The potential of Red Supergiants as extra-galactic abundance probes at low spectral resolution

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Red Supergiants (RSGs) are among the brightest stars in the local universe, making them ideal candidates with which to probe the properties of their host galaxies. However, current quantitative spectroscopic techniques require spectral resolutions of R>17,000, making observations of RSGs at distances greater than 1Mpc unfeasible. Here we explore the potential of quantitative spectroscopic techniques at much lower resolutions, R ~2-3000. We take archival J-band spectra of a sample of RSGs in the Solar neighbourhood. In this spectral region the metallic lines of FeI, MgI, SiI and TiI are prominent, while the molecular absorption features of OH, H_2O, CN and CO are weak. We compare these data with synthetic spectra produced from the existing grid of model atmospheres from the MARCS project, with the aim of deriving chemical abundances. We find that all stars studied can be unambiguously fit by the models, and model parameters of log g, effective temperatures Teff, microturbulence and global metal content may be derived. We find that the abundances derived for the stars are all very close to Solar and have low dispersion, with an average of [logZ]=0.13+/-0.14. The values of Teff fit by the models are ~150K cooler than the stars' literature values for earlier spectral types when using the Levesque et al. temperature scale, though this temperature discrepancy has very little systematic effect on the derived abundances as the equivalent widths (EWs) of the metallic lines are roughly constant across the full temperature range of RSGs. Instead, elemental abundances are the dominating factor in the EWs of the diagnostic lines. Our results suggest that chemical abundance measurements of RSGs are possible at low- to medium-resolution, meaning that this technique is a viable infrared-based alternative to measuring abundance trends in external galaxies.

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