Young Stars Near Earth: Progress and Prospects
ASP Conference Series, Vol. 244, 2001
Ray Jayawardhana and Thomas P. Greene, eds.

The Young Stellar Group Associated with HD 199143

Mario E. van den Ancker

Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, MS 42, Cambridge, MA 02138

Mario R. Pérez

Emergent-IT Corp., 9315 Largo Drive West, Suite 250, Largo MD 20774

Dolf de Winter

TNO-TPD, Stieltjesweg 1, 2600 AD Delft, The Netherlands

Abstract. Recently, several groups of young stars in the solar neighborhood have been discovered. Given their proximity, these systems are ideally suited for detailed studies of star and planet formation. Here we report on a group of young stars associated with the bright F8V star HD 199143. At a distance of only 48 pc, this is the closest YSO group containing a classical T Tauri star (HD 358623; K7–M0e). New ground-based mid-infrared data shows that both HD 199143 and HD 358623 have large infrared excesses due to circumstellar disks. A systematic search for new members of this *Capricornius association* has yielded four new probable members, which we use to derive an age of 5–10 Myr for the group as a whole.

1. Introduction

In recent years, a fascinating picture of the recent star formation history of the solar neighborhood has emerged: 10–40 million years ago an ensemble of molecular clouds were forming stars at a modest rate near the present position of the Sun. About 10 Myrs ago, the most massive of these newly formed stars exploded as a supernova, terminating the star formation episode and generating the very low density region seen in most directions from the present Sun. This scenario can not only explain the presence of young stellar groups close to the earth such as the TW Hydrae and the newly identified Tucanae Association (Kastner et al. 1997; Zuckerman & Webb 2000 and these proceedings), but also explains how the β Pic moving group can be so young (20 Myr; Barrado y Navascués et al. 1999), and yet so close.

In a recent *A&A letter* (van den Ancker et al. 2000) we have identified two nearby objects, the bright F-type star HD 199143 and the late-type emission-line star HD 358623, as young stars. In these *proceedings* we will extend this work by presenting new mid-infrared observations of HD 199143 and HD 358623, demonstrating that both possess circumstellar disks. We will also present the results

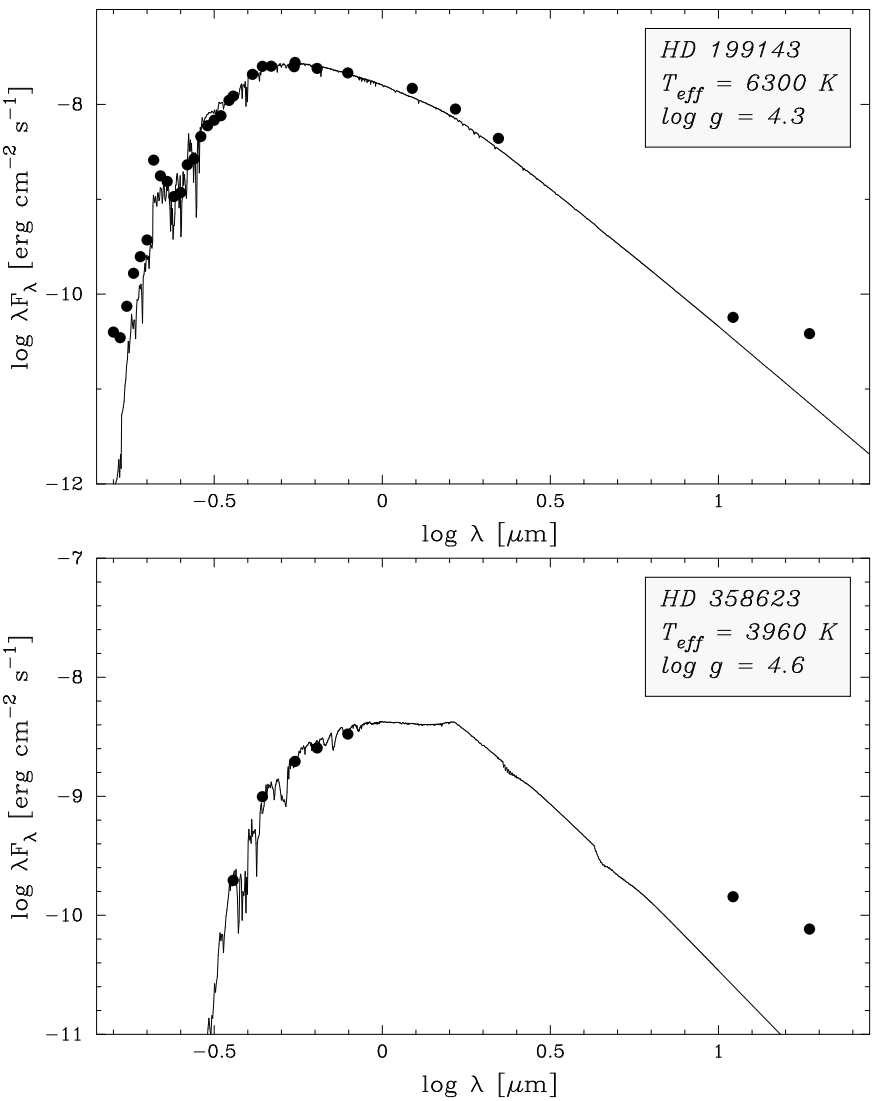

Figure 1. Spectral Energy Distributions of HD 199143 (top) and HD 358623 (bottom). Also shown are Kurucz models for the stellar photospheres, fitted to the observed energy distribution. Note the presence of strong infrared excesses in both sources and the presence of excess UV emission in HD 199143.

of a systematic search for further candidates, showing that both stars belong to a larger group of young stars, which we tentatively name the *Capricornius association*. In the final section of this contribution we will discuss its relation to the other young stellar groups discussed in these proceedings and briefly touch upon its formation history.

2. HD 199143 and HD 356823

HD 199143 is a bright ($V = 7.27$), nearby (Hipparcos distance of 47.7 ± 2.4 pc) F8V star, which would be completely inconspicuous if it hadn't been detected as a bright extreme-ultraviolet source by the *ROSAT* and *EUVE* missions. A recent study of the optical and UV spectrum of HD 199143 by van den Ancker et al. (2000) revealed the presence of emission lines of Mg II, C I, C II, C III, C IV, Si IV, He II and N V and a large amount variability, both in the continuum and line fluxes. The fact that these phenomena were only found in the ultraviolet part of the spectrum suggests that HD 199143 is a binary system, consisting of a rapidly rotating F-type primary and a low-mass chromospherically active companion which dominates the ultraviolet and infrared light of the system.

A literature search for sources near HD 199143 revealed that a photometrically variable K7–M0e dwarf, HD 358623 (BD$-17°6128$), is located only a few arcminutes from HD 199143. This star was previously studied by Mathioudakis et al. (1995), who found strong Hα emission and evidence for a high Li abundance, i.e. the characteristics of a classical T Tauri star. Data from the Tycho-2 catalog shows that HD 199143 and HD 358623 have identical proper motions. Both the closeness of the two stars and the similarity of the space motions strongly suggest that the two stars must form a physical group. The only explanation for the presence of two active stars of such different masses in such close proximity is to pose that the two stars are young.

New observations of HD 199143 and HD 356823 were obtained with the TIMMI2 instrument on the ESO 3.6m telescope. Both sources were detected in the N (11 μm) and Q (19 μm) bands. Spectral Energy Distributions (SEDs) of HD 199143 and HD 358623, which include the newly determined N and Q band data, are shown in Fig. 1. As can be seen clearly from this figure, both stars possess large excesses above photospheric levels in the mid-infrared. We explain these infrared excesses as being due to the presence of circumstellar disks in both systems. In the case of HD 199143 it is not clear whether this disk is in the form of a disk around the low-mass companion, or is in the form of a circumbinary disk.

3. Further Capricornius Association Members

Based on a systematic search for stars near HD 199143 with strong X-ray fluxes we have identified four probable new members of our newly discovered association in Capricornius. All four have *ROSAT* Point Source Catalog fluxes which are an order of magnitude higher than those of normal late-type stars at 48 pc and have a projected distance of less than five degrees (4.2 pc at $d = 48$ pc) from HD 199143. Similarly strong X-ray sources are not found in adjacent fields of identical size, leading us to believe that these stars are indeed members of the

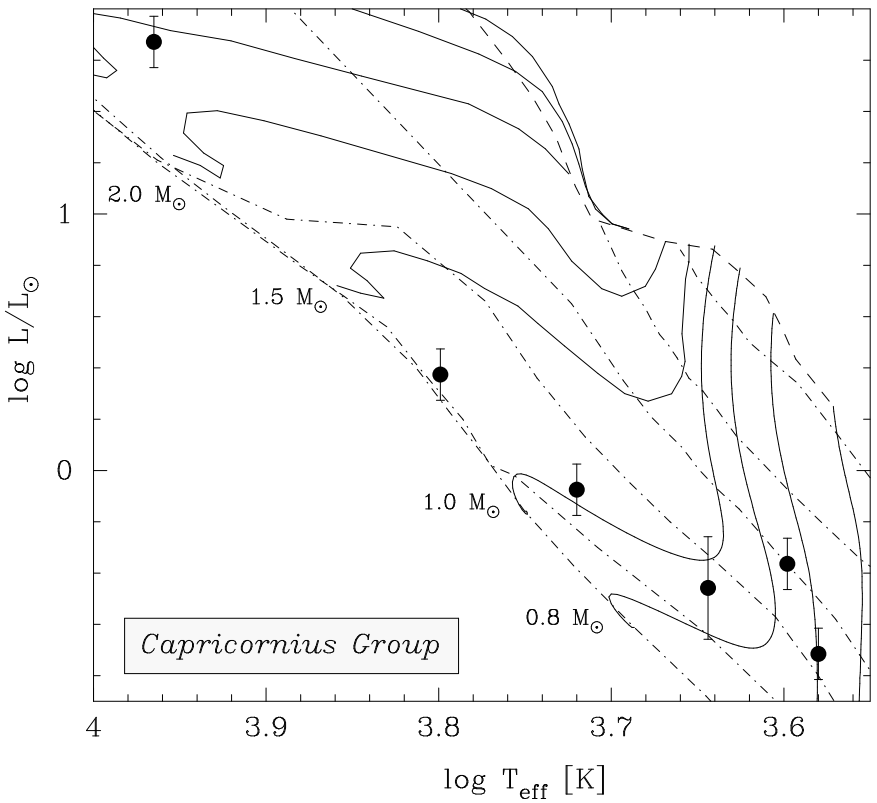

Figure 2. Hertzsprung-Russell diagram of the Capricornius group. Also shown are the evolutionary tracks (solid lines) and isochrones (dash-dotted) by Palla & Stahler (1993).

Capricornius association. For two of the newly identified candidate members, proper motions are available, which are in agreement with those of HD 199143 and HD 358623.

Further indications for the hypothesis that our four new candidate members belong to the Capricornius association comes from the observation that if we assume a common distance of 48 pc, HD 199143 and HD 358623, as well as the four new candidate members form a smooth curve in the Hertzsprung-Russell diagram (Fig. 2). According to the models by Palla & Stahler (1993), all stars are located between the isochrones with ages between 5×10^6 and 10^7 years. Although the youth of our newly selected candidate members remains to be confirmed through spectroscopic means, we conclude that most likely these four stars are indeed members of a more extended group of young stars associated with HD 199143. Since the search we performed here for new members is certainly not complete (it is based on the catalog data in the Simbad database), we expect to be able to find additional low-mass members of the Capricornius association through dedicated imaging. Such observations are currently planned.

4. Discussion and Conclusions

In these proceedings we have argued that HD 199143 and HD 358623 are part of a larger group of young stars, which we tentatively name the Capricornius association. Several of the properties of this newly discovered group make it unique: not only is it at a distance of 48 pc the closest association containing a *bona fide* classical T Tauri star (the TW Hya group is at slightly more than 50 pc), but its declination of $-17°$ also clearly separates it from the other newly discovered YSO groups, which are all located much further to the South.

Yet kinematically our Capricornius association may be related to the other nearby regions of recent star formation. HD 199143 has a galactic space velocity (U, V, W) of $(-10 \pm 13, -13 \pm 6, -13 \pm 6)$ km s^{-1}, similar to that found for the Tucanae and TW Hydra associations (Zuckerman & Webb 2000). This, as well as the similarity in the ages (5–10 Myr for Capricornius vs. $\sim$ 10 Myr for both Tuc and TW Hya), suggests that all three associations may have formed from the same cloud complex. Star formation in this large cloud may have progressed linearly, as is also observed commonly in more distant star forming regions (Elmegreen et al. 2000 and references therein), starting with the most southern association (Horlogium, Tucanae, TW Hydra) and progressing to our newly identified Capricornius group. Whether star formation ended here or whether more northern associations, and possibly even remnants of the parent molecular cloud, exist and remain to be discovered is a question that awaits further investigation. In any case the Capricornius group represents a unique opportunity to not only gain a better understanding of the star formation history in the solar neighborhood, but to also allow us more insight in the structure of protoplanetary disks and hence our own origins.

References

Barrado y Navascués, D., Stauffer, J.R., Song, I., & Caillault, J.P. 1999, ApJ 520, L123

Elmegreen, B.G., Efremov, Y., Pudritz, R.E., & Zinnecker, H. 2000, in Protostars & Planets IV, ed. V. Mannings, A.P. Boss & S.S. Russell (Tucson: Univ. of Arizona Press), 179

Kastner, J.H., Zuckerman, B., Weintraub, D.A., & Forveille, T. 1997, Science 277, 67

Mathioudakis, M., Drake, J.J., Craig, N., et al. 1995, A&A 302, 422

Palla, F., & Stahler, S.W. 1993, ApJ 418, 414

van den Ancker, M.E., Pérez, M.R., de Winter, D., & McCollum, B. 2000, A&A 363, L25

Zuckerman, B., & Webb, R.A. 2000, ApJ 535, 959