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Metallicity gradients in M31, M33, NGC 300, and Milky Way using Argon abundances

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Abstract. We studied Planetary Nebulae (PNe) metallicity gradients using Ar abundances. We compared them with H II regions in the galaxies of the local universe M 31, M 33, NGC 300 and in the Milky Way. Galactocentric radio (R_G) and chemical abundances were collected from the literature, carefully selecting an homogeneous sample for each galaxy. In these galaxies, metallicity gradients computed with PNe abundances are flatter than those of H II regions.

Keywords. ISM: planetary nebulae, galaxies: ISM

It has recently been shown that O in PNe may be enriched in low-metallicity environments (Peña *et al.* 2007; Flores-Durán *et al.* 2017) and also in Galactic PNe with carbon-rich dust (Delgado-Inglada *et al.* 2015). On one hand, metallicity gradients derived from O abundances in PNe might be affected by stellar nucleosynthesis and, thus, the O/H gradient might not be always adequate for chemical evolution studies. On the other hand, Ar abundances in PNe are not modified during the PN progenitor lifetime. Hence we propose to use Ar to trace the metallicity gradients in the galaxies of the local universe M 31, M 33, NGC 300, and the Milky Way.

The results for each galaxy are listed below. For M 31 the linear fits of the Ar gradient for PNe is $(6.12 \pm 0.04) - (0.00005 \pm 0.0006)R_G$ and for H II regions is $(6.38 \pm 0.18) - (0.021 \pm 0.013)R_G$. In the case of M 33, Ar metallicity gradient fits are $(6.20 \pm 0.06) - (0.018 \pm 0.014)R_G$ and $(6.27 \pm 0.04) - (0.045 \pm 0.016)R_G$ for PNe and H II regions respectively. We found that Ar metallicity gradients in NGC 300 are $(6.31 \pm 0.02) - (0.051 \pm 0.012)R_G$ for PNe and $(6.33 \pm 0.04) - (0.104 \pm 0.014)R_G$ for H II regions.

In the Milky Way we compare metallicity gradients of PNe using Galactocentric distances from Frew *et al.* (2016) and Stanghellini & Haywood (2010), no big differences were found. The Ar metallicity gradient fits for PNe computed with Frew *et al.* (2016) distances is $(6.48 \pm 0.01) - (0.015 \pm 0.001)R_G$ and for H II regions is $(6.83 \pm 0.14) - (0.042 \pm 0.021)R_G$.

By comparing PNe metallicity gradients with H II regions in M 31, M 33, NGC 300, and the MW we found that PNe show flatter gradients.

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