Boletim da Sociedade Astronômica Brasileira, **31**, no. 1, 114-115

Radial metallicity distribution of the galaxy NGC4254 using multislit GEMINI/GMOS spectra: Looking for corotation signatures

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Abstract. In this work we present multislit spectra of the galaxy NGC 4254 observed with Gemini / GMOS in order to improve and extend its radial metallicity sample and verify signatures of the corrotation radius in its metallicity profile. We used the empirical calibration method O3N2 to obtain the metallicity in several HII regions along this galaxy. After the data processing and the application of a new method to extract spectra from low continuous background we obtained the metallicity radial profile in which we adjusted a ordinary linear regression to determine the metallicity gradient. Our results pointed out to a $-0.04 \pm 0.01\, dex/kpc$ metallicity gradient in accordance with data from literature, but now exploring new objects in the galaxy, which are better distributed along it and with results statistically more significant.

Resumo. Neste trabalho apresentamos observações multi-fenda da galáxia espiral NGC 4254 utilizando o espectrógrafo GMOS do Gemini com o objetivo ampliar e estender a amostragem da distribuição radial de metalicidades e verificar evidências do raio de corrotação através do perfil radial de metalicidade. Nós utilizamos o método de calibração empírica O3N2 para estimar a metalicidade em diversas regiões ao longo da galáxia. Depois do processamento dos dados e da aplicação de um novo método para extrair os espectros com contínuo baixo obtivemos o perfil radial de metalicidades, sobre o qual ajustamos uma regressão linear para determinar o gradiente de metalicidade da galáxia. Nossos resultados indicaram um gradiente de metalicidade de $-0.04 \pm 0.01\, dex/kpc$, de acordo com resultados encontrados na literatura, porém explorando novos objetos na galáxia, que estão melhores distribuidos nela e com resultados estatisticamente mais significativos.

Keywords. Galaxies: Abundances – Techniques: imaging spectroscopy

1. Introduction

The study of chemical abundances in spiral galaxies is an important branch in Astronomy since from them we might to determine others physical quantities as ages, evolution tracers and structural secular effects. An important example of this happens when the velocities of the disk and spiral arms are the same (at the corotation radius). In this case no gas will enter the spiral arms, producing a reduction of the star formation rate.

For this reason breaks and inflections on the metallicity distribution are expected in spiral galaxies (Scarano Jr & Lépine, 2013). According these authors, NGC4254 is a strong candidate to have the corotation radius inside the optical disk.

Several procedures are involved to measure the metallicity of a region and many factors can influence the measurement. One way to estimate the metallicity is by means of Statistical Methods, or Strong Line Methods. This method consists on using the statistical correlation between photoionization models, empirical calibrations based on well-known measurements of electronic density and temperatures and correlations of those with the ratio between emission lines frequently observed in HII regions spectra.

In this project, we propose to increase the amount of HII regions observed for NGC 4254 in terms o abundances using GEMINI observations with GMOS spectrograph in multislit mode. Using the Strong Line Method O3N2, we intend to improve the number of objects that sample the metallicity radial profile and compare our results, in first order, with the metallicity gradient in the literature to verify if it is possible to analyze metallicity gradients in higher orders, and then to check possible effects of the corotation radius.

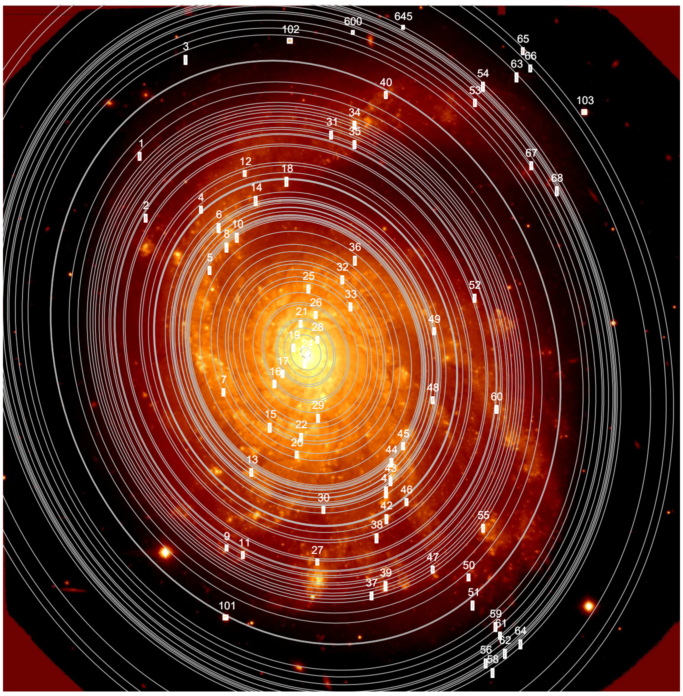

Figure 1. Spiral Galaxy NGC 4254 taken at Gemini Telescope using r' filter. The boxes with numbers represent the slits and the elipses are isodistance regions.

2. Methodology

We used DS9 and PYRAF tasks to develop a simple method to combine spectra of many observations. Its is based on the procedure to identify the position of the observed spectral lines on the

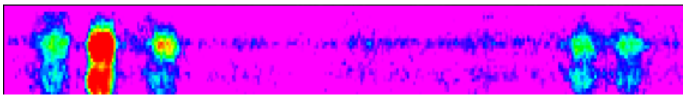

Figure 2. Bidimensional spectrum extracted for one of 69 regions analyzed. Note that the spectrum present the dispersion of two regions in reason of two different HII regions inside the slit. In this case we chose the most intense dispersion region.

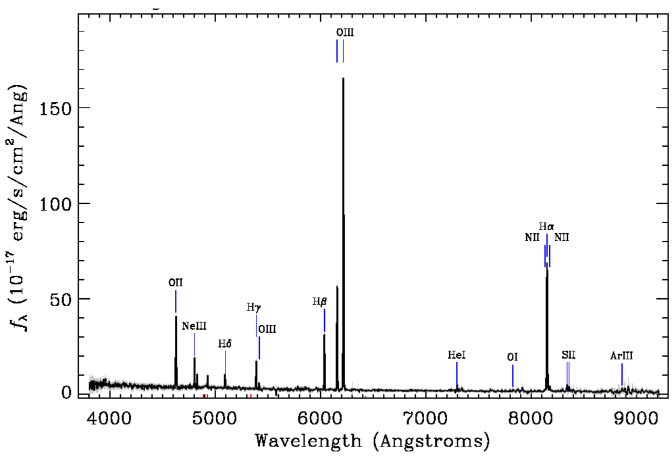

Figure 3. Example of spectrum used to identify the lines position at the unidimensional spectra extracted of NGC 4254.

detector and during the traditional extraction procedure to force a spline to be fitted only over these selected points, from which the unidimensional spectrum is recovered with a better quality than the previous procedures. (See Fig. 2).

To obtain the emission line fluxes, we have used the PYRAF task *SPLOT*. We identified the spectral lines visually for each spectrum (Fig. 3) and we fit Gaussians over the emission lines of Balmer series ($H\alpha$ and $H\beta$), Nitrogen, Sulfur and Oxygen.

3. Results

From the total amount of slits observed, we were able to obtain only 10 regions from which it was possible to apply the method O3N2 to obtain Oxygen abundances. After deriving the radial distances using elliptical fits (Fig. 1) we plotted the data to obtain the metallicity radial profile.

Despite this metallicity distribution covers all the 4 different radii where corotation can occur, the minimum amount of 16 regions needed for an appropriated study of the metallicity gradient (Dutil & Roy, 2001) was not achieved. So, in reason of the poor spatial sampling it was not possible look for breaks or inflexions in the metallicity distribution.

Comparing our results with the data obtained by Zaritsky, Kennicutt & Huchra (1994), who studied the metallicity gradients of 39 galaxies, we verified that the NGC 4254 metallicity radial profile has a very typical decreasing gradient, as it can be seen in Figure 5. Furthermore, these authors observed less regions than we did for this galaxy, for which they estimated that its metallicity gradient was $-0.03 \pm 0.02\, dex/kpc$, compatible with our first order results.

Acknowledgements. We are grateful to PROEST/UFS and INCTA for all support.

References

Dutil, Y. , & Roy, J.-R. 2001, AJ,122, 1644-1655.

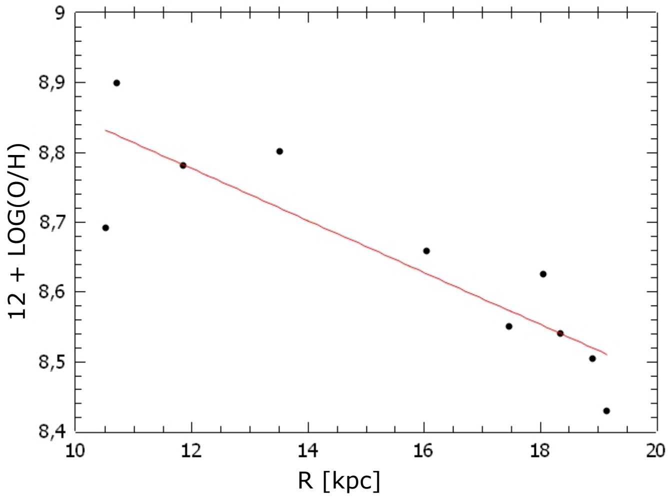

Figure 4. Metallicity radial profile obtained with our data to NGC 4254 galaxy overlapped by the linear regression. The adjust shows that metallicity gradient (slope) obtained is $-0.04 \pm 0.01\, dex/kpc$ and the central metallicity (level) to this galaxy is around $9.2 \pm 0.1\, dex$.

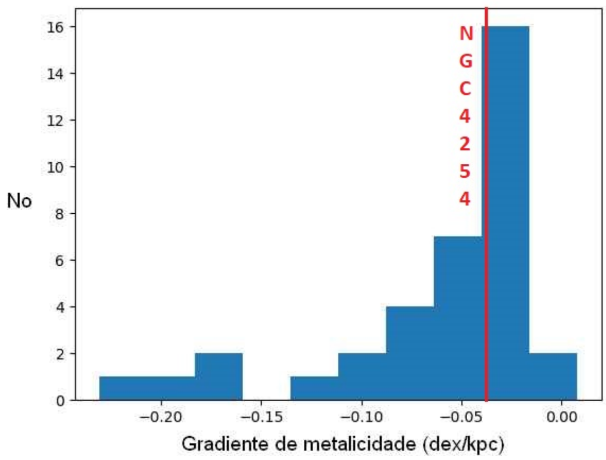

Figure 5. Metallicity gradients histogram by Zaritsky et al. (1994). The red vertical line represents the value determined by us to the metallicity gradient of NGC 4254. As it can be seen, the galaxy NGC 4254 is quite typical.

Huchra, J. P. 1994, ApJ, 1994, 420, 87-109.
Pettini, M., & Pagel, B. E. J. 2004, MNRAS, 348, 59.
Scarano S., & Lépine J. R. D. 2013, MNRAS 428. 625–640.
Zaritsky, D., Kennicutt, JR., R. C., & Huchra, J. P. 1994, ApJ, 420, 87.