crease towards later B types. Usually, at B9 only Hα is in emission and Hβ is only seen up to B8. Before A0 the emissions are much stronger than the level of the continuum (see also Slettebak, 1986) whereas for A-type stars no case is known with emission exceeding this level. This is so striking that one may discriminate the Be from Ae stars. P Cygni type profiles are only seen in two very peculiar objects HD31648 and 41511. Moreover no [Fe II] emission lines are reported for Ae stars.

Similarly, N82 is probably not a pre-main sequence Herbig Ae/Be star, as it does not meet two of the three membership criteria (Strom et al., 1972): (1) it does not lie in an obscured region, and (2) it does not illuminate fairly bright nebulosity in its immediate vicinity. Moreover, N82 is too bright to be a Herbig Ae/Be star. Strom et al. (1972) give a list of 12 Galactic stars of this type with known distances. If we place these stars in the SMC, their V magnitudes will range from 17 to 22. The brightest one, HD 200775, assumed to lie at 440 pc from the Sun (Whitcomb et al., 1981), may be fainter than 17 if its distance is overestimated.

The two-component absorption feature is probably due to the shell phenomenon. It would probably suggest that non-radial pulsations can enhance the mass flux from the equatorial regions of rapidly rotating Be stars (Waters et al., 1987). This is the first time such a feature is detected in a Magellanic B[e] star.

Zickgraf et al. (1986) concluded that the MC B[e] stars are massive post-main sequence objects of mass $30 \leq M \leq 80\ M_{\odot}$. The present result hints that these stars may originate from lower initial masses. This raises the question: how small can the mass of a B[e] star in the MCs be? If future surveys confirm the presence of low mass B[e] stars in the MCs, this will have important implications for current models of massive star evolution in the Clouds.

In particular, it would support the binary hypothesis for the B[e] supergiants. It should be underlined that two of the three already known B[e] stars in the SMC, R4 and S18, are interpreted to be double systems (Zickgraf et al., 1987; Shore et al., 1987, Zickgraf et al., 1989). It is interesting to consider the case of the LMC P Cygni star R81. Wolf et al. (1981) had estimated a mass of higher than 50 $M_{\odot}$ for this star. Recently, Stahl et al. (1987), owing to several years of almost continuous monitoring with high photometric precision, discovered that R81 is an eclipsing close binary system. The new data reduce the mass of R81 to $\sim 33\ M_{\odot}$.

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CASPEC Observations of the Most Metal-Deficient Main-Sequence Star Currently Known

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The apparent absence of first generation stars with zero or negligible amounts of heavy elements is a long-standing problem in connection with theories of nucleosynthesis in stars and models of galactic chemical evolution. Despite extensive search on objective-prism plates, only two stars are known to have a metal abundance less than 1/1000 of the solar metal abundance, i.e. [Fe/H] < −3.0. The first one is G64-12, a main-sequence turnoff star, with [Fe/H] = −3.5 (Carney and Peterson 1981). The other one is CD −38°245, a red giant with [Fe/H] = −4.5 (Bessell and Norris 1984). Here I briefly report on some CASPEC observations of a main-sequence turnoff star having a similar low metal abundance as CD −38°245. Surprisingly, this new ultra-metal-deficient star is a double-lined spectroscopic binary.

The observations with the Cassegrain Echelle Spectrograph (CASPEC) at the ESO 3.6-m telescope were carried out October 13–17, 1989, under excellent conditions. The sky was clear and the seeing was extremely good. At Cerro Vizcachas the monitor displayed an *average* FWHM of the seeing profile of 0.″66, 0.″49, 0.″61 and 0.″66 on the four nights. At the 3.6-m the seeing was around one arcsec. This gave a high throughput of CASPEC even if the entrance slit was set to a width of 1.″2 only in order to obtain the maximum (two pixel) resolution, R = 35.000, of the instrument.

The aim of the observing programme

(carried out in collaboration with W.J. Schuster, UNAM, Mexico) is to determine abundance ratios of various elements in a large sample of very metal-deficient stars. Most of the stars were selected from a catalogue of 220 halo stars with metallicities determined from uvby-β photometry (Schuster and Nissen 1989). Spectra with S/N $\gtrsim$ 100 in the wavelength range 5150–6150 Å were obtained for 55 stars of which the majority have [Fe/H] in the range −3.0 to −2.0. When the spectra have been reduced and analyzed by model atmosphere techniques the trends of abundances of α-elements, odd-Z elements, iron-peak elements, and s-process elements can be studied as a function of [Fe/H]. The results are expected to give new information about the formation of the first heavy elements in the universe and the early evolution of the Galaxy.

One star immediately turned out to be much more metal deficient than the other stars. It had been selected from Beers, Preston and Shectman (1985), who on the basis of objective-prism plates and medium-resolution spectroscopy of the CaII K line suggested star No. CS 22876-32 to be very deficient in metals.

From UBV photometry (V = 12.82, B-V = 0.40 and U-B = −0.27) the star is estimated to be at the main-sequence turnoff for old halo stars. In Figure 1 the spectral region around the MgI triplet is shown for this star and a sequence of stars with decreasing values of [Mg/H]. The stars are main-sequence turnoff stars and have about the same effective temperature as CS 22876-32 ($T_{eff} \simeq$ 6000 K) according to the Strömgren uvby-β photometry. The remarkable line weakness of CS 22876-32 is obvious and there is no doubt that the star is a binary.

From the equivalent widths measured, the magnesium abundance of CS 22876-32 is estimated to be 1/10000 of the solar magnesium abundance i.e. [Mg/H] = −4.0. This is an order of magnitude lower than the abundance of G64-12, the other ultra-metal-deficient main-sequence star known, and it is comparable to the magnesium abundance of the red giant CD −38°245. Other metals in CS 22876-32 may be even more deficient. Thus, it is striking that the NaI doublet at 5890 Å is not seen in CS 22876-32.

In the last few years there has been an increased interest in the chemical composition of very metal-deficient stars. The reason is that non-standard, inhomogeneous Big Bang models produce a significant fraction of heavy elements (Applegate, Hogan and Scherer 1987). The inhomogeneities are supposed to arise in connection with the transition from the QCD phase of the early universe to the hadron phase and lead to neutron-rich and neutron-poor regions. The chemical compositions of stars like CS 22876-32 set upper limits to the amount of heavy elements produced in the Big Bang, and may therefore be used as a discriminatory test between homogeneous (standard) and inhomogeneous models. In particular it would be very interesting to measure the beryllium abundance in very metal-deficient stars. Thus, Malaney and Fowler (1989) conclude that if a primordial Be/H ratio of 10^{-13} or higher is detected in metal-deficient stars then it would be a dramatic confirmation of inhomogeneities in the early universe and would also leave open the possibility of Ω_{Baryon} = 1. The Be abundance can be determined from the BeII resonance doublet at 3130 Å. The blending by metal lines is very severe in normal stars but would be much less of a problem in an ultra-metal-deficient star like CS 22876-32.

However, the high atmospheric absorption at 3100 Å (~1$^{m}_{.}$5 at La Silla) and the relative low CCD sensitivity in the UV may prohibit high resolution, high S/N spectra to be taken at this wavelength at least with present-day telescopes.

The binary nature of CS 22876-32 makes it an even more interesting star. Spectra obtained on three consecutive nights show about the same separation between the two sets of Mg lines suggesting that the orbital period is rather long. Further high resolution observations with the aim of determining the orbital parameters of CS 22876-32 would be very useful. This and other metal-deficient, double-lined spectroscopic binaries should also be checked for eclipses. If we are lucky to find a metal-deficient, spectroscopic and eclipsing binary then masses and luminosities of the components can be determined with high precision. This would allow us to make a unique test of models of metal-deficient stars and thereby the age determination of the Galaxy would be much more reliable.

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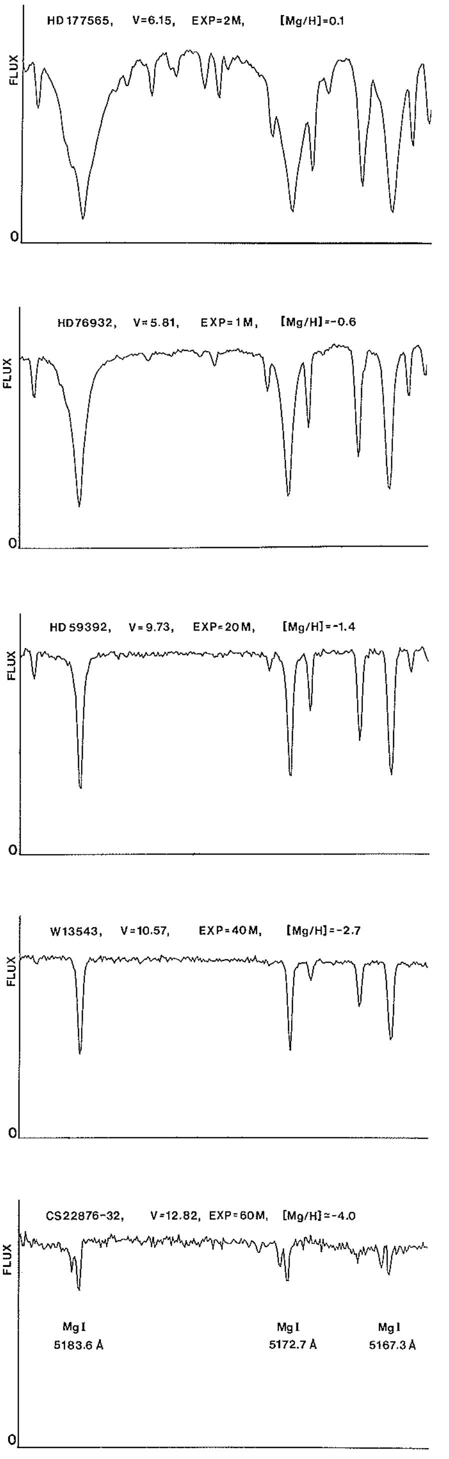

Figure 1: *Spectra of the MgI triplet for main-sequence turnoff stars having about the same effective temperature ($T_{eff} \simeq$ 6000 K) but widely different values of the Mg/H abundance ratio. Note that CS 22876-32 is a binary star and has extremely weak lines.*
The spectra were obtained with the ESO 3.6-m CASPEC instrument during a recent observing run, October 13–17. Exposure times (EXP) are given on the figure. The spectra were reduced on-line using the IHAP system available at the telescope. Bias, dark and scattered light have been subtracted, and the spectra are flat-fielded but not rectified and normalized. However, the zero-point for the flux is marked on each spectrum. Note that wavelength is increasing towards the left.