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Near-IR Spectroscopy of CEMP Stars with SOAR/OSIRIS

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Abstract. We report on medium-resolution near-IR spectroscopy of a sample of over 60 Carbon-Enhanced Metal-Poor (CEMP) stars observed with SOAR/OSIRIS, selected from the HK survey of Beers and colleagues and the Hamburg/ESO Survey of Christlieb and colleagues. Oxygen abundances from the molecular CO lines as well as rough estimates of $^{12}C/^{13}C$ ratios are estimated from the near-IR spectra of these stars. Near-IR model spectra with varying oxygen abundances, in combination with previously determined parameters from optical spectra are used for the estimation of abundances for this sample. As both oxygen abundances and $^{12}C/^{13}C$ ratios are tracers of nucleosynthesis, we hope to gain information about Galactic nucleosynthesis through the analysis of this sample.

Keywords. stars: abundances, stars: carbon, Galaxy: halo, surveys

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1. Introduction

Carbon, nitrogen, and oxygen abundances, in addition to $^{12}C/^{13}C$ ratios, are important in order to constrain properties of different types of carbon-enhanced, metal-poor stars in the Galactic halo. There are two categories of CEMP stars: those with neutron-capture enhancement (CEMP-s, CEMP-r, CEMP-r/s), and those without (CEMP-no). Abundance patterns of those stars with neutron-capture enhancement are posited to be the result of mass transfer from AGB companion stars. The origin of the abundance patterns in CEMP-no stars is less certain. Proposed models include low-metallicity AGB mass-transfer (in which the s-process is suppressed), mass loss by rapidly rotating mega metal-poor ([Fe/H]<-6.0) stars (Hirshi *et al.* 2006; Meynet *et al.* 2006), or pollution by early supernovae. The $^{12}C/^{13}C$ ratios in CEMP-no stars tend to be quite low (Aoki *et al.* 2007), which suggests that substantial mixing has occurred in the progenitor object. The $^{12}C/^{13}C$ and [O/Fe] abundances are crucial to distinguish the origin of the different types of CEMP stars, and they are not easily available through optical observations due to the weakness of the [OI] λ6300 Å lines. The near-IR region or the spectrum is ideal for such abundance measurements.

2. Techniques and Results

Model atmospheres with carbon enhancement (see Beers *et al.* 2007 and references therein) were used in order to determine the abundances of [O/Fe] as well as the $^{12}C/^{13}C$ ratios for the sample. In the near-IR region between 2.25μm and 2.45μm, there are prominent rovibrational bands of CO that can be used for abundance determinations. Previously determined atmospheric parameters are available from analysis of optical and near-IR photometry and optical spectra (Beers *et al.* 2007). By using a set of previously determined T_{EFF}, log(g), [Fe/H], and [C/Fe] for each star as input parameters, we used a grid of model atmospheres to create models with varying values of [O/Fe] and $^{12}C/^{13}C$ that can be used to fit the data. Using χ^2 minimization, we are able to select the best-fitting abundance. In Figure 1 the distribution of the [O/Fe] results is shown with respect to carbon abundance. Note that the majority of the stars in the sample are carbon-enhanced ([C/Fe]> +1.0), as defined by Beers & Christlieb (2005).

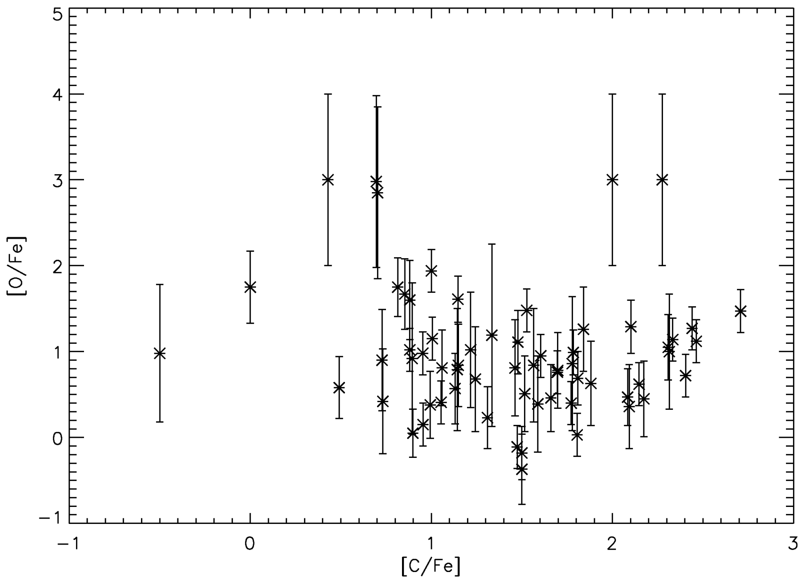

Figure 1. New [O/Fe] estimates with error bars for the entire sample as compared to [C/Fe] estimated from optical spectra.

The $^{12}C/^{13}C$ ratios are estimated using a similar technique, although our results include only rough estimates for 20 of the stars in the sample. A refined technique will be employed in the near future that will allow for more accurate estimates of this value for a larger sample of stars. In addition to revised $^{12}C/^{13}C$ estimates, future analysis of this sample will include comparison of our estimates to values predicted by AGB models as well as models of rapidly-rotating, mega metal-poor stars.

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