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The PN candidates in NGC 3109: VLT-FORS1 imaging and spectroscopy

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Abstract. From VLT FORS1 on-band, off-band imaging of the dIrr NGC3109 we have identified about 13 PN candidates. According to our criteria for PN candidate selection, most of the candidates reported by Richer & McCall (1992) are in fact compact HII regions. Further multi-object VLT FORS1 spectroscopy has confirmed the PN nature of at least 6 candidates. All but one of the PNe analyzed are low excitation nebulae, showing no He II emission lines. For several PNe and HII regions, we derived chemical abundances based on electron temperatures measured from the [O III] 4363/5007 line ratios. Preliminary results show that PNe present log(O/H)+12 in the range from 7.7 to 8.4, while in HII regions this quantity spreads in a much narrower range from 7.6 to 7.8. Thus, the ISM in NGC 3109 seems chemically homogeneous.

Keywords. planetary nebulae, HII regions, abundances, galaxies

1. Introduction

The dIrr NGC 3109 is the dominant member of the small group of metal-poor dwarf galaxies formed by Sextans A, Sextans B and Antlia, just beyond the Local Group. NGC 3109 seems to be similar to the SMC in luminosity and chemical composition. Richer & McCall (1992) reported the discovery of 7 PN candidates in the central zone of this galaxy. From spectroscopy for some of these PN candidates and one HII region, Kniazev *et al.* (2005) derived no chemical differences between these objects. Leisy *et al.* (2005) reported to have found 18 PN candidates and discuss some of their chemistry.

We have performed VLT FORS1 on band - off band imaging of the whole galaxy, to identify PN candidates and separate them from compact HII regions. The criteria for this selection are discussed in §2. Further multi-object spectroscopy has confirmed the PN nature of some candidates. In §2 and 3 we present and discuss some preliminary results.

Our long term purpose is to analyze the chemistry of the different populations in NGC 3109 and NGC 6822 (for which we have similar data) and to study the chemical evolution of these objects so similar to the Magellanic Clouds.

2. Imaging and spectroscopy

VLT-FORS1 pre-imaging with [O III] 5007 on-band, off-band filters was obtained in November 2005, for two fields covering the whole galaxy. The on-band images show numerous line emitting objects. In the continuum-subtracted images, 13 PN candidates and a large number of compact HII regions were detected. Other few faint objects detected are still under analysis.

PN candidates were selected as those compact emitting objects with stellar appearance and no detectable stellar continuum. Also, for the objects with available spectroscopy

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we checked for the excitation degree, selecting as PNe those with high [O III]/[O II]. In addition, we also considered that low excitation PNe should be fainter than compact HII regions, due to the lower number of ionizing photons from their central stars. With these constraints we found that most of the 7 PN candidates reported by Richer & McCall (1992) are in fact compact HII regions. The only true PN in their list is PN6, and also (possibly) PN1. Their PN2, PN3, PN4, PN5 and PN7 show noticeable stellar continuum, low excitation and some of them appear resolved, so they are classified as compact HII regions.

On January 2006, FORS1 in MOS mode, with the grisms 600B+12 (3700-5200 Å) and 600V+94 (4900-7000 Å), was used to obtain spectra of 25 objects distributed all over the galaxy. Exposure times were of about 1-1.5 hrs. for each spectral range. Thus [O III]4363 and [S II]6717,31 lines, important for plasma diagnostic, were detected for several objects. Chemical abundances have been derived based on the [O III] temperature.

Interestingly, we found that only one of the 6 PNe analyzed so far shows the He II 4686 line, indicating a central star with $T_{\rm eff} \geqslant 75000$ K. All the others have no He^{++}.

Our preliminary results show that the O/H abundance ratios derived for PNe are in the range from 7.7 to 8.4, while this range is much narrower (7.6 to 7.8) for HII regions. The large spread in PN abundances in NGC 3109 was also reported by Leisy *et al.* (2005).

Our O/H average for HII regions is 7.73±0.10, equal within uncertainties to the values given by Lee *et al.* (2003) and Kniazev *et al.* (2005), although the latter author's results are apparently based on some "PNe" of Richer & McCall (1992) which are HII regions. Our analyzed HII regions are located in very different zones of NGC 3109, therefore the narrow O/H abundance range is indeed indicating that the ISM in this galaxy is chemically homogeneous.

3. Conclusions

- About 13 PN candidates have been found in NGC 3109. Most of the candidates reported by Richer & McCall (1992) are in fact HII regions and they were excluded from our PN sample.

- Only one of the 6 PNe analyzed spectroscopically shows He^{++}. Therefore most of the central stars have $T_{\rm eff} \leqslant 75000$ K.

- PNe in NGC 3109 present a larger spread in O/H abundances than HII regions. Some PNe appear as (slightly) O enriched objects and a couple of them seem to be also N-rich.

- The HII regions analyzed are a chemically homogeneous sample.

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