BURST OF STAR FORMATION IN DETACHED EXTRAGALACTIC H II REGIONS: A QUALITATIVE ANALYSIS

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Abstract. A calibration previously determined for the evolution of the equivalent width of the emission line Hβ with age for H II regions (Dottori, 1981) is applied to detached extragalactic H II regions. The frequency distribution of ages seems to indicate that some of these regions had other bursts of star formation so important as the observed last one.

1. Introduction

In a previous paper (Dottori, 1981, hereafter called Paper I) the equivalent width of the Hβ emission line was pointed out as a good indicator of the state of evolution of H II regions. A calibration of $W_{H\beta}$ vs age was obtained using models of stellar evolution by Stothers and Chin (1976) combined with different IMF. The influence of the metallicity on the calibration was also discussed, though in the present state of knowledge it should be considered only a qualitative approach. Since the application of these models gave interesting results for H II regions of M33, M51, and M101 (Paper I) and the LMC (Dottori and Bica, 1982, hereafter called Paper II) (Lequeux et al., 1981), we apply it in this paper to data on Detached Extragalactic H II Region compiled from the literature.

2. Data on $W_{H\beta}$ for Detached Extragalactic H II Regions

French (1980) quotes $W_{H\beta}$ for 12 detached extragalactic H II regions obtained spectroscopically with slit of $2''4 \times 4''0$ for 12 of them and with $8'' \times 10''$ and $10'' \times 30''$ for NGC3690 and NGC7714, respectively.

Neugebauer et al. (1976) give $j_{H\beta}$ and $F_\nu$ for 8 objects obtained with entrance apertures of $7''$ and $10''$ in diameter. From these data we calculated $W_{H\beta} = (c/v_{H\beta}) (j_{H\beta}/F_\nu)$ and the values obtained are quoted in Table I. All these row data are plotted in the graphic of $W_{H\beta}$ vs Age of Figure 1.

As was pointed out in Paper I, $W_{H\beta}$ is generally misestimated with slit spectroscopy since the total light coming from the ionizing and ionized regions does not enter the slit. The entrance apertures of Neugebauer et al. (1976) seem to completely embrace the object in all cases, but in French’s measurements this effect seems to play an important role, as can be seen by comparing his data with that of Neugebauer et al. for Mrk 36,
Fig. 1. Evolution of $W_{H\beta}$ vs Age for two different IMF $\psi(M) = M^{-X}$. We collect in this figure the raw data of French (1981) and Neugebauer et al. (1976). Differences for the common objects came be see between both authors, as in the case of Mrk 36.

$W_{H\beta} = 84$ and 270, respectively (see Figure 1). We tried to correct French’s data, taking into account the relative size of the slit entrance and the apparent size of the objects. If $f$ is the fraction of light entering the slit, the ratio between observed and true $W_{H\beta}$ is

$$W_{H\beta}(\text{observed}) = \frac{f_{\text{HII}}}{f_{\text{ass}}} W_{H\beta}(\text{true}) .$$

The value of $f$ for an spherical region of radius $r$, emitting under case B conditions, centered on a slit of size $2s \times 2l$ is:

$$f = \frac{4}{3} \pi r^3 - \left( 2 \frac{2}{3} \pi (r-s)^2 (2r-s)^2 + 2sr^2 \frac{(r^2 - l^2 - s^2/4)^{1/2}}{(r^2 - (s^2/4))^{1/2}} \right) .$$

$$f_{\text{ass}} = \frac{4}{3} \pi \left( \frac{r}{2} \right)^3 - \left( 2 \frac{2}{3} \pi \left( \frac{r}{2} \right)^2 \left( 2 \left( \frac{r}{2} \right) - s \right)^2 + 2s \left( \frac{r}{2} \right)^2 \frac{\left( \left( \frac{r}{2} \right)^2 - l^2 - \left( \frac{s}{2} \right)^2/4 \right)^{1/2}}{\left( \left( \frac{r}{2} \right)^2 - \left( \frac{s}{2} \right)^2/4 \right)^{1/2}} \right) .$$