formation rate $2 - 3$ times higher than that inferred from de-reddened ultraviolet estimates.

In this paper we will show that the local Hα star formation rate is itself also a significant underestimate, by comparing it with the local radio luminosity density of star forming galaxies. By inference even the dereddened Hα luminosity densities at higher redshifts are also underestimates, adding further evidence that the apparent redshift cut-off in the SFR is not real.

This paper is structured as follows. In section 2 we present the sample used in this paper, and corresponding selection criteria. Section 3 presents a calculation of the local radio luminosity function and luminosity density. Implications of these results are discussed in section 4.

Table 1. Local 1.4GHz luminosity function paramters: $\phi(L)dL = \phi_*(L/L_*)^{\alpha} \exp(-L/L_*) d(L/L_*)$ Mpc^{-3}

Parameter	min-χ^2 value	$\pm 1\sigma$ range
ϕ_* (Mpc^{-3})	4.9×10^{-4}	$(3.7 - 5.9) \times 10^{-4}$
L_* (W Hz^{-1})	2.8×10^{22}	$(1.9 - 3.3) \times 10^{22}$
$-\alpha$	1.29	1.21 − 1.35
$L_* \phi_* \Gamma(2+\alpha)$		
(W Hz^{-1} Mpc^{-3})	1.73×10^{19}	$(1.35 - 2.08) \times 10^{19}$

2 SAMPLE DEFINITION

Unlike the far-IR, Hα and UV, the radio luminosity density traces both obscured and unobscured star formation, as well as being free of cirrus contamination which affects far-IR estimates at faint luminosities (Condon, Anderson & Helou 1991). At low radio frequencies ($\sim$ 1GHz) the luminosity is dominated by non-thermal emission, plausibly from cosmic ray electrons accelerated by supernovae, which can be calibrated to the recent star formation rate using the supernova rate in the Galaxy (Condon 1992; section 3). The low frequency radio luminosity density is therefore an ideal estimator of the local volume-averaged star formation rate.

The $B \leq 12$ spiral galaxies in the Revised Shapley-Ames catalogue were mapped at 1.4GHz by Condon (1987) with the VLA to limiting flux densities of (typically) $0.1 - 0.5$ mJy, obtaining detections of virtually 100% of the sample. The survey spans a sufficiently large cosmological volume for large scale stucture density fluctuations to be negligable in comparison with the shot noise on the luminosity density and overall number density (Condon 1989; Oliver, Gruppioni & Serjeant 1998), though as a precaution the Local Group is excluded by elimimating the 10 galaxies within 1.7 Mpc, and the Virgo Cluster excluded by removing the 27 within 10° of the cluster centre. These exclusions leave a sample of 267 spiral galaxies. With the correction for galactic extinction, the resulting survey has an effective areal coverage of $\simeq 7.1$ sr (Condon 1989). We then eliminated the 36 galaxies listed as Seyferts in the Véron-Cetty & Véron (1993) catalogue, differing somewhat from the approach of Condon (1989) (with a non-negligable effect on the luminosity function; section 3). A key advantage of this sample is that its well-studied nature makes AGN segregation as robust and reliable as possible. The exclusion of AGN neglects any contributions from circumnuclear star formation in these objects, so the luminosity density from star formation derived in this paper should strictly speaking be treated as a lower limit.

3 THE RADIO LUMINOSITY FUNCTION

In figure 1 we plot the $1/V_{\mathrm{max}}$ estimate of the radio luminosity function (Schmidt 1968) for this sam-