Search for Extreme Metal-Poor Stars in the Edinburgh-Cape Blue Object Survey (EC Survey)

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Introduction

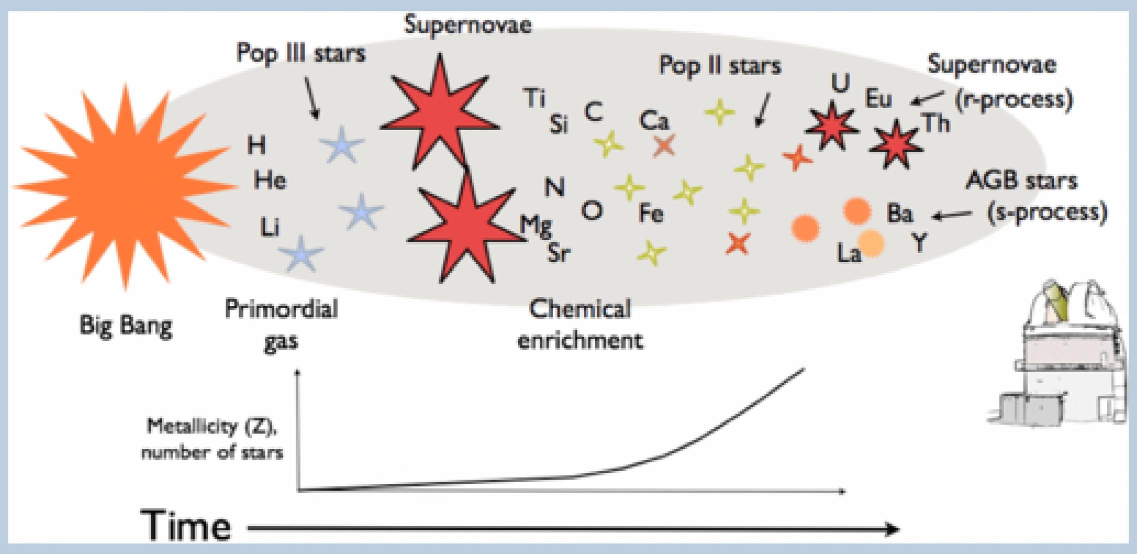

Figure 1: Schematic of the evolution of elements in the Universe. The metal abundance distribution of the most extreme metal poor stars gives us clues about the properties of the first population of stars in the Universe. Image credit H.R. Jacobson (2014)

Studying extreme metal poor stars provides an opportunity to investigate the conditions in the early universe, not long after the Big Bang, in particular the nature of the first stars [1]. There has been recent success on the hunt for extreme metal poor stars with SM0313 [1] and HE1327-2326 [2] being the most iron-deficient observed thus far, with [Fe/H] < -5.5.

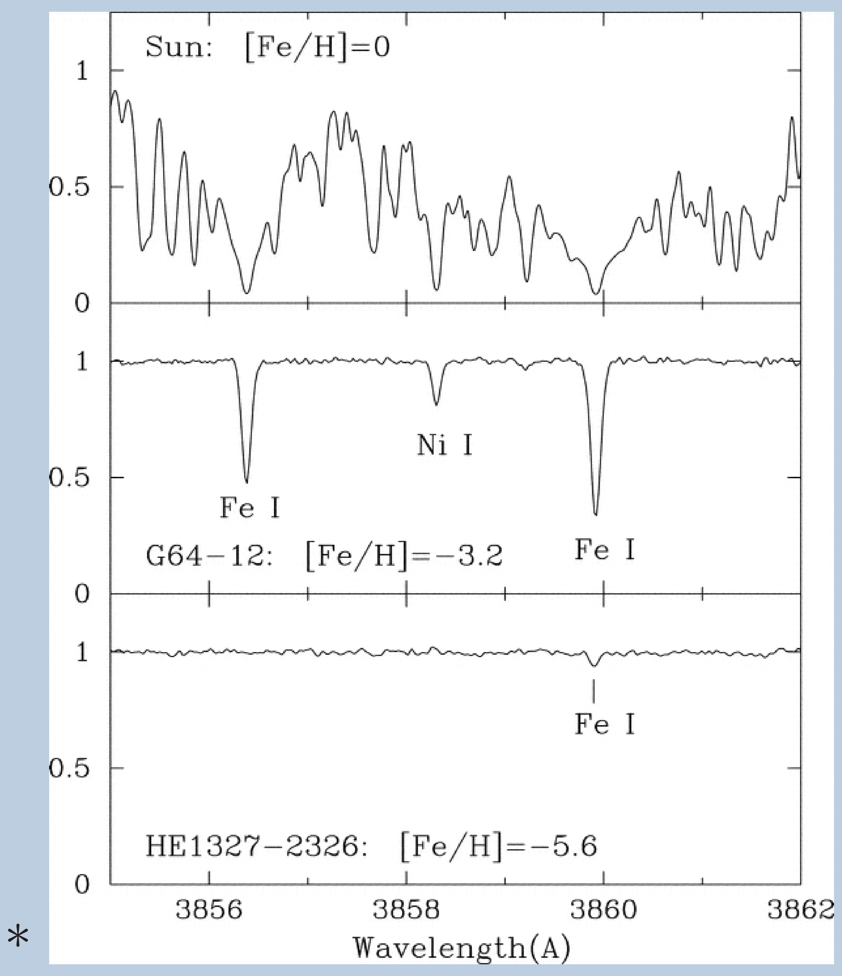

Figure 2: Fe I 3860 Å line in the spectrum of HE1327-2326 (bottom), compared with spectra of the Sun (top) and another metal-poor star G64-12 (middle). Figure taken from Ref. [3].

Aim

The aim of this project is to determine metal abundances of extreme metal-poor candidate stars, identified in the Edinburgh-Cape Blue Object Survey, using SALT high resolution HRS spectra.

References

[1] A. Frebel *et* al., ApJ **786**, 74 (2013).

[2] S.C. Keller *et* al., Nature **506**, 463 (2014).

[3] N. Christlieb *et* al., Nature **419**, 904 (2002).

[4] A. Frebel et al., Nature **434**, 871 (2005).

Acknowledgements

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Target selection and Data

Candidate stars were selected are from the Edinburgh-Cape Blue Object Survey using the U-B vs B-V colour plane as a selection tool (see figure 3). The target stars have typically smaller U-B values compared to normal F and G stars. The latter being possibly due to a lack of absorption in metal lines below about 4000 Å. In figure 3 we show some candidate stars, including the position of the confirmed metal poor star HE1327-2326.

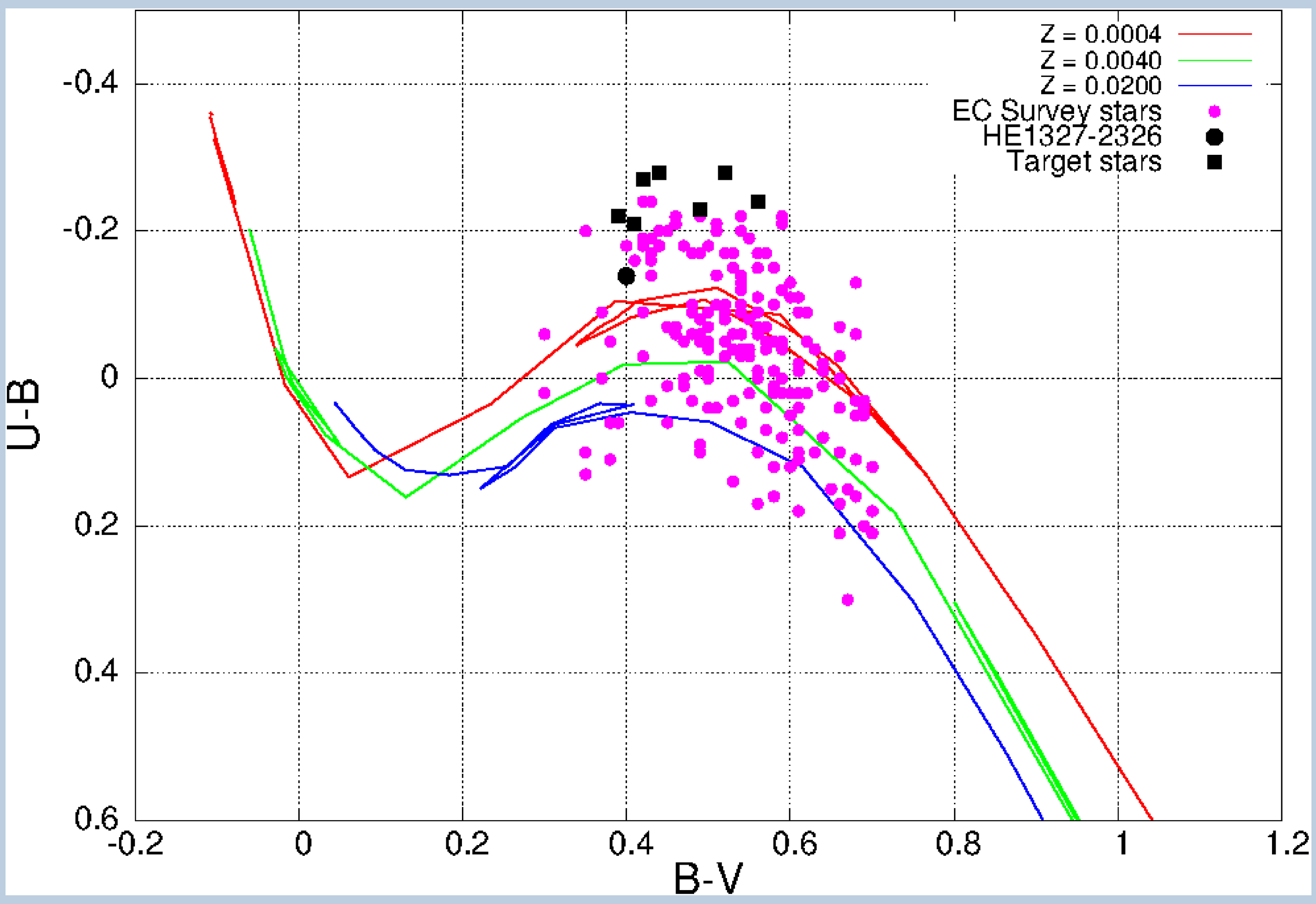

Figure 3: Two color-color diagram for potential metal-poor stars in the EC-Survey. Our target stars have a typically smaller/bluer (U-B) colour than the known extreme metal-poor star HE 1327-2326.

Using the SALT HRS simulator for a typical G-type stellar spectrum we estimate that for 10 exposures of about 2500 seconds each in high resolution mode for the brighter targets in our candidate star list, we should obtain a signal-to-noise ratio of about 40 at 4000 Å and 100 or more around 7000 Å. These numbers are comparable with the data for HE1327-2326 in [4].

We were awarded HRS PV phase time, for which we got a single HRS spectrum with an total exposure time of 2700 seconds for the target EC04564-2629. We tested extracting the echelle orders using the *IRAF* task *DOECSLIT*. We were able to get a rough wavelength calibration in the blue, though this was not possible in the red since the arc images obtained were not suitable and finding a reliable wavelength solution proved to be difficult. The SALT archived HRS arc reference spectra could not be used, as the HRS set-up appeared to have changed somewhat since the PV phase data were obtained. Figure 4 shows a section of the spectrum in the blue.

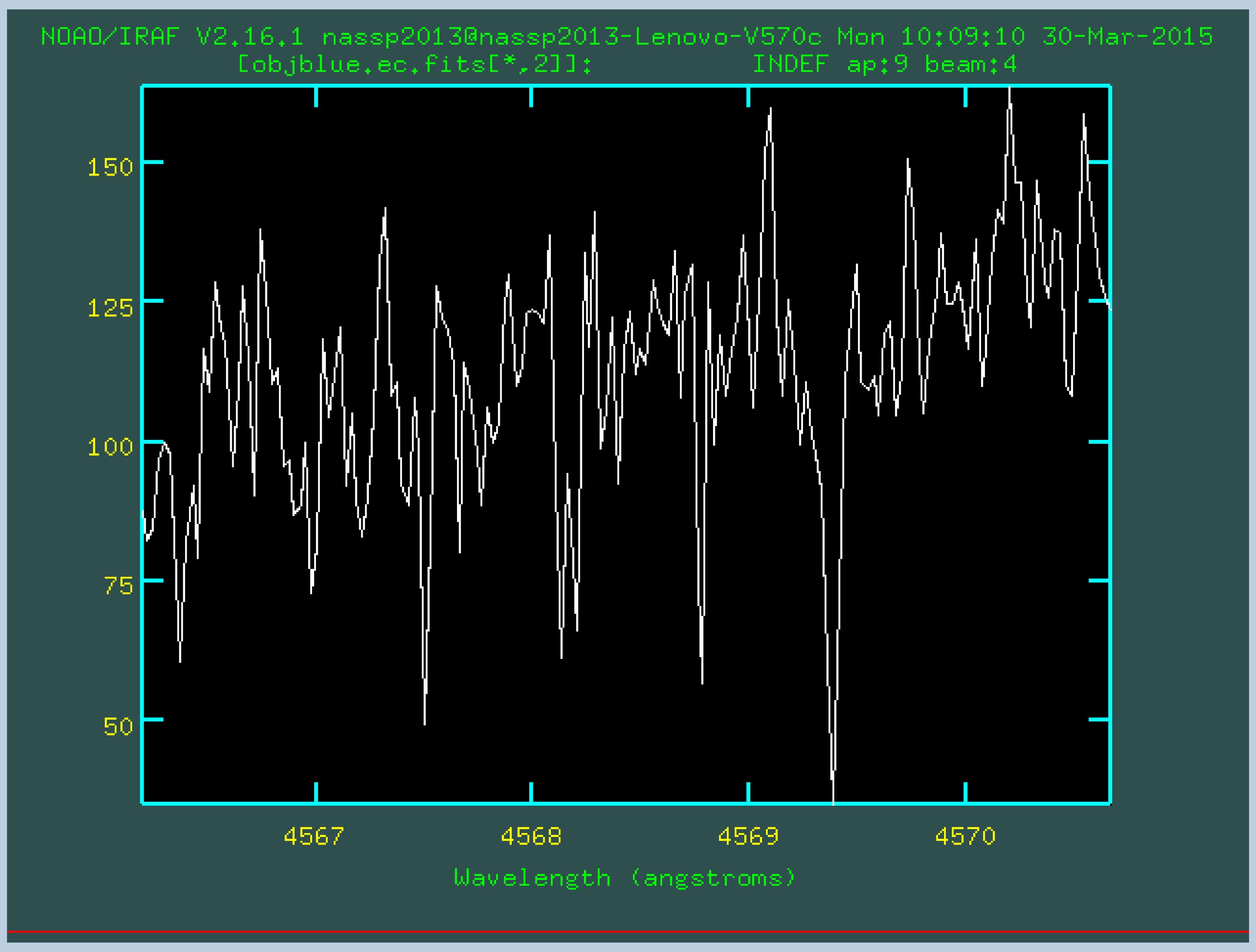

Figure 4: A section of the SALT HRS spectrum obtained during PV Phase for the target EC04564-2629 with V = 14.16. The exposure time was 2700 seconds.

Looking Forward

We recently obtained five SALT HRS spectra for the target EC20291-3603 with an exposure time of about 2500 seconds each. We have been allocated another 16000 seconds for this project during the current semester for the same target. I will combine all the spectra, perform spectral reductions and do a metal abundance analysis of the star as part of my M.Sc project. Once we have successfully demonstrated the feasibility of the project, we plan to extend the investigation by including more of the stars in our target list.