A LITHIUM RICH STAR IN SCO–CEN

R. M. Catchpole

(Communicated by the Radcliffe Observer)

(Received 1971 August 2)

SUMMARY

The Sco–Cen star HD 113703 (KoVe) is shown to have a high lithium abundance (log $N_{Li} \simeq +2.8$).

Observations of main sequence and pre-main sequence F–K stars indicate that there is an inverse correlation between lithium abundance and age. This effect becomes more marked for later spectral types. The evidence for this is the well defined sequence of decreasing lithium abundance given by T Tauri stars (age $\sim 10^6$ yr), Pleiades stars ($3 \times 10^7$ yr) and the Hyades stars ($4 \times 10^8$ yr). This effect is thought to be caused by destruction of lithium in the stars themselves. Later than G8 these results depend on only four cluster stars while Danziger’s (1967) results for the Ursa Major Nucleus cluster, considered intermediate in age between the Pleiades and Hyades, give lithium abundances less than or equal to that of the Hyades. Therefore it seems important to extend lithium observations to other young objects.

The 10.8 $m_V$ companion, of the 4.7 $m_V$ B star HD 113703 (d = 12"), has been observed, in the red, at a dispersion of 82 A mm$^{-1}$, on 103 aF, with the F1 camera, at the coudé focus of the Radcliffe 1.88-m reflector. The spectra appear normal except for showing very weak or absent H$\alpha$ absorption and a strong lithium line.

This star has previously been classified as KoVe by Thackeray (1966) who noted Ca, H and K emission while demonstrating common radial velocity as well as the known common proper motion. There is thus good evidence for the physical relationship of the two stars and for the youth of the K star.

Photoelectric observations by A. J. Wesselink and P. J. Andrews using a trailing technique to eliminate the light scattered from the primary give

$$m_V = 10.8 \quad B-V = +0.82.$$

The $B-V$ is in good agreement with the spectral type. In spite of uncertainties in the photometry of this star and in the distance of Sco–Cen this value of $m_V$ places the star somewhat above the zero age main sequence. This is compatible with the age of $2 \times 10^7$ yr given by Bertiau (1958) for Sco–Cen.

Equivalent widths, showing an internal standard error of $\pm 0.04$ A, measured on four spectra, the result of 8 hr observing, are listed below.

| 6717 Ca I | 6707 Li I | 6439 Ca I |
| 0.21 A | 0.28 A | 0.22 A |
| 0.12 A unblended |
Short Communications

The Ca I 6439 line was selected for comparison with lithium as it was found to be the only unblended line suitable for comparison at this dispersion on 103 aF. Line strengths were obtained from the Cowley & Cowley (1964) curve of growth, after corrections had been made for Doppler broadening and the intrinsic blending of the lithium doublet, following Herbig’s (1965) case III. A microturbulent velocity of 1 km s\(^{-1}\) was used. While the lithium line strength is insensitive to changes in microturbulence, calcium is not. An increase in microturbulent velocity to 4 km s\(^{-1}\) causes a decrease in lithium log line strength of \(\pm 1\) while decreasing the calcium line strengths by \(\pm 4\) in the log.

Using Cayrel & Jugaku’s (1963) scaled solar models, with \(\theta = 1\).5, log \(g = 4.5\) and \(A = A_{\odot}\), to compare lithium 6707 with Ca 6439 and assuming the abundance of calcium is unchanged between the Sun and the star, a logarithmic overabundance for lithium, with respect to the Sun, of +1.5 is obtained. A straight comparison of the lithium line strength in the Sun and in the star gives an overabundance of +1.4. A value of log \(N_{\text{Li}}/N_{\odot}\) of 1.23 (log \(N_{\text{Li}}/N_{\odot} = 12.0\)) and a solar equivalent width of 3.7 mA is used to bring these results onto the system of Wallerstein & Conti (1969).

Unfortunately the calcium 6717 line used by Conti & Danziger (1966), Danziger & Conti (1966) and Danziger (1967) on which their Pleiades and Hyades abundances depend is blended at this dispersion.

Adopting the relative equivalent widths of this feature in the Arcturus Atlas, an unblended equivalent width of \(0.12\) \(\AA\) is obtained. This value is equal to the equivalent width in the Sun and is undoubtedly too weak if a normal solar abundance of Ca occurs in HD 113703 ft.

Following Danziger & Conti (1966) and applying their equation (5), where they obtain an abundance ratio as a function of the ratio of the observed equivalent widths of 6717 and 6707, relative log abundances with respect to the Sun of +1.70 and +1.4 are obtained, depending on whether the corrected or uncorrected equivalent width for 6717 is used.

These results are exactly comparable with the results given by Danziger (1967) for the coolest Pleiades stars and should represent upper and lower limits to the abundance in HD 113703.

Following the paper of Conti & Danziger (1966) in which line strengths obtained and corrected, as previously described, are used, upper and lower abundance limits of +1.95 and +0.93 are obtained for lithium. In the mean these values are in agreement with the results obtained from 6439 using the Cayrel and Jugaku models. Calcium 6717 is not suitable for abundance estimates at this dispersion but it was considered important to attempt to bring these observations onto Conti and Danziger’s system.

The mean logarithmic overabundance of lithium in the faint component of HD 113703, with respect to the Sun, is +1.5 corresponding to a value of log \(N_{\text{Li}}\) of 2.8.

The two Pleiades stars of similar spectral type have a mean value of log \(N_{\text{Li}} = 2.6\).

The uncertainty based on the internal standard error of the equivalent widths corresponds to \(\pm 0.25\) in log abundance.

Evidently the correlation between age and lithium abundance shown by the Pleiades and Hyades stars is supported by this star in the younger Sco–Cen association.
Confirmation and extension of this result to other stars must however await observation at much higher dispersions presumably with red sensitive image tubes.

I am very grateful to Dr M. W. Feast, Dr A. D. Thackeray and Dr P. R. Warren for their help and to Dr P. J. Andrews for results in advance of publication.

Radcliffe Observatory, P.O. Box 373, Pretoria, South Africa

REFERENCES