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# Measurements of the Equivalent Width of the $H_\beta$ Emission Line and Age Determination of HII Regions of the LMC and SMC

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**Summary.** The equivalent width of the emission line $H_\beta$ was measured photoelectrically in 29 H II regions of the LMC and 2 of the SMC respectively. The age of these regions was obtained through a calibration of $W_{H_\beta}$. A relation was found between $W_{H_\beta}$ and the ratio of the H II region radius to that of the embedded stellar association.

**Key words:** magellanic clouds – H II regions – age – star formation

## I. Introduction

Traditionally the equivalent widths $W$ of emission lines in extragalactic H II regions and in nuclei of galaxies are measured spectroscopically. Since the emission of the line comes from the ionized gas and the continuum mainly from the embedded stars, $W$ as measured with slit spectroscopy is biased if the slit does not include the whole emission region. This effect restricts in practice to distant H II regions (Searle, 1971) and nuclei of galaxies the possibility of measuring unbiased equivalent widths of emission lines by spectroscopy and certainly eliminates the possibility of obtaining reliable data for nearby H II regions such as those of the Magellanic Clouds or our own galaxy.

In order to measure $W_{H_\beta}$ in H II regions of the LMC and SMC we used a photometric method which will be described in the next section. This method allows to measure $W_{H_\beta}$ on large surface areas.

It is thus possible to determine the age of the observed H II regions by means of a calibration of $W_{H_\beta}$ obtained elsewhere (Dottori, 1981, hereinafter Paper I).

## II. The Observations

The observations were carried out photoelectrically during different nights from October 1979 to January 1980 with a photon counter device attached to a 50 cm Cassegrain reflector with a scale of 1′ = 1.87 mm at the focal plane. The filters used were the 45 (centered at 4517 A) and the 48 (centered at 4866 A) of the DDO system (den Bergh and McClure, 1968). The integration times were 16 and 32 s according to the brightness of the H II region and the observations were made with a diaphragm of 10′ in the order $B$–$R$–$B$ ($B$ = background, $R$ = region) repeating at least twice the filter sequence 45–48–48–45. The background observations include both the sky and the foreground stars. The observed H II regions are listed in Table 1. The columns give successively: 1. the number in the NGC, IC or SL (Shapley and Lindsay, 1963) catalogues; 2.

**Table 1.** Columns 1–7 are explained in Sect. II, Column 8 in Sect. III at the end of paragraph b and Column 9 at the end of Sect. III

| OBJECT | HII REGION | POSITION |  | N | BACKGROUND |  | LINE INTENS. SOURCE | $W_{H_\beta}$ (A) |
|---|---|---|---|---|---|---|---|---|
|  |  | R.A. | DEC. |  | R.A. | DEC. |  |  |
| LARGE MAGELLANIC CLOUD |  |  |  |  |  |  |  |  |
| NGC 1727/2 | N 79 | $04^h52^m.3$ | $-69°23'$ | 2 | $04^h52^m$ | $-68°00'$ | N79E | 107 |
| NGC 1743/37/45/8 | N 83 | 04 54.2 | - 69 15 | 2 | 04 54 | - 68 00 | N79E* | 105 |
| NGC 1761/60 | N 10 | 04 56.7 | - 66 31 | 2 | 04 30 | - 66 30 | N11B* | 53 |
| NGC 1763 | N 10 | 04 56.8 | - 66 26 | 4 | 04 30 | - 66 30 | N11B | 189 |
| NGC 1770 | N 91 | 04 57.5 | - 68 27 | 2 | 04 57 | - 68 00 | N91A | 78 |
| NGC 1769 | N 10 | 04 57.6 | - 66 30 | 2 | 04 30 | - 66 30 | N11B* | 180 |
| NGC 1858 | N 105 | 05 10.0 | - 68 56 | 2 | 05 10 | - 68 10 | N105A | 85 |
| NGC 1876/4/7/80 | N 113 | 05 13.4 | - 69 23 | 2 | 05 13 | - 70 45 | N113D | 46 |
| NGC 1910/SL 360 | N 119 | 05 18.4 | - 69 15 | 2 | 05 18 | - 70 40 | N119 | 68 |
| NGC 1936/5/4/7/29<br>IC 2126/7 | N 44 | 05 22.1 | - 67 59 | 2 | 05 22 | - 67 30 | N44B | 43 |
| IC 2128 | N 44 | 05 23.0 | - 68 05 | 3 | 05 23 | - 67 30 | N44B* | 30 |
| NGC 1948 | N 48 | 05 26.0 | - 66 15 | 2 | 05 26 | - 65 50 | N55A* | 48 |
| NGC 1955/SL 456 | N 51 | 05 26.0 | - 67 31 | 2 | 05 26 | - 68 00 | N59A* | 48 |
| NGC 1970/65/6/2 | N 144 | 05 26.8 | - 68 50 | 2 | 05 27 | - 68 00 | N157A* | 61 |
| NGC 1968/74 | N 51 | 05 27.6 | - 67 28 | 3 | 05 28 | - 68 00 | N59A* | 31 |
| NGC 2018 | N 206 | 05 31.6 | - 71 05 | 3 | 05 32 | - 71 30 | N214C* | 117 |
| SL 553 | N 55 | 05 32.2 | - 66 28 | 2 | 05 32 | - 65 30 | N55A | 87 |
| NGC 2014 | N 57 | $05^h32^m.5$ | $-67°43'$ | 2 | $05^h33^m$ | - 68 10 | N59A* | 72 |
| NGC 2030 | N 63 | 05 35.7 | - 66 03 | 2 | 05 36 | - 65 30 | N55A* | 84 |
| NGC 2032/5/40/29 | N 59 | 05 35.5 | - 67 35 | 3 | 05 36 | - 68 00 | N59A | 268 |
| NGC 2044 | N 157 | 05 36.1 | - 69 12 | 2 | 05 36 | - 68 20 | N157A* | 76 |
| NGC 2060 | N 157 | 05 38.0 | - 69 11 | 2 | 05 38 | - 68 20 | N157A* | 200 |
| NGC 2070 (30 DOR) | N 157 | 05 39.0 | - 69 06 | 3 | 05 39 | - 68 20 | N157A | 258 |
| NGC 2074 | N 158 | 05 39.3 | - 69 30 | 3 | 05 39 | - 68 20 | N157A* | 77 |
| NGC 2080/77/85/6 | N 160 | 05 40.0 | - 69 38 | 4 | 05 40 | - 68 20 | N160A | 77 |
| NGC 2079/8/83/84 | N 159 | 05 40.3 | - 69 45 | 4 | 05 40 | - 68 20 | N159A | 70 |
| NGC 2081 | N 158 | 05 40.3 | - 69 25 | 2 | 05 40 | - 68 20 | N157A* | 55 |
| NGC 2103 | N 214 | 05 42.0 | - 71 21 | 3 | 05 42 | - 71 45 | N214C | 115 |
| NGC 2122 | N 180 | 05 49.1 | - 70 05 | 2 | 05 49 | - 69 40 | N159A* | 114 |
| SMALL MAGELLANIC CLOUD |  |  |  |  |  |  |  |  |
| NGC 346 | N 66 | 00 58.2 | - 72 19 | 2 | 00 58 | - 72 00 | N66 | 115 |
| NGC 371 | N 76 | 01 02.5 | - 72 13 | 2 | 01 03 | - 71 40 | N76 | 33 |

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the number from the catalogue of H II regions in the Magellanic Clouds (Henize, 1956); 3. and 4. coordinates for the epoch 1975; 5. number of observations; 6. and 7. the coordinates of the zones adopted as being representative of the background brightness. The other columns will be discussed later.

The filter 45 measurements are intended to provide the continuum intensity to be subtracted from the intensity measured in the filter 48. The errors introduced by this assumption are discussed in the next section.

## III. Measurements of $W_{\mathrm{H}\beta}$ and Sources of Error

The formula used to evaluate $W_{\mathrm{H}\beta}$ is,

$$W_{\mathrm{H}\beta} = \frac{B_{45}\left[\varphi \cdot \alpha \cdot \dfrac{N_{48}}{N_{45}}\right] - B_{48}}{1 + \tau_1 \cdot \eta_1 + \tau_2 \cdot \eta_2} + W_{\mathrm{H}\beta\mathrm{abs}} \tag{1}$$

where $B_i$ is the equivalent passband (in our case $B_{45} = 43.4$ A and $B_{48} = 102$ A) and $N_i = N_{i\mathrm{obj}} - N_{i\mathrm{back}}$, $N_{i\mathrm{obj}}$ being the mean value of the counts in the cycles corresponding to the object and $N_{i\mathrm{back}}$ the same quantity for the background. The four sources of error detected are:

a) $\varphi$ is the ratio of the continuum intensity at $\lambda 4517$ and $\lambda 4866$; it takes into account the difference in the continuum emission of the ionizing association in the bands of filters 45 and 48.

b) $\alpha$ is the ratio of the differential absorption between the two mentioned bands.

c) The contamination of the $\mathrm{H}_\beta$ counts in the filter 48 by the doublet $\lambda\lambda 4959, 5007$ of the [O III] is taken into account through $\tau_i = T_i/T_{\mathrm{H}\beta}$, the filter 48 transmission at the line $i$ relative to that at $\mathrm{H}_\beta$ and $\eta_i = N'_i/N'_{\mathrm{H}\beta}$ the gas emission at the wavelength $i$ relative to that at $\mathrm{H}_\beta$.

d) $W_{\mathrm{H}\beta}$ corrects the lowering of the emission due to the $\mathrm{H}_\beta$ absorption line present in stellar types from O 6 to F 2.

The evaluation of each factor was carried out in the following way:

a) The factor $\varphi$ can be evaluated by adopting a given mass function if the flux $f_\lambda$ and the radius $R$ of each spectral type are known. We have adopted the Salpeter's IMF, $f_\lambda$ was taken from Kurucz (1979) and the stellar radii from Panagia (1973). $\varphi$ is given by:

$$\varphi = \frac{\sum\limits_i f_{4517}\, m_i^{-2.45} R_i^2}{\sum\limits_i f_{4866}\, m_i^{-2.45} R_i^2} \tag{2}$$

and the resulting value is $\varphi = 1.48$. It should be noted that $\varphi$ is practically insensitive to the IMF.

b) The influence of the differential absorption can be obtained from the observed $\mathrm{H}_\alpha/\mathrm{H}_\beta$ ratio using a relation given by Osmer et al. (1974) and supposing a normal absorption law. $\alpha$ is given by:

$$\alpha = \exp_{10}\left\{-0.4 \times 4.69\left(\frac{1}{0.4866} - \frac{1}{0.4517}\right)\log\frac{\mathrm{H}_\alpha}{2.8\,\mathrm{H}_\beta}\right\}. \tag{3}$$

In Table 2 we summarize the available data (Dufour, 1975; Dufour and Harlow, 1977; Pagel et al., 1978; Peimbert and Torres Peimbert, 1974) on line intensity ratios necessary for the subsequent calculations. By columns we quoted: 1. The designation of the measured portion of H II region. The corresponding value will be assigned to the whole H II region and in some cases to nearby ones. 2. The ratio $\mathrm{H}_\alpha/\mathrm{H}_\beta$. 3. The value of $\alpha$. For each H II region Column 8 of Table 1 lists the region of Table 2 whose values were adopted in the corrections (an asterisk denotes extrapolation).

**Table 2.** Columns 1–3 are explained in Sect. III paragraph b and Columns 4 and 5 in Sect. III at the end of paragraph c

| NAME | $\frac{I_{\mathrm{H}_\alpha}}{I_{\mathrm{H}_\beta}}$ | $\alpha$ | $\frac{I_{4959}}{I_{\mathrm{H}_\beta}}$ | $\frac{I_{5007}}{I_{\mathrm{H}_\beta}}$ |
|---|---|---|---|---|
| N11B | 2.86 | 1.01 | 1.05 | 3.23 |
| N44B | 2.80 | 1.00 | 2.90 | 7.80 |
| N55A | 2.81 | 1.00 | 0.91 | 2.75 |
| N59A | 3.00 | 1.02 | 1.86 | 5.37 |
| N66 | 2.83 | 1.00 | 1.70 | 5.25 |
| N76 | 2.85 | 1.01 | 2.14 | 6.17 |
| N79E | 3.02 | 1.02 | 0.41 | 1.32 |
| N91A | 2.94 | 1.01 | 0.88 | 2.63 |
| N105A | 3.03 | 1.03 | 0.93 | 2.82 |
| N113D | 2.82 | 1.00 | 0.77 | 2.40 |
| N119 | 2.74 | 1.00 | 0.47 | 1.41 |
| N157A | 2.90 | 1.01 | 1.16 | 3.48 |
| N159A | 2.85 | 1.01 | 1.44 | 3.98 |
| N160A | 2.97 | 1.02 | 1.51 | 4.46 |
| N214C | 2.68 | 1.00 | 0.95 | 2.95 |

c) The contamination due to the [O III] doublet was evaluated as follows; if $N'_\lambda$ is the number of photons of wavelength $\lambda$ emitted by the gas that reaches filter 48 and $N_\lambda$ is the number passing through the filter, then the counting assigned to $\mathrm{H}_\beta$ is:

$$N^*_{\mathrm{H}\beta} = T_{\mathrm{H}\beta} N'_{\mathrm{H}\beta} + T_{4959} N'_{4959} + T_{5007} N'_{5007}$$

where $T_\lambda$ is the transmission of the filter 48 at the wavelength $\lambda$. With the definition of $\tau_i$ and $\eta_i$ given above it results for the relation between the counted number of $\mathrm{H}_\beta$ photons ($N^*_{\mathrm{H}\beta}$) and the true one ($N_{\mathrm{H}\beta}$);

$$N^*_{\mathrm{H}\beta} = N_{\mathrm{H}\beta}(1 + \tau_1\eta_1 + \tau_2\eta_2)$$

The values of $\tau_i$ can be obtained from the filter transmission curve (in our case $\tau_1 = 0.614$, $\tau_2 = 0.123$) and those of $\eta_i$ from the available data on $[\mathrm{O\,III}]/\mathrm{H}_\beta$ listed in Columns 4 and 5 of Table 2.

d) The lowering of the emission produced by the absorption line $\mathrm{H}_\beta$ present in stars of types O 6 to F 2 tends to decrease the final values of the measured $W_{\mathrm{H}\beta}$. By using a procedure as that shown in Paper I it is easy to synthesize $W_{\mathrm{H}\beta\mathrm{abs}}$ by adopting as in the former cases a Salpeter's IMF. The values of $W_{\mathrm{H}\beta}$ in absorption for individual stars are given by Sinnerstadt (1961). These data lead to a value of about 1 A for $W_{\mathrm{H}\beta\mathrm{abs}}$ which shows that it can be disregarded from formula 1.

The resulting $W_{\mathrm{H}\beta}$ are shown in Table 1 column 9. The mean internal error of these data due to the spread in the 45 and 48 counts is $\varepsilon(W_{\mathrm{H}\beta}) = \pm 14$ A.

## IV. The Age of the Observed H II Regions

In Paper I a calibration was obtained for the variation of the $W_{\mathrm{H}\beta}$ as a function of the evolution of the ionizing association for a single burst of star formation, which provides a means to measure the age of the H II regions. As shown in Paper I three main factors determine the actual $W_{\mathrm{H}\beta}$, the metallicity, the IMF and the age. As shown by Kahn (1974), the metallicity determines basically the upper mass limit of the stars to be formed in a given medium. This parameter does not alter the evolution of a given star, as shown by

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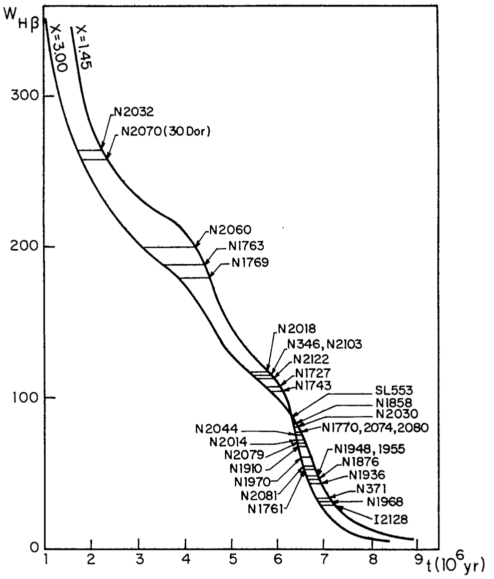

**Fig. 1.** Age determination of H II regions in the Magellanic Clouds, where $x$ means $\varphi(M)=M^{-(1+x)}$

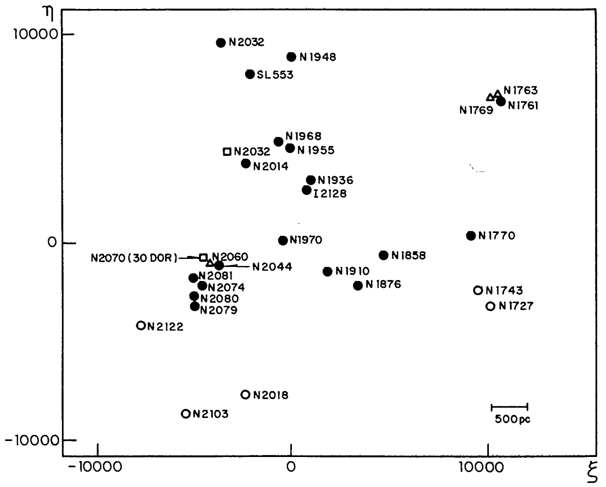

**Fig. 2.** Age distribution on the surface of the LMC in coordinates $(\xi, \eta)$. □ 1.8–2.3 $10^6$ years, △ 3.1–4.6 $10^6$ yr, ○ 5.3–6.2 $10^6$ yr and ● 6.3–7.2 $10^6$ yr

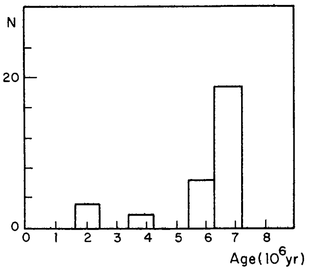

**Fig. 3.** Number of H II regions formed in the LMC reduced to intervals of 0.9 $10^6$ yr. A burst of star formation ocurred around 7 $10^6$ yr ago

Although the upper mass limit seems to be low for the H II regions of the MCs, the effect of changing the mass limit would only be to change the age scale: the order of magnitude of the ages and the relative ages would remain roughly correct (we are indebted to Lequeux for bringing this point to our attention). For the IMF $\varphi(M)=M^{-(1+x)}$ we have considered two limiting cases, namely the Salpeter's $x=1.45$ and another $x=3.0$ as quoted by Ostriker et al. (1974) for some H II regions of the Milky Way. The stellar fluxes as a function of the temperature for a large sample of stellar atmosphere models was obtained from Kurucz's tables (1979). We have computed (Paper I) the synthetic $W_{H_\beta}$ of H II regions opaque to Lyman photons. The function $W_{H_\beta}$ vs age is plotted in Fig. 1, where it is seen that the relation is not significantly affected by the form of $\varphi(M)$ for $1.45<x<3.0$. In this figure we have also plotted the observed H II regions of the LMC and SMC, fixing their ages according to the model described.

Figure 2 shows the age distribution on the surface of the LMC in coordinates $(\xi, \eta)$ (Wesselink, 1959).

Figure 3 displays the histogram of H II regions as a function of age. This figure shows that the major part of the observed H II regions in the LMC has ages between 6.2 and 7.2 $10^6$ years. On the other hand, as it can be seen in Fig. 1, it is not possible to infer anything about older H II regions since they are practically undetectable by means of $W_{H_\beta}$ measurements.

Although our sample of H II regions is small, the loci of equal age in Fig. 2 resemble those of Ardeberg (1976) and Hodge (1973).

Finally it is interesting to emphasize that the age derived for 30 Dor from Fig. 1, about 1.8 to 2.3 $10^6$ yr agrees well with determinations by other authors. The values quoted are; Ardeberg (1976), $<4\,10^6$ y; Hodge (1973), $<3\,10^6$ y; Hyland et al. (1978), $<3\,10^6$ yr.

## V. An Empirical Relation between $W_{H_\beta}$ and the Dimensions of the H II Region and the Involved Association

We have made several attempts in order to check possible relations between $W_{H_\beta}$ and the dimensions of the H II regions and/or that of the ionizing stellar associations. A relation was found involving the ratio of the projected areas of the H II region and the related association.

$$\beta = 2\log(R_{\mathrm{H\,II}}/R_A),$$

where $R_{\mathrm{H\,II}}$ is the mean radius of the H II region and $R_A$ that of the stellar association. Figure 4 shows the relation $W_{H_\beta}$ vs $\beta$.

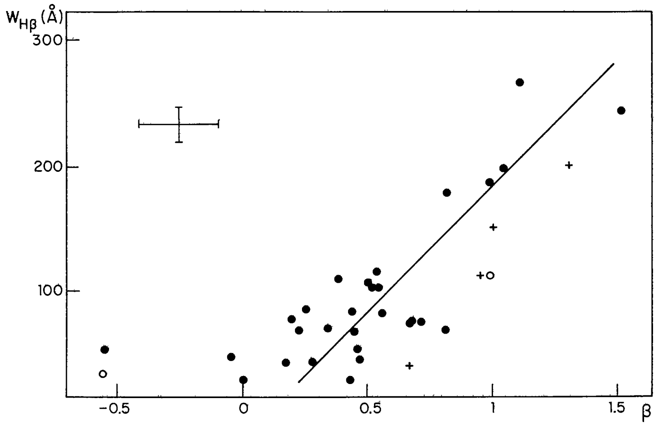

**Fig. 4.** Relation of $W_{H_\beta}$ vs $\beta = 2\log(R_{\mathrm{H\,II}}/R_A)$. ● H II regions of the LMC, ○ of the SMC, + of M33

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Stothers and Chin (1978). We have adopted stellar evolutionary tracks given in that paper with an upper mass limit of about 60 $M_\odot$.

The dimensions of the H II regions of the LMC and SMC were measured on the $H_\alpha$ plates in Davies et al. (1976) and those of the associations on the blue plates in the atlases of the LMC and SMC (Hodge and Wright, 1967, 1977). The measurement criteria were:

a) The dimensions of the H II regions are equivalent sizes representative of the total surface area projected on the sky. The equivalent diameter $2R_{\mathrm{H\,II}}$ is the geometrical mean of the largest and smallest diameters. The overexposed sharp edges define well the borders of the H II regions contrary to the case of the associations.

b) Attached and detached knots were disregarded unless their dimensions were on the same order as the main body. In these cases a mean $\beta$ was adopted.

d) The limits of stellar associations were defined as being where stars could no more be distinguished from the field star density.

Table 3 lists in successive columns: 1. Name of the H II region; 2. and 3. the mean diameters of the H II region and of the related association respectively. Two values indicate two main bodies; 4. the resulting $\beta$.

The values are the mean of two independent measurements yielding as mean errors $\varepsilon(2R_{\mathrm{H\,II}}) = \pm 9$ pc, $\varepsilon(2R_A) = \pm 12$ pc, and $\varepsilon(\beta) = \pm 0.16$.

The data of $R_{\mathrm{H\,II}}$ show homogeneity among Davies et al. ($D_a$) (1976), Geyer and Hopp (GH) (1980), and us (DB). Using the H II regions in common among the different authors we obtained the following relations, for the equivalent radii:

$$R_{\mathrm{H\,II}}(\mathrm{GH}) = 0.77\,R_{\mathrm{H\,II}}(\mathrm{D_a}) + 1$$

correlation 78%, size of sample 19 points, range of values $5 \lesssim R_{\mathrm{H\,II}}(\mathrm{GH}) \lesssim 80$ and $5 \lesssim R_{\mathrm{H\,II}}(\mathrm{D_a}) \lesssim 95$

$$R_{\mathrm{H\,II}}(\mathrm{DB}) = 0.70\,R_{\mathrm{H\,II}}(\mathrm{D_a}) + 2$$

correlation 81%, size of sample 19 points, range of values $20 \lesssim R_{\mathrm{H\,II}}(\mathrm{DB}) \lesssim 95$ and $30 \lesssim R_{\mathrm{H\,II}}(\mathrm{D_a}) \lesssim 130$. A comparison of GH and DB is inconclusive because we have only 4 H II regions in common. The comparison of the association diameters between Lucke and Hodge (LH) (1970) and us, leads to the following result

$$R_A(\mathrm{DB}) = 2.01\,R_A(\mathrm{LH}) - 36$$

correlation 72%, size of sample 22 points, range of values $13 \lesssim R_A(\mathrm{DB}) \lesssim 58$, $24 \lesssim R_A(\mathrm{LH}) \lesssim 47$.

**Table 3.** Columns are explained in Sect. V

| NAME | $2R_{\mathrm{HII}}$ (pc) | $2R_A$ (pc) | β |
|---|---|---|---|
| LMC | | | |
| NGC 1727/2 | 60/28 | 30/17 | 0.52 |
| NGC 1743/37/45/8 | 50/40 | 32/20 | 0.50 |
| NGC 1761/60 | 45 | 85 | - 0.55 |
| NGC 1763 | 103 | 33 | 0.99 |
| NGC 1770 | 71 | 57 | 0.19 |
| NGC 1769 | 66 | 26 | 0.81 |
| NGC 1858 | 72 | 38 | 0.56 |
| NGC 1876/4/7/80 | 55 | 40 | 0.28 |
| NGC 1910/SL 360 | 145 | 113 | 0.22 |
| NGC 1936/5/4/7/29<br>IC 2126/7 | 112 | 92 | 0.17 |
| IC 2128 | 73 | 73 | 0.00 |
| NGC 1948 | 70 | 74 | - 0.05 |
| NGC 1955/SL 456 | 136 | 45/35 | 0.47 |
| NGC 1970/65/6/2 | 142 | 56 | 0.81 |
| NGC 1968/74 | 130 | 79 | 0.43 |
| NGC 2018 | 158 | 86 | 0.53 |
| SL 553 | 80 | 60 | 0.25 |
| NGC 2014 | 129 | 87 | 0.34 |
| NGC 2030 | 53 | 32 | 0.44 |
| NGC 2032/5/40/29 | 95 | 27 | 1.09 |
| NGC 2044 | 172 | 78 | 0.69 |
| NGC 2060 | 80 | 25 | 1.01 |
| NGC 2070 | 267 | 47 | 1.51 |
| NGC 2074 | 103 | 45 | 0.72 |
| NGC 2080/77/85/6 | 125 | 57 | 0.68 |
| NGC 2079/8/83/4 | 73 | 44 | 0.44 |
| NGC 2081 | 103 | 61 | 0.46 |
| NGC 2103 | 52 | 34 | 0.37 |
| NGC 2122 | 86 | 46 | 0.54 |
| SMC | | | |
| NGC 346 | 182 | 57 | 1.00 |
| NGC 371 | 84 | 160 | - 0.56 |
| M33 | | | |
| IC 142 | 100 | 46 | 0.67 |
| REG 15 | 94 | 21 | 1.30 |
| NGC 604 | 330 | 101 | 1.03 |
| IC 131 | 80 | 27 | 0.94 |

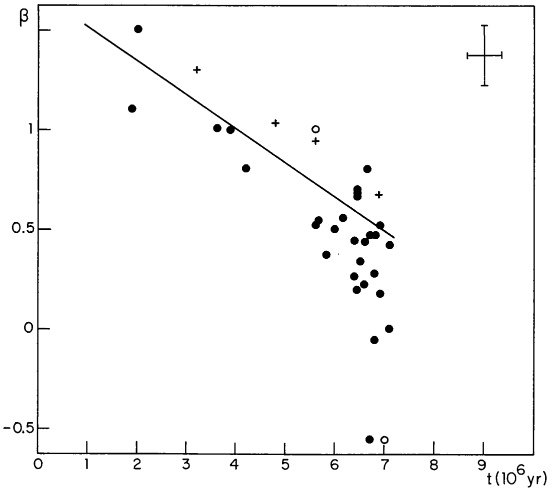

**Fig. 5.** Relation of $\beta$ vs age. ● H II regions of the LMC, ○ of the SMC, + of M33

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The diameters quoted by GH for the four associations we have in common are systematically smaller than ours. GH and LH have seven associations in common from which three agree well and four are much smaller in GH's sample.

In Fig. 4 we have also included four H II regions of M33 for which it was possible to find all the necessary data. Searle (1971) obtained $W_{\mathrm{H}\beta}$ for IC 142, region 15, NGC 604 and IC 131 quoting 42 Å, 204 Å, 152 Å and 115 Å respectively, Table 3 lists $2R_{\mathrm{H\,II}}$, $2R_A$ and $\beta$ for these regions. The H II region dimensions were obtained from measurements on $H_\alpha$ plates by Boulesteix et al. (1974) and those of the association were measured on the blue plate in Walker (1964).

Although $\beta$ should be a function of many parameters through $R_{\mathrm{H\,II}}$ (electronic density, structure, age, number and temperature of the ionizing stars) and through $R_A$ (age and number of stars), Fig. 4 together with Sect. IV suggest that the age is the main parameter determining $\beta$. The functional dependence of $R_{\mathrm{H\,II}}$ and of $R_A$ on the total number of stars is surely ruled out by the ratio $R_{\mathrm{H\,II}}/R_A$. In Fig. 5 we plot $\beta$ vs age. The age assigned to each H II region was obtained from Fig. 1 interpolating to $x = 2.0$ (Lequeux, 1979).

## VI. Conclusions

The $W_{\mathrm{H}\beta}$ of large apparent size H II regions in the LMC and SMC was determined photoelectrically.

It is possible to determine an age scale for the H II regions of the LMC and SMC for which the $W_{\mathrm{H}\beta}$ was measured.

The H II regions age maximum frequency corresponds to the range 6.2 to 7.2 $10^6$ yr, but older H II regions are practically undetectable by $W_{\mathrm{H}\beta}$ measurements.

The relation between the morphological parameter $\beta$ and $W_{\mathrm{H}\beta}$ suggests that $\beta$ is essentially an age indicator for ages $< 6\,10^6$ yr.

The result on the $\beta$ parameter raises a further doubt about the present use of H II regions as extragalactic distance indicators, but offers a way of making some corrections to this use (this point was also brought out by Lequeux).

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