A Massive Star Odyssey, from Main Sequence to Supernova
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B-type supergiants in M 31

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Abstract. We present the spatial distribution of chemical species in M 31, as derived from intermediate resolution spectra of seven B-type supergiants, lying within four OB associations, covering a galactocentric distance of 5 - 12 kpc. We do not detect any systematic oxygen gradient across this galactocentric range. We find that the inner regions of M 31 are not, as previously thought, very 'metal-rich'. Our abundances of C, N, O, Mg, Si, Al, S and Fe in the M 31 supergiants are very similar to those of massive stars in the solar neighbourhood.

Discussion

Most previous studies on abundance gradients in external galaxies are based on H II regions and supernova remnants (SNRs). However, the reliability of the abundances measured from low excitation nebulae, such as those in the inner regions of M 31, is as yet unclear. In these nebulae, empirical calibrations are implemented to estimate abundances. As evident from Figure 1, the derived abundances from H II regions, and hence the radial gradients, have a strong dependence on the empirical calibration adopted (see Pagel *et al.* 1980; Mc Gaugh 1991; Zaritsky *et al.* 1994; Pilyugin 2001). In the case of M 31, a difference in oxygen abundance of ~ 0.56 dex and radial oxygen gradient of -0.013 dex kpc^{-1} is obtained by using four different empirical calibrations on a group of 11 H II regions from Blair *et al.* (1982). Due to this ambiguity, an independent method of investigating the spatial distribution of elements in distant galaxies is necessary. Fortunately, B-type supergiants provide us with such a diagnostic tool.

From intermediate resolution spectra, we derived the chemical composition of seven B-type supergiants in M 31. The radial abundance gradients of oxygen, silicon and magnesium indicate towards a negligible abundance gradient and solar metallicity in the inner regions of the galaxy (see Figure 1). There is an offset between the oxygen abundances obtained from the H II regions and that of the B-type supergiants (~ 0.15 - 0.4 dex), at the same galactocentric distance, which depends on the empirical calibration implemented.

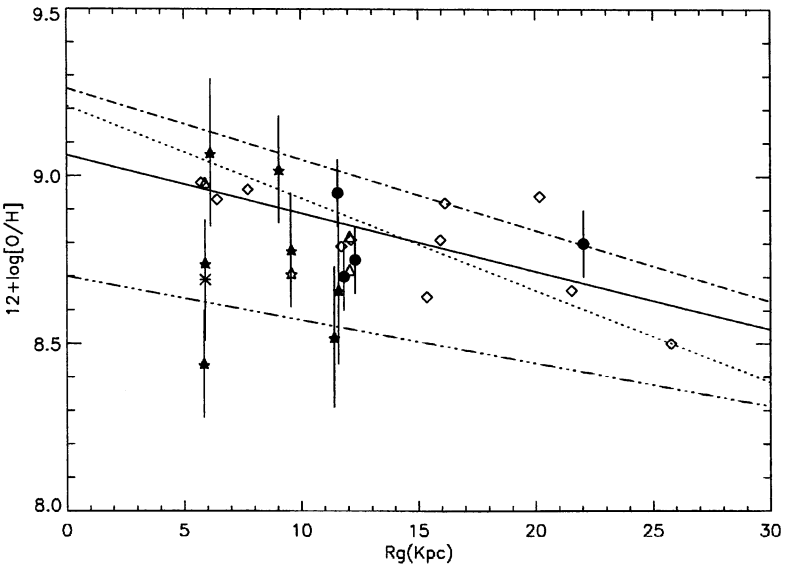

Figure 1. Oxygen abundances for H II regions and supergiants in M 31 as function of galactocentric distance. Solid stars (⋆): abundance results of the seven B-type supergiants in this study. Unfilled star: non-LTE oxygen abundance for OB78-277. Asterisk (∗): photospheric non-LTE abundance of OB10-64 (Smartt *et al.* (2001). Open diamonds (◇) and open triangles (△): abundances of the H II regions from Blair *et al.* (1982) and Galarza *et al.* (1999), respectively, calculated using McGaugh (1991) calibrations. Solid circles (•): abundances of four A-F-type supergiants (Venn *et al.* 2000). Dotted (···), solid (-), dash-dot (-·-) and dash-dot-dot-dot (-·· ·-) lines: least squares fit through the H II regions of Blair, using Mc Gaugh (1991), Pagel *et al.* (1980), Zaritsky *et al.* (1994) and Pilyugin (2001) calibrations, respectively. The error bars in the stellar results represent the standard error in the mean.

Details are given in Trundle *et al.* 2002.

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