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ENVELOPES OF PECULIAR LATE TYPE STARS

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RESUMEN. Se estudiaron tres estrellas de carbono con alta y baja resolución espectroscópica. Los espectros fueron obtenidos en el Laboratório Nacional de Astrofísica, Brasópolis, Brasil. Para poder medir el C^{12}/C^{13} y para tratar de clasificar la estrella de carbono C1003 ,usamos el método empírico de iso-intensidades (Fujita et al. 1966).

ABSTRACT. Three carbon stars are studied through low and high resolution spectroscopy. The spectra were obtained in the Laboratório Nacional de Astrofísica, Brasópolis, Brazil. In order to measure the C^{12}/C^{13} and try to classify the C1003 carbon star we used the empirical iso-intensities method (Fujita et al. 1966).

Key words: STARS-ABUNDANCES -- STARS-CARBON -- STARS-LATE TYPE

I. INTRODUCTION

Since the discovery of the C^{13} isotope features in the spectra of carbon stars, the determination of the C^{12}/C^{13} ratio has been obtained by many authors. Ratios obtained are usually smaller than the terrestrial value of 98. The exceptions are some peculiar types of R stars (Fujita et al. 1966). The purpose of the present paper is to examine the C^{12}/C^{13} ratios in cool carbon stars using the iso-intensities method described by Fujita et al.(1966). Also we will try to classify the C1003 star. For this purpose, we need to know the intensities of C_2 bands and the temperature.

The iso-intensities method requires spectra in the near infrared region because this region is appropriate to the study of the C^{12}/C^{13} ratio.

II. OBSERVATIONS

The spectra analysed in the present study were obtained with the Coudé spectrograph attached to the 160-cm reflector of the Laboratório Nacional Astrofísico, Brasópolis, Brasil . In 1989. We used the first order of the grating spectrum which gives a linear dispersion of 20 A/mm in the 7800.-8100 A region.

We removed the absorption of the earth's atmosphere making use of an early type star spectrum, obtained at the same position of the dispersion grating of the source.

III. IDENTIFICATION AND MEASUREMENTS

We used the molecular components of $C^{12}N$ and $C^{13}N$ in the 7800-8100A region in order to calculate the C^{12}/C^{13} ratio. The identification of these components was made using the data of Domini et al. (1978), Querci and Querci

(1970), and Pearse and Gaydon (1976). For our purpose it is necessary to select the lines of $C^{12}N$ as well as of $C^{13}N$ wnich are free from blendings of impurities.

As indicated by Fujita et al. (1966), we measure the central depths of the selected lines after flat field correction, from a fiducial continuum determined by level of higher fluxes in the wavelength range of each spectrum.

IV. THE ISO-INTENSITIES METHOD

The iso-intensities method is an empirical method to estimate the ratios of abundance between elements (Fujita et al. 1966) in late type stars, where it is impossible to know the continuum level.

In this case, the logarithms of the central dephts of the selected $C^{12}N$ and $C^{13}N$ lines are plotted against :

$$\log X = \log f_{\nu',\nu''} + \log S_{k',k''} - (\chi_{\nu''} + \chi_{k''})\ \vartheta_{ex} - \log Q_1(T) + cte$$

$f_{\nu',\nu''}$ = band oscillator strength

$S_{k',k''}$ = Honl-London factor (Arnold and Nicholls 1972)

$\chi_{\nu''}$ = energy of the lower vibrational level (in ev)

$\chi_{k''}$ = energy of the lower rotational level (in ev)

ϑ_{ex} = reciprocal excitation temperature

$Q_1(T)$ = internal partition function

The relative horizontal shift between the empirical pseudo curve of growth for $C^{12}N$ and that of $C^{13}N$ gives the relative abundance of $C^{12}N$ to $C^{13}N$ and hence the C^{12}/C^{13} ratio.

The Franck-Condon factor for the CN red system utilized in the oscillator strength was taken from Halmann and Laulicht (1966), Sneden and Lambert (19B2) and Splinder (1965). For some cases, the Franck-Condon factor was the same for $C^{12}N$ and $C^{13}N$.

V. RESULTS

ln the case of C2567 carbon star, wnich is classified as C4,5J (Yamashita 1972), the results of the iso-intensities method agree with the values found by other authors (Fujita and Tsuji 1977; Climenhaga et al. 1977).

The results for the star C2219 are a little different from the values found for stars of the same spectral type (C5.5 - Warner 1963). However the C^{12}/C^{13} ratio is very sensitive to the excitation temperature. The determination of these temperatures is very complex for the CN molecule.

The resulting pseudo curves of growth are shown in Figures 1 and 2.

The results obtained in the case of C1003 star are not satisfactory and another method of analysis will be necessary. The method chosen is the spectrum synthesis in wavelength regions of some 20 A with 9 A/mm dispersion. In this method we calculate the synthetic spectra taken into account all the atomic and molecular species that can be present in the spectral region. The better agreement with the observed spectrum gives abundances of all species involved.

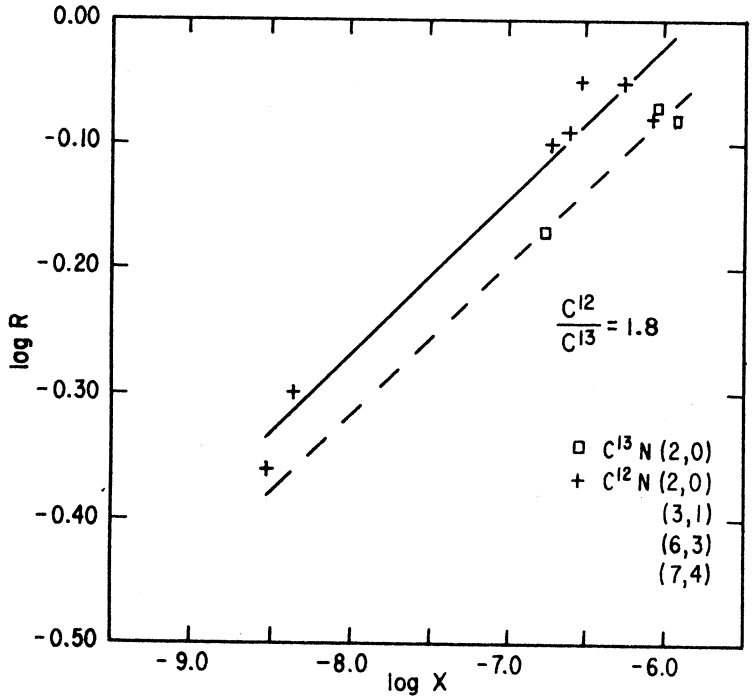

Fig.1.- Pseudo curves of growth of $C^{12}N$ and $C^{13}N$ for C2567 (ϑ_{ex} = 2.2)

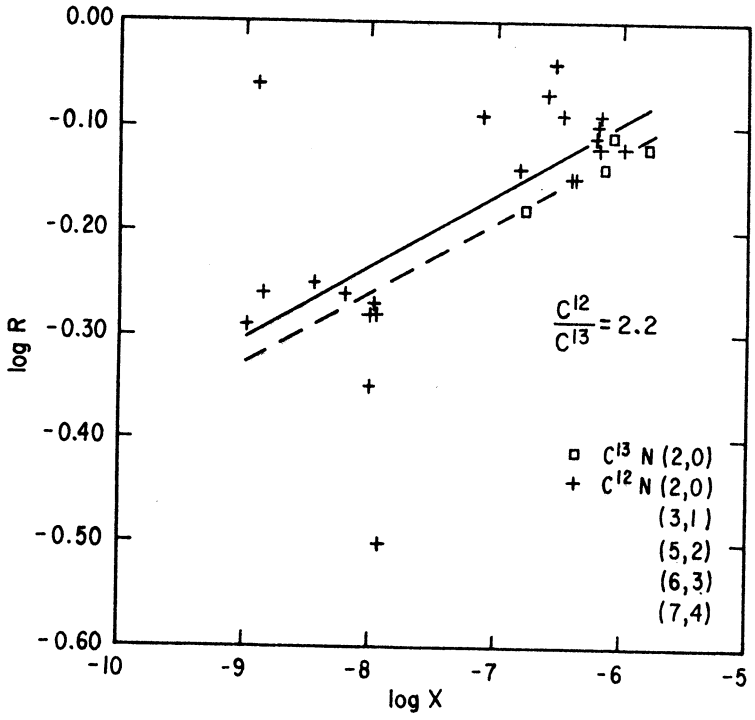

Fig.2.- Pseudo curves of growth of $C^{12}N$ and $C^{13}N$ for C2219 (ϑ_{ex} = 2.0)

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