The Light Elements and Their Evolution
IAU Symposium, Vol. 198, *2000*
L. da Silva, M. Spite, J. R. de Medeiros, eds.

Li in chromospherically active stars with large velocity components

H. J. Rocha-Pinto, B. V. Castilho and W. J. Maciel

Depto. de Astronomia, Instituto Astronômico e Geofísico, Universidade de São Paulo, CP 3386, 01060-970, São Paulo SP, Brazil

Abstract. We present lithium abundances for nine chromospherically young, kinematically old late-type stars. The data support the interpretation that these objects can be formed during the coalescence of a short-period binary.

1. Observational Sample and Lithium Ages

Some late-type dwarfs present high chromospheric activity and large velocity components. Their peculiar nature becomes more clearly demonstrated in an age-velocity diagram (Soderblom 1990). They do not follow the typical behavior of the other coeval objects. We use the acronym CYKOS to designate these chromospherically young, kinematically old stars. Their nature is the subject of this research.

Spectra were obtained with the 1.60-meter LNA telescope, mounted with a coudé spectrograph, with a resolution of $R \sim 25000$. The observations were made during August, 7-11, 1998, in the Li region ($\lambda\lambda$6627-6759), for 15 stars, 9 of which are CYKOS. Lithium abundances were determined by spectral synthesis.

Figure 1 shows a lithium-depletion diagram, as a function of the stellar age and temperature. The curves indicate the expected lithium abundance for the objects with ages from 0 to 4 Gyr, according to Soderblom (1983). All objects shown are late-type chromospherically active dwarfs, with ages supposedly lower than 1.5 Gyr. Note that CYKOS generally show systematic lithium depletion, implying ages greater than 2 Gyr. The same does not occur for the normal stars, which present signs of high Li. Moreover, the anomalous depletion found in CYKOS cannot be assigned to the effects of the Boesgaard-Tripico dip.

2. CYKOS and Red Stragglers

The red stragglers (word proposed by Poveda, Allen, & Herrera 1996) are expected to result from the coalescence of two low-mass stars (each having > 0.5 $M_\odot$) originally in a short-period binary system. The angular momentum loss, due to the high magnetic activity, favours the synchronization of the orbital and rotational momenta, forming first close synchronized binaries, which eventually evolve to the state of contact binaries.

The approximation can lead to the coalescence of the pair, giving birth to a larger star. The coalescence can operate in a timescale of 2.5 Gyr (Stępień

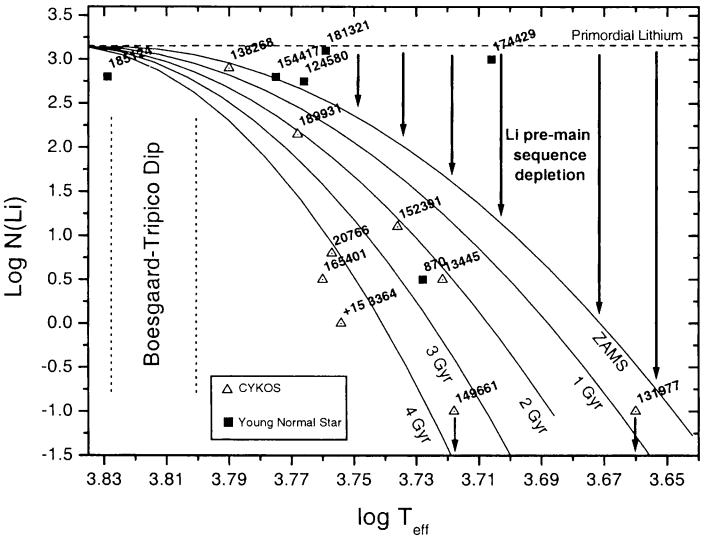

Figure 1. Lithium depletion diagram, adapted from Soderblom (1983). Lithium abundance for the stars in the sample are compared to depletion curves, which roughly define a lithium age for the stars. The labels of each point indicates its HD number, with exception of BD +15 3364

1995) for systems with initial orbital period of 2 days. The large rotation rate of the resulting star, connected to the stellar outer convective zone would produce a copious chromospheric activity, similar to that found in young stars. It would resemble a normal young star in most of its properties, even regarding its position on the ZAMS. However, it would inherit the same velocity components of the center-of-mass of the original binary system, and would have the light elements depleted due to the evolution before the coalescence. These are just the properties we observe in CYKOS.

References

Poveda, A., Allen, C., & Herrera, M. A. 1996, RMAA Ser.Conf., 5, 16
Soderblom, D. R. 1983, ApJS, 53, 1
Soderblom, D. R. 1990, AJ, 100, 204
Stępień, K. 1995, MNRAS, 274, 1019

https://doi.org/10.1017/S0074180900167221 Published online by Cambridge University Press