Abstract. We are conducting a large survey of star formation within ∼ 400 nearby spiral and irregular galaxies through imaging of the Hα emission. We present here some of our first results from 104 of the galaxies in our sample, investigating the variation of SFR and Hα EWs along the Hubble sequence for these galaxies. We find a strong dependence of SFR on Hubble type, peaking for Sbc galaxies, but with large dispersions within each type. There is a possible dependence of SFR on bar presence, but none on group membership. There is an increase in EWs for later Hubble types, but with large dispersions within each type. We find no dependence of EW on bar presence, group membership or on absolute magnitude.

1. The Hα Galaxy Survey

The Hα Galaxy Survey (HαGS) is a major survey of star formation in the local Universe, using the 1m Jacobus Kapteyn Telescope (JKT) at La Palma, and redshifted Hα filters to determine the quantity and spatial distribution of ionized gas in ∼ 400 spiral and irregular galaxies within 30 h⁻¹ Mpc. We are using broad- and intermediate-band R filters for continuum subtraction. Our sample was selected, using the Uppsala Galaxy Catalogue (Nilson 1973) as the parent catalogue, within 5 redshift shells, but with the angular area of the selection region decreasing such that all shells have equal volumes.

The well-defined selection criteria, and the large total number of galaxies, mean that it will be possible to combine the data for all shells such that galaxies with a wide range of luminosities, diameters and surface brightness are represented. Previous studies, e.g. those of Kennicutt & Kent (1983) and Young et al. (1996), have been weighted heavily towards large, luminous and relatively rare Sa-Sc spirals. The low luminosity, dwarf galaxies in our sample are the most populous in the Universe, and our survey will determine whether they are in fact responsible of a significant fraction of the total star formation locally.

We have been awarded 14 weeks of observing time over 2000-2002 (long-term status) on the JKT to complete the Hα observations.

We are aiming to address such questions as:
- What is the total star formation rate (SFR) in the local Universe?
- Which galaxy types and morphologies dominate?
- Does nuclear activity (star formation or AGN) depend on galaxy properties
and environment?
- What is the star formation distribution within galaxies?
- How does environment affect star formation rate?

In this paper we will present preliminary results from SFRs and equivalent widths (EWs) so far calculated for 104 of the galaxies in our sample. These galaxies were all observed under photometric conditions.

2. Star formation rates

The total SFR for each galaxy was calculated from the $H\alpha$ luminosity using the conversion of Kennicutt, Tamblyn, & Congdon (1994):

$$\text{SFR}(M_\odot yr^{-1}) = L_{H\alpha}(W) \times 7.94 \times 10^{-35}$$

In this preliminary reduction, the luminosities were corrected for internal extinction assuming a constant value of 1.1mag for each galaxy (Kennicutt 1983) and the Galactic extinction value given by Cardelli, Clayton, & Mathis (1989). Corrections for contamination by the $[\text{N} \text{II}]$ doublet lines which lie either side of the $H\alpha$ line were applied using the $H\alpha/(H\alpha+[\text{N} \text{II}])$ ratios derived spectrophotometrically by Kennicutt (1983): 0.75±0.12 for spirals and 0.93±0.05 for irregulars.

For the 104 galaxies investigated, the SFRs range between ~ 0 and 6$M_\odot yr^{-1}$. 75 of these galaxies are classified as spiral galaxies and the mean SFR for these is 0.525 (±0.100)$M_\odot yr^{-1}$. The mean SFR for the 29 irregular galaxies is 0.146 (±0.072)$M_\odot yr^{-1}$.

58 of the 104 galaxies also have IRAS far-infrared fluxes. In Figure 1 we have plotted our $H\alpha$ SFRs against the IRAS SFRs. The dashed lines represents an exact match between the two sets of values. It can be seen that the points do not lie on the line, but nevertheless form a good correlation. The solid line is the best fit through the points and has a slope of 0.83±0.06.

In Figure 2 we have plotted the mean SFR for each galaxy type. The error bars show $\sigma/\sqrt{n}$. We see that there is a strong dependence of SFR on
Hubble type with the highest values being for Sb-Scd galaxies, peaking at Sbc. From the error bars, and also from Figure 3, where we have plotted each galaxy individually, we see that there is a large variation present in the SFRs amongst galaxies of the same type. This variation is most likely real, and not just due to measurement errors.

In Figure 3 we have split the sample into barred and unbarred galaxies. There seems to be a slight trend for late type (Sd-Irr) barred galaxies to have higher SFRs than late type unbarred galaxies, however, the full sample of 400 galaxies will be required to see if this observation is real.

When we split the sample into 71 field galaxies and 33 group galaxies (as defined by Huchra & Geller 1982), we find no definite difference between the star formation properties of the two samples.

### 3. Equivalent width measurements

SFRs are biased by galaxy size. Larger galaxies are more likely to have more star forming regions and emit more Hα. EW gives a measure of SFR per unit (red) luminosity, and thus helps to remove size biases. EW is also distance independent.

The EWs calculated range between 0.7 and 33nm. The 75 spirals have a mean EW of 3.55(±0.30)nm, while the 26 irregulars have a mean value of 5.74(±1.48)nm. Thus, once we normalise for galaxy size, the irregulars have similar star formation rates per unit mass to the spirals.

In Figure 4 we have plotted the mean EW for each galaxy type. We see a clear trend for later type (Sc - Irr) galaxies to have higher mean EWs than earlier types (S0/a - Sbc). From the error bars (σ/√n) and from Figure 5, where we have plotted each galaxy separately, we again see that there is a large dispersion amongst galaxies of the same type. These findings are in agreement with those of Kennicut (1998).

From Figure 5 we see that there is no detectable dependence on the presence of a bar (again in agreement with Kennicutt 1998). We also find no detectable difference between field and group galaxies.
The two highest EWs, which in fact go off the scale of Figure 5, belong to UGC3847 (33nm) and UGC3851 (28nm) - an interacting pair of irregulars. This finding is in agreement with theories that galaxy interactions increase the star formation activity of the galaxies involved.

In Figure 6 we investigate the relationship between EW and absolute V magnitude. Gavazzi, Pierini, & Boselli (1996) find that Hα EW increases steeply with decreasing luminosity. We find no correlation overall, although the two highest EW values are found among the low luminosity irregulars as noted above.

4. Summary

From a preliminary subset of 104 galaxies ($\sim 1/4$ of the final sample) we find:
- a correlation between our HαGS SFRs and IRAS SFRs;
- a strong dependence of SFR on Hubble type, but with large dispersions within each type;
- a possible dependence of SFR on bar presence for late type galaxies, but none on group membership;
- an increase in EWs for later types, but large dispersions within each type;
- no dependence of EW on bar presence or group membership;
- no correlation between EW and absolute magnitude.

5. Further work

The survey is due to finish in January 2002. With the full sample we hope to be able to further investigate the above findings as well as to answer the remaining questions mentioned in §1.

We also aim to derive our own extinction corrections from Brγ observations taken with the WHT and UKIRT, and our own [Nii] corrections using [Nii] imaging with the JKT. In both cases we will be able to formulate corrections that take into account both galaxy type and the distribution of dust of [Nii] within the galaxies. Preliminary investigations show that the [Nii] emission does not trace the Hα emission.

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References

Cardelli, J.A., Clayton, G.C., & Mathis, J.S. 1989, ApJ, 345, 245
Gavazzi, G., Pierini, D., & Boselli, A. 1996, A&A, 312, 397
Huchra, J.P., & Geller, M.J. 1982, ApJ, 257, 423
Kennicutt, R.C. 1983, ApJ, 272, 54
Kennicutt, R.C. 1998, ARA&A, 36, 189
Kennicutt, R.C., & Kent, S.M. 1983, AJ, 88, 1094
Kennicutt, R.C., Tamblyn, P., & Congdon, C.W. 1994, ApJ, 435, 22
Nilson, P. 1973, “Upssala general catalogue of galaxies”
Young, J.S., Allen, L., Kenney, J.D.P., Lesser, A., & Rownd, B. 1996, AJ, 112, 1903