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IDENTIFICATION OF A NEARBY STELLAR ASSOCIATION IN THE *HIPPARCOS* CATALOG: IMPLICATIONS FOR RECENT, LOCAL STAR FORMATION

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ABSTRACT

The TW Hydrae Association ($\sim$55 pc from Earth) is the nearest known region of recent star formation. Based primarily on the *Hipparcos* catalog, we have identified a group of nine or 10 comoving star systems at a common distance ($\sim$45 pc) from Earth that appear to comprise another, somewhat older association ("the Tucanae Association"). Together with ages and motions recently determined for some nearby field stars, the existence of the Tucanae and TW Hydrae Associations suggests that the Sun is now close to a region that was the site of substantial star formation only 10–50 Myr ago. The TW Hydrae Association represents a final chapter in the local star formation history.

Subject headings: open clusters and associations: general — open clusters and associations: individual (TW Hydrae) — stars: formation — stars: pre–main-sequence

1. INTRODUCTION

For many years, the only known star clusters within 70 pc of Earth were the rich Hyades (at $\sim$45 pc) and the sparse UMa nucleus (at $\sim$25 pc). Then a group of stars $\sim$55 pc from Earth was established as a bona fide association of T Tauri stars of age $\sim$10 Myr (Webb et al. 1999; Sterzik et al. 1999; R. A. Webb, I. N. Reid, & B. Zuckerman 2000, in preparation). This TW Hydrae Association (hereafter TWA) was unrecognized for many decades in spite of its being the nearest region of recent star formation (Kastner et al. 1997). A ubiquitous signpost of newly formed stars has been a nearby molecular cloud. But no interstellar cloud has been found near TW Hya despite multiple searches. Therefore, we ask: do additional unrealized young associations far from molecular clouds exist near Earth?

Different teams have used the *Hipparcos* catalog to search for previously unrecognized stellar associations. For example, Platais et al. (1998) undertook a "search for star clusters from the *Hipparcos* Data" and listed basic data for five "very likely" new clusters and associations as well as 15 "possible" ones. Yet, in their own words, "At distances less than 100 pc, the survey is incomplete as a result of the chosen search strategy." Of the 20 potential new groupings in their Table 1, the closest, which contains 11 members from *Hipparcos*, is 132 pc away.

By contrast, the "Tucanae Association" we propose in the present paper is only $\sim$45 pc from Earth and much younger than the UMa and Hyades clusters. Just as the sparse UMa cluster nucleus is accompanied by more numerous UMa stream stars, we suggest that the Sun is embedded in a stream of stars with similar space motions (the "Tucanae Stream"), with the Tucanae Association playing a role analogous to the UMa nucleus. Figures 1*a* and 1*b* depict the Tucanae Association and some stream stars, respectively. These stars likely represent some of the younger, nearer, members of the more extensive Pleiades group or Local Association proposed by Eggen (e.g., see Jeffries 1995 and references therein).

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2. OBSERVATIONS

Excepting TW Hya itself, the first T Tauri stars in the TWA were identified in a study of *IRAS* sources at high Galactic latitude (de la Reza et al. 1989; Gregorio-Hetem et al. 1992). It has been shown that, on the main sequence, young stars are more likely 60 μm *IRAS* sources than are old stars (e.g., Jura et al. 1993, 1998; M. D. Silverstone et al. 2000, in preparation), and young stars are also more apt to be members of associations than are older stars. Therefore, we interrogated the *Hipparcos* catalog within a 6° radius of two dozen stars detected by *IRAS* at 60 μm and scattered around the sky. The stars were those with, in our opinion, reliable excesses at 60 μm listed by Mannings & Barlow (1998), Backman & Paresce (1993), and/or M. D. Silverstone et al. (2000, in preparation). We searched for *Hipparcos* stars with similar proper motions and distances to the IRAS stars; results for our most interesting regions are presented in Figure 1, Tables 1 and 2 and are discussed below. Results at additional *IRAS* stars will be discussed in a later paper.

To verify or deny common space motions of Table 1 stars with similar distances and proper motions in the *Hipparcos* catalog, we measured radial velocities with the Bench Mounted Echelle (BME) spectrograph on the 1.5 m telescope at the Cerro Tololo Interamerican Observatory (CTIO). The spectra cover from $\sim$5000 to 8200 Å at a typical measured resolution of 0.15 Å. The data, obtained 1999 August 21–26 (UT), were reduced and calibrated in *IRAF*.

Six radial velocity standard stars were observed during the run with spectral types ranging from F6 to M1.5. Radial velocity was determined by cross-correlating the spectrum of the target and a standard star of similar spectral type observed close in time to the target. Approximately 15 echelle orders, chosen to produce strong correlations and have few atmospheric features, were used to compute the correlation. The accuracy of these measurements is strongly dependent on the signal-to-noise ratio (S/N) of the spectra and the spectral type and rotational velocity of the target

TABLE 1

POTENTIAL MEMBERS OF THE TUCANAE ASSOCIATION

CATALOG NUMBER			NUCLEAR MEMBER?	J2000.0							PROPER MOTION (mas yr^{-1})	
HIP	HD	HR		Right Ascension	Declination	m_v	$B-V$	SpT	*ROSAT* (cps)	π (mas)	α	δ
A. Probable and Possible Members of the Tucanae Nucleus or Stream												
1481	1466	...	Y	00 18 26.0	−63 28 38	7.5	0.54	F8	0.26	24.42	90	−56
1910	...	...	Y	00 24 08.9	−62 11 04	11.3	1.39	M0	...	21.59	93	−46
1993	...	...	Y	00 25 14.6	−61 30 48	11.3	1.35	K7	...	26.69	85	−63
2484	2884	126	Y	00 31 32.6	−62 57 29	4.37	−0.07	B9	...	23.35	92	−59
2487	2885	127	Y	00 31 33.4	−62 57 56	4.54	0.15?	A2+A7	...	18.95	98	−51
2578[a]	3003	136	Y	00 32 43.8	−63 01 53	5.09	0.04	A0	...	21.52	94	−51
2729	3221	...	Y	00 34 51.1	−61 54 58	9.6	1.05	K4	0.5	21.78	87	−59
92680	174429	...	...	18 53 05.9	−50 10 49	7.8(8.5)	0.78	K0	1.0	20.14	17	−85
93815	177171	7213	...	19 06 19.9	−52 20 26	5.2	0.53	F7	2.08	19.07	26	−117
95261[a]	181296	7329	...	19 22 51.2	−54 25 25	5.05	0.02	A0	...	20.98	28	−83
95270[a]	181327	...	...	19 22 58.9	−54 32 16	7.0	0.48	F5	...	19.77	28	−82
99803[b]	191869	...	...	20 14 56.1	−56 58 34	7.24	0.49	F6.5	...	15.32	33	−92
100751	193924	7790	...	20 25 38.8	−56 44 06	1.94	−0.12	B7	...	17.60	7	−87
104308	200798	...	...	21 07 51.2	−54 12 59	6.7	0.24	A5	...	15.05	28	−82
105388	202917	...	...	21 20 49.9	−53 02 02	8.6	0.69	G5	0.62	21.81	30	−94
105404	202947	...	...	21 20 59.8	−52 28 39	8.9	0.85	K0	0.67	21.72	34	−105
107345	...	...	...	21 44 30.1	−60 58 38	11.7	1.4	M1	0.137	23.66	41	−92
107947	207575	...	...	21 52 09.7	−62 03 08	7.2	0.51	F6	0.42	22.18	44	−94
108195	207964	8352	...	21 55 11.3	−61 53 11	5.9	0.39	F3	0.19	21.49	48	−93
PPM 366328[b,c]	...	...	?	23 15 01.2	−63 34 25	9.8	0.80	K0	0.15	20(guess)	116	−44
116748	222259	...	Y	23 39 39.4	−69 11 44	8.2	0.78	G5/G8 IV	0.81	21.64	79	−60
118121	224392	9062	Y	23 57 35.0	−64 17 53	5.0	0.06	A1	...	20.53	83	−58
B. Improbable Members												
459	67	...	...	00 05 28.3	−61 13 32	8.8	0.67	G5	...	18.57	87	−78
1399	...	...	...	00 17 30.3	−59 57 04	11.3	1.4	M0	...	22.54	113	−40
93096	175531	...	...	18 57 56.6	−44 58 06	9.8	...	G8/K0	...	15.51	27	−75
94051	177720	...	...	19 08 51.1	−54 02 17	8.7	0.56	G0	...	14.60	−1	−66
94858	180134	7297	...	19 18 09.8	−53 23 13	6.4	0.5	F7	...	21.94	25	−81
94997	...	...	...	19 19 49.6	−53 43 13	12.1	1.58	M3	...	16.67	14	−90
95302	181516	...	...	19 23 20.5	−50 41 20	9.0	0.74	G6 IV	...	13.24	31	−87
97705	187101	...	...	19 51 23.6	−58 30 34	8.0	0.58	F8/G0	...	14.73	36	−85
101636	195818	...	...	20 36 02.3	−54 56 28	8.6	0.58	G0	...	15.16	50	−84
101844	...	...	...	20 38 19.4	−55 36 19	11.36	1.42	K4	...	31.24	14	−79
103438	199065	...	...	20 57 22.4	−59 04 33	7.95	0.66	G2/G5	0.052	19.63	12	−59
104256	200676	...	...	21 07 17.5	−57 01 55	8.8	0.82	K1	...	18.69	35	−112
107806	207377	...	...	21 50 23.7	−58 18 17	7.9	0.73	G6	...	24.46	50	−93
109612	210507	...	...	22 12 16.8	−54 58 40	9.66	0.95	K3	...	20.39	108	−67
114236	218340	...	...	23 08 12.2	−63 37 41	8.4	0.62	G3	...	17.61	101	−63

NOTE.—Right ascension is given in hours, minutes, and seconds, and declination is given in degrees, arcminutes, and arcseconds; Position, apparent V magnitudes (m_v), color ($B-V$), and parallax (π in mas) are from the *Hipparcos* catalog unless otherwise noted. Spectral types (SpT) are taken from various sources in the literature, luminosity classes are main sequence (V) unless otherwise noted. A "Y" in the "nuclear member" column indicates the star is likely a member of the Tucanae Association (or nucleus), a blank indicates possible membership in the "stream." The *ROSAT* fluxes in counts per second (cps) are from the *ROSAT* Bright Source Catalog (Voges et al. 1998). Proper motions are an average of the *Hipparcos* and PPM values, if both exist.

[a] Star has definite or possible far-infrared excesses as measured by *IRAS*.

[b] Possible member. Space motion is somewhat descrepant or star does not show expected signs of youth.

[c] PPM 366328 is included as a possible member despite lack of a Hipparcos parallax because its high X-ray flux indicates potential youth and its photometric distance is ~ 50 pc. Proper motion and m_v are from PPM catalog.

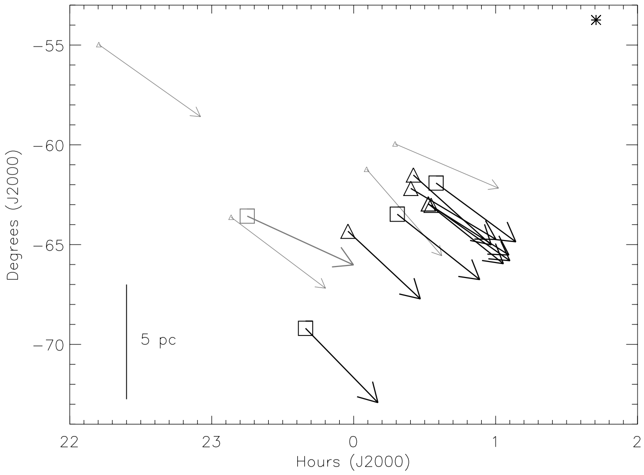

FIG. 1*a*

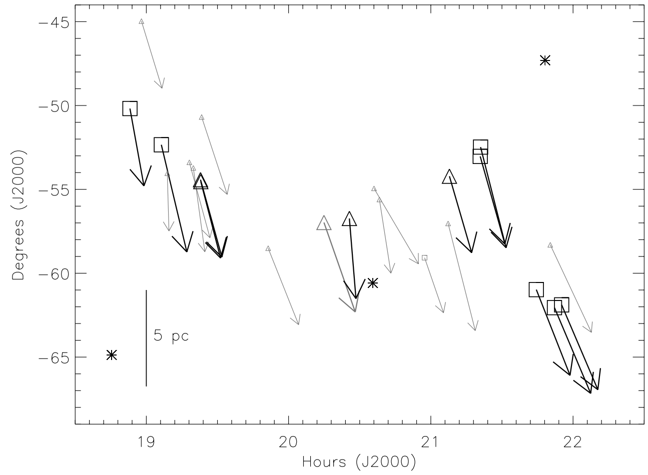

FIG. 1*b*

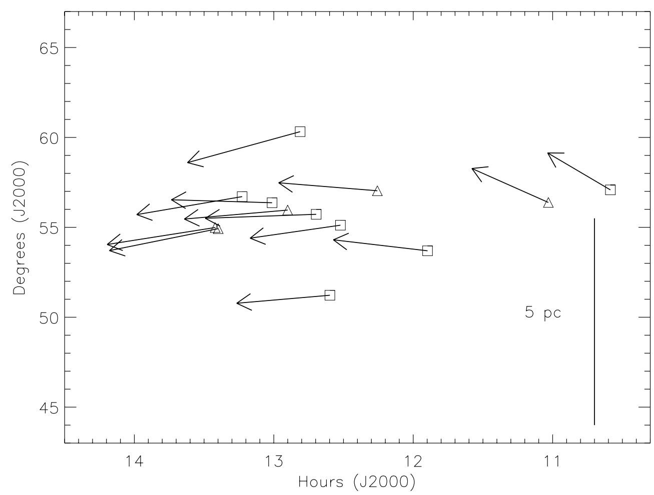

FIG. 1*c*

FIG. 1.—Potential moving group members in Table 1. (*a*) The Tucanae Association or nucleus, (*b*) some of the Tucanae stream stars, and (*c*) UMa nucleus stars shown for comparison. The right ascension and declination axes are scaled to roughly show the true appearance on the sky though a distortion exists because of the square grid used. The vectors represent the proper motion over 200,000 yr. Probable members of the Tucanae Association and stream are indicated,with large symbols and dark vectors; improbable members, with small symbols and light dotted or dashed vectors. Two "possible" members are shown with large symbols and light vectors. The bar represents 5 pc at the approximate distance to each group. X-ray (RASS-BSC) sources are marked with squares; non–X-ray sources, with triangles. Positions of four additional young stars with similar space motions that appear in the foreground of the Association are indicated by asterisks (see text).

star. The uncertainty ranges from $\sim$1 to 10 km s^{-1}, the majority being less than 2 km s^{-1}. Hα line profiles and equivalent widths of lithium (6708 Å) were also measured and are listed in Table 2.

Projected rotation velocities ($v \sin i$) were measured and are listed in Table 2. We used a procedure similar to that of Strassmeier et al. (1990); specifically, we followed the prescription described in their § IIId. We measured the FWHM of lines in the 6420 Å region and corrected them for the instrumental broadening (0.134 km s^{-1}, FWHM) determined from five ThAr lamp lines at similar wavelengths. Following Strassmeier et al., we assumed a macroturbulent velocity, ζ, equal to 3 km s^{-1}. For a few of the faint late–K-type and M-type stars, $v \sin i$ is quite uncertain owing to low S/N.

With the 0.9 m telescope at Cerro Tololo Inter-American Observatory (CTIO) we obtained *BVRI* photometry of stars in Table 1. The purpose was to determine whether any of the stars were sufficiently young to still be above the main sequence. These data will be reported in a later paper.

3. RESULTS AND DISCUSSION

Properties of the 37 star systems we observed at CTIO are listed in Tables 1 and 2. The calculated ***U***, ***V***, ***W*** and the age indicators usually agree in the sense that the stars with space motions similar to those of stars in the youthful TWA (Soderblom, King, & Henry 1998; R. A. Webb et al. 2000, in preparation), β Pic moving group (Barrado y Navascues et al. 1999), and Local Association (Jeffries 1995), usually also have additional indications of youth. Youth is deduced from one or more of the following characteristics: *ROSAT* All-Sky Survey Bright Source Catalog (RASS-BSC; Voges et al. 1999) X-ray source, strong lithium 6708 Å absorption, Hα emission or weak (filled-in) absorption, rapid rotation, *IRAS* far-infrared excess emission, and, for the A- and late–B-type stars, location near the bottom envelope of brightness of stars of comparable spectral type, i.e., on or near the zero-age main sequence (Jura et al. 1998; Lowrance et al. 2000).

We interpret Tables 1A and 2A in the following way. Nine or 10 star systems near zero hours right ascension are

TABLE 2

MEASURED AND DERIVED QUANTITIES

HIP	Hα PROFILE	Li 6708 Å (EW mÅ)	$v \sin i$ (km s^{-1})	RV (km s^{-1})	SPACE MOTION (km s^{-1}) *U*	*V*	*W*
			A. Probable and Possible Members of the Nucleus or Stream				
1481	Filled?	125	18.4	+7.0	−8.9	−19.8	−1.5
1910	EW = −2.2	210	18	+4.0	−12.6	−19.4	+0.3
1993	EW = −1.2[a]	<50	17	+7.0	−6.5	−19.0	−1.0
2484	...	...	107	+9.0(0 ,10, 14)[b]	−8.3	−22.4	−1.7
2487[c]	...	18	6.1[c]	+9.0(−10.5 & +18, 8, 13)	−13.0	−25.9	−1.7
2578	...	...	78	+7.0 (1, 5, 7.5, 14)	−11.0	−22.0	−0.6
2729	EW = −2.0	350	110	−1.0[b]	−11.5	−18.6	+6.9
92680	Filled	260	63	+0.0 (0, −14, 0, 4, −3)[b]	−7.7	−16.4	−9.4
93815[d]	Filled	≲70[e]	26.3[e]	+3 (+90 & −82,+ 2)[b,d]	−9.7	−24.7	−13.9
...	Filled	<25[f]	36.6[f]	...	...	...	...
95261	...	...	Very large[g]	−2.0 (−17, 13)[b]	−10.9	−14.6	−7.9
95270	Filled?	125	15.7	−0.5	−10.1	−15.7	−9.1
99803−SW	Filled	<30	33	−18.0	−28.7	−20.2	+1.8
99803−NE	Filled	<45	30	−16.0	...	...	...
100751	...	...	16	+2.0 (3, 2)[b]	−6.5	−22.6	−1.7
104308	...	...	>100(?)	−10.0[b]	−17.6	−22.9	+3.6
105388	Filled	205	13.3	−1.0 (−1, −5)	−7.9	−20.0	−0.8
105404	Filled	150	12.8	+6.0	−3.8	−23.8	−6.0
107345	EW = −1.3[a]	<40	14	+2.0	−7.8	−18.7	−1.0
107947	Filled	110	30	+3.0	−8.3	−20.8	−1.2
108195	...	100	110	−3.0 (−7, 1)[b]	−12.8	−19.3	+2.6
PPM 366328	Filled[h]	?	Very large?	−5.0[b]	−25.1	−16.0	−0.7
116748−S	Filled	215	15.7	+7.5	−9.7	−20.7	−1.9
116748−N	Filled	220	13.4	+6.0	−9.5	−21.9	−1.0
118121	...	...	152[g]	+0.6 (−3)[i]	−13.1	−19.1	+3.4
			B. Improbable Members				
459	Normal	12	5.1	+7.0	−10.7	−28.7	+1.2
1399	Normal	<30	~7	−4.5	−19.3	−16.1	+5.1
93096	Normal	<25	5.9	−13.5	−20.5	−16.1	−9.9
94051	Normal	37	5	−30.0	−34.2	−11.3	+7.8
94858	Normal	<10	5.9	−22.5 (−22.5, −24)	−27.7	−8.6	+1.4
94997	Normal	<30	~13	+18.0	+4.9	−26.7	−16.1
95302	Normal	<15	5.5	+32.5	+14.8	−32.1	−30.0
97705	Normal	62	5.5	+17.5	−1.8	−27.9	−20.2
101636	Normal	65	4.4	−22.5	−33.1	−18.4	+2.4
101844	Normal?	<40	~8	−26.0	−24.1	−5.0	+14.8
103438	Normal	65	5.5	+11.0	+2.3	−16.7	−6.9
104256	Normal	<20	7.0	+22.0	+3.7	−33.0	−16.3
107806	Normal	<20	9.2	+13.5	−0.8	−22.1	−10.6
109612	Normal?	<15	6.5	−10.5	−26.6	−16.6	−1.7
114236	Normal	23	4.9	+4.0	−20.1	−24.8	−4.9
			C. Nearby Moving Groups				
TWA	...	...	...	...	−11	−18	−5
Local Assoc.	...	...	...	...	−11	−21	−11
UMa	...	...	...	...	+13	+1	−8
Hyades	...	...	...	...	−40	−16	−3

NOTE.—In the Hα column, "Normal" indicates an absorption line similar to inactive stars of comparable spectral type (e.g., see figures in Soderblom et al. 1998). "Filled" indicates a shallow absorption or completely absent Hα feature. Negative equivalent widths (EW) indicate an emission line. Stars without entries in the Hα, Li, and FWHM columns are A- and B-type stars with broad Hα lines and few other photospheric features. The Li equivalent widths (EW) are not corrected for possible contamination from Fe I 6707.44 Å line whose contribution is typically ≲ 10 mÅ for F- and G-type stars and ≲25 mÅ for K- and M-type stars. First listed radial velocity (RV) is used to calculate ***U***, ***V***, ***W***. This value is generally our CTIO measurement. If additional values appear, the first value in parentheses ( ) is our CTIO measurement followed by alternative measurements that appear in the literature. CTIO measured velocities have an error of less than 2 km s^{-1} unless otherwise noted. Heliocentric ***U***, ***V***, ***W*** space motions have been computed according to the equations of Johnson & Soderblom (1987), positive ***U*** in the direction of the Galactic center, ***V*** the direction of Galactic rotation, and ***W*** toward the north Galactic pole. The space motions for moving groups are from Jefferies 1995 (Local Assoc. taken from Eggen 1992), Soderblom & Mayor 1993 (UMa & Hyades), and R. A. Webb et al. 2000, in preparation (TW Hya Assoc. = TWA) and are included for comparison.

[a] Double-peaked Hα profile

[b] Error of the RV measurement is significantly larger than typical because the star is a rapid rotator and/or an early spectral type with few spectral features. Uncertainty of these measurements is typically 10 km s^{-1}.

[c] The BSC lists HIP 2487 as a 0″.4, A2 + A7 binary system, several ionized metal lines are double peaked and the red peak is not well fitted by a Gaussian profile. Nonetheless, we measure velocities of the components at −10.5 km s^{-1} and +18 km s^{-1} (with a large uncertainty). For calculation of ***U***, ***V***, ***W***, we adopt an average of our weighted mean system velocity and previously measured velocities. $v \sin i = 6.1$ applies to the blueshifted star. The redshifted component, based on deblending of only four lines, appears to be somewhat more rapidly rotating but the non-Gaussian profile suggests the situation is more complicated. All measurements as of HJD 2,451,414.934.

[d] Double-lined spectroscopic binary. Strength of photospheric features is approximately equal and components are at $RV = -82$ and +90 km s^{-1} on HJD 2,451,415.472. If stars are equal mass, average system velocity = +4 km s^{-}, also previously measured to be +2 km s^{-1}.

[e] Blueshifted component

[f] Redshifted component

[g] Very broad Hα profile

[h] Extreme rapid rotator? Spectrum is essentially featureless. Broad shallow depressions appear at the positions of a couple of strong spectral lines that are likely rotationally broadened features.

[i] We adopt $RV = 0.6$ km s^{-1} from Grenier et al. 1999 in preference to our measurement of −3 km s^{-1}, which has a larger uncertainty

likely to be part of a small stellar association similar to the TWA or the UMa nucleus (see Fig. 1*c*). These 10 stars are indicated in the fourth column of Table 1A and we dub them "the Tucanae Association"; their distribution is shown in Figure 1*a*. Other stars in the tables and figures may be placed into one of the following categories: (1) a member of the stream of nearby, young Local Association stars, or (2) a star with no obvious indications of youth that happens to have distance from Earth and proper motions similar to those of the Tucanae Association. Some of these stars may indeed be Tucanae Association members without signatures of youth (e.g., see discussion of HD 207129 below). An excess of stars with similar proper motions and distance from Earth seems to exist in the Tucanae region, indicating some stars listed in Table 1b may be Tucanae members. But individually, each of these stars is unlikely to be a member.

Ages have been deduced for a few stars in Table 1a. For example, HIP 92680 (PZ Tel) is above the main sequence and estimated to be 15–20 Myr old (Favata et al. 1998; Soderblom et al. 1998). With the near-infrared camera and multiobject spectrometer (NICMOS) on the *Hubble Space Telescope* (*HST*), Lowrance et al. (2000) discovered a late–M-type object within 4″ of the A-type star HR 7329; if a companion, which appears very likely, then the object is a brown dwarf of age $\lesssim$30 Myr. Other stars with similar space motions and ages around 20 Myr have been identified close to the Sun, for example, Beta Pictoris (Jura et al. 1993; Barrado y Navascues et al. 1999) and Gliese 799 and 803 (Barrado y Navascues et al. 1999).

The Tucanae Association itself is probably somewhat older than 20 Myr. We tentatively assign an age of 40 Myr based on the strength of Hα emission lines seen in HIP 1910, 1993, and 2729, which are brighter than in stars of similar spectral type in the α Per cluster (see Fig. 16 in Prosser 1992) whose age has recently been estimated to be 90 ± 10 Myr (Stauffer et al. 1999). Other indicators of age, the presence of rapid rotators, stars with high Li abundance and or large X-ray flux, all agree with this estimate but are somewhat less diagnostic. For example, the X-ray counts per second of the K- and M-type stars in Table 1a imply L_X/L_{bol} comparable to that of late-type stars in very young clusters (see Fig. 1 in Kastner et al. 1997). And L_X/L_{bol} of the late–F- and G-type stars in Table 1a are typically 3 orders of magnitude larger than L_X/L_{bol} of the Sun (T. A. Fleming 1999, private communication), which suggests an age younger than the Pleiades (see Fig. 2 in Gaidos 1998).

Over 40 Myr, dispersion as small as 1 km s^{-1} in the critical *V* component of space velocity would lead to a 40 pc separation between stars. Since no such separation is present among the nuclear members (Fig. 1*a*), either the range in *V* given in Table 2A is due to measurement error or the stars are younger than 40 Myr or both. Measurement errors are characterized by, for example, differences between *Hipparcos* and PPM proper motions and the large uncertainty in radial velocity for A- and B-type members. Also, close companions in unrecognized binary systems will generate orbital motion that could shift the measured value of *V* away from the true *V* velocity of the binary system.

We chose the stars in Table 1 for further study at CTIO because of similar distances from Earth and proper motions. However, once radial velocities were measured it became clear that many of these stars share similar space motions (***U***, ***V***, ***W***) with other very young nearby stars found in very different directions. The mean ***U***, ***V***, ***W*** for the nine likely member systems of the Tucanae nucleus (PPM 366328 not included) is $(-10.5, -20.8, +0.3) \pm (2.3, 2.4, 3.0)$. For comparison, ***U***, ***V***, ***W*** for the TWA is -11, -18, -5 (R. A. Webb et al. 2000, in preparation) and, for the β Pic moving group, -10.3, -16.5, -10.2 (Barrado y Navascues et al. 1999). In addition, we calculate ***U***, ***V***, ***W*** $= -11$, -18, -10 for η Cha, the brightest member of the recently identified, young, compact η Chamaeleontis cluster (Mamajeck, Lawson, & Feigelson 1999). Similar space motions are also evident for some stars with far-IR excess emission as measured by *IRAS* or having strong lithium 6708 Å lines (Jeffries 1995). As noted by Jeffries, many of these lithium stars have space motions similar to that of Eggen's Local Association (***U***, ***V***, ***W*** $= -11$, -21, -11). Four such stars, HD 172555, HD 195627, HD 207129 and HD 10647, are plotted as asterisks on Figures 1*a* and 1*b*. These four stars were not targeted by us for CTIO observations because they are significantly closer to Earth than stars in Table 1 and we did not initially recognize them as potential members of a common stream.

The G-type star HD 207129 is of special interest because it is surrounded by a cold dust ring detected by *IRAS* and is only 15.6 pc from Earth. Jourdain de Muizon et al. (1999) argue that this star is 4.7 Gyr old and construct a corresponding model for evolution of the dust ring. In contrast, we believe that HD 207129, ***U***, ***V***, ***W*** $= -13.7$, -22.3, $+0.6$, is actually a member of the Tucanae stream and probably only about as old as the Tucanae Association. Stars with space motions within the range encompassing the young groups listed above, $(-15, -23, -13) < ($***U***, ***V***, ***W***$) < (-9, -16, +3)$, comprise less than 2% of the stars in Gleise's Catalog of Nearby Stars. Thus the chance that HD 207129 is as old as 4.7 Gyr and yet have a space motion so similar to many very young stars is small. Also, location of HD 207129 in the same direction as the Tucanae stream stars seen in Figure 1 supports the idea that they are kinematically associated. This strikes us as more compelling evidence for youth than the weak Ca II K-line emission, relied on by Jourdain de Muizon, as an indicator of a much older star. Not all young stars have activity in the Ca II lines. For example, the very young, F-type star HD 135344, which has a huge far-IR excess and associated CO rotational emission (Zuckerman, Forveille, & Kastner 1995), has no Ca activity (Duncan, Barlow, & Ryan 1997). Finally, we note that the intrinsic X-ray luminosity of HD 207129 as measured by *ROSAT* is about 10 times that of the Sun.

Many papers published recently describe field stars with high lithium abundance, large X-ray fluxes, and other indicators suggestive of youth, but no consistent or compelling picture has been established for the solar vicinity. We believe it is now possible to paint a plausible picture of the recent star formation history of the present solar neighborhood.

Between 10 and 40 Myr ago in a comoving frame centered near the present position of the Sun, an ensemble of molecular clouds were forming stars at a modest rate. The spectral types of these stars ranged primarily from A to M, but included a few B-type stars also. About 10 Myr ago, the most massive of the B-type stars exploded as a supernova at about the time that stars in the TWA were forming. This event terminated the star formation episodes and helped to generate a very low density region with radius of order 70 pc in most directions from the present position of the Sun

(Welsh, Crifo, & Lallemont 1998 and references therein). Thus we now have a "150 pc conspiracy" whereby molecular clouds (Taurus, Lupus, Cha, Sco, Oph) are seen in various directions, typically ~ 150 from Earth, and, like the star-forming clouds 10-40 Myr ago, mostly at negative declinations. If the rate of supernovae in the Galaxy is one per 50 yr, then in a typical sphere of radius 70 pc, a supernova will explode every $\sim 10^7$ yr. Ten Myr ago, the Sun would have been further than 100 pc from the supernova explosion.

The above picture is consistent with one painted by Elmegreen (1992, 1993), which was based on more general considerations pertaining to local Galactic structure and Gould's Belt. In particular, Elmegreen remarks, "The local star formation activity began 60 million yr ago when the Carina arm passed through the local gas. ... This scenario is largely speculative...." The recent discoveries of very nearby young star clusters and field stars in the southern hemisphere, greatly enhances the likelihood of Elmegreen's speculative scenario.

4. CONCLUSIONS

We have found a previously unrecognized southern association—"the Tucanae Association"—which is only ~ 45 pc from Earth, but not quite as young as the recently established TW Hydrae Association. Thus, in the past year, the number of known stellar associations within 60 pc of Earth has increased from two (the Hyades and UMa) to four. The existence of the Tucanae and TW Hydrae Associations resolves the mystery of how the β Pictoris moving group can be so young, 20 ± 10 Myr (Barrado y Navascues et al. 1999) and yet so near to Earth (within 20 pc). That is, 10–40 Myr ago, the region through which the Sun is now passing experienced a significant era of star formation that produced the β Pictoris group, the two southern associations, and related stream stars.

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