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THE TUCANA/HOROLOGIUM, COLUMBA, AB DORADUS, AND ARGUS ASSOCIATIONS: NEW MEMBERS AND DUSTY DEBRIS DISKS

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ABSTRACT

We propose 35 star systems within ~70 pc of Earth as newly identified members of nearby young stellar kinematic groups; these identifications include the first A- and late-B-type members of the AB Doradus moving group and field Argus Association. All but one of the 35 systems contain a bright solar- or earlier-type star that should make an excellent target for the next generation of adaptive optics (AO) imaging systems on large telescopes. AO imaging has revealed four massive planets in orbit around the λ Boo star HR 8799. Initially, the planets were of uncertain mass due in large part to the uncertain age of the star. We find that HR 8799 is a likely member of the ~30 Myr old Columba Association, implying planet masses ~6 times that of Jupiter. We consider *Spitzer Space Telescope* MIPS photometry of stars in the ~30 Myr old Tucana/Horologium and Columba Associations, the ~40 Myr old field Argus Association, and the ~70 Myr old AB Doradus moving group. The percentage of stars in these young stellar groups that display excess emission above the stellar photosphere at 24 and 70 μm wavelengths—indicative of the presence of a dusty debris disk—is compared with corresponding percentages for members of 11 open clusters and stellar associations with ages between 8 and 750 Myr, thus elucidating the decay of debris disks with time.

Key words: circumstellar matter – stars: evolution – stars: kinematics and dynamics – stars: pre-main sequence

Online-only material: color figures

1. INTRODUCTION

Young stars within 100 pc of Earth are excellent laboratories for the study of stellar and planetary system evolution during ages from about ten to hundreds of millions of years. Except for the Sun, it is difficult to deduce even a moderately accurate age of an individual star. Astronomers have circumvented this problem by studying stars in rich open and globular clusters. Except for the Hyades, no such clusters exist within 100 pc of Earth. Fortunately, beginning in the late 1990s, the existence of various substantial co-moving, co-eval, associations of young nearby stars has become evident (see reviews by Zuckerman & Song 2004 and Torres et al. 2008).

Investigation of such stars will enhance knowledge of early stellar evolution. However, as a consequence of their proximity to Earth, in the long term the most valuable contribution of these youthful stars to astronomy will likely lie in the realm of the origin and early evolution of planetary systems—proximity buys one enhanced brightness and, for a given linear scale, an enhanced angular scale. Table 1 lists papers in which new members of the four nearest co-moving groups of young stars have been proposed previously; according to Torres et al. (2008), the mean distance from Earth is less than 50 pc for the most secure members of each of these four groups. As new telescopes and cameras are being developed for imaging of young planets and the dusty disks out of which they form, it is important to complete the inventory of young stars near Earth.

A principal motivation of the present paper is the identification of new members of the AB Doradus and Tucana/Horologium Associations. While considering the latter association, we recognized new members of the Columba Association (Torres et al. 2008) including the now famous HR 8799 (=HIP 114189) which is orbited by at least four giant planets (Marois et al. 2010). The age and some other properties of HR 8799 are considered in Section 5.3.

While considering the AB Dor Association we have identified its first known A- and late-B-type members. In addition, we have identified field members of the Argus Association that are of earlier spectral type and generally nearer to Earth than members previously proposed by Torres et al. (2008).

The *Infrared Astronomical Satellite* (*IRAS*) discovered the phenomenon of dusty debris disks in orbit around main-sequence stars (Aumann et al. 1984). By now ~150 main-sequence stars within 120 pc of Earth appear to have excess infrared emission detectable with *IRAS*. Almost all of these excesses are measured most convincingly at 60 μm wavelength (Moor et al. 2006; Rhee et al. 2007b, and references therein), although occasionally instead at 25 μm (Rhee et al. 2007a; Melis et al. 2010, and references therein). While the *Infrared Space Observatory* (*ISO*) added a few new debris disk stars (e.g., Habing et al. 2001; Silverstone 2000), *Spitzer Space Telescope* surveys provided the next major advance; open clusters, nearby stellar associations, and nearby field stars have all been studied. *Spitzer* surveys included a variety of goals—for example, an understanding of the evolution of the quantity and temperature of the dusty debris with time, the association of debris disks with stars of different spectral classes, and association or lack thereof of debris with known planetary and stellar secondaries. *IRAS* was an all-sky survey whereas *ISO* and *Spitzer* pointed at only a small fraction of the sky. They were followed by the AKARI all-sky survey that, typically, was no more sensitive than *IRAS*. Most recently, the Wide Field Infrared Survey Explorer (WISE) has performed a mid-infrared all-sky survey far more sensitive than those of *IRAS* or AKARI.

A focus of the present paper is the evolution of debris disks as a function of their age. We present published and unpublished *Spitzer* data for Tucana/Horologium, Columba, AB Doradus, and Argus Association members, identifying some previously unrecognized dusty systems. Then we compare the overall debris disk status of these associations with previously

Table 1
Papers Proposing Memberships in the Nearest Known Young Stellar Associations

Paper	Tuc/Hor	AB Dor	TW Hya	β Pic
Kastner et al. (1997)			X	
Webb et al. (1999)			X	
Zuckerman & Webb (2000)	X			
Torres et al. (2000)	X			
Zuckerman et al. (2001a)				X
Zuckerman et al. (2001b)	X			
Zuckerman et al. (2001c)			X	
Gizis (2002)			X	
Song et al. (2003)	X		X	X
Zuckerman et al. (2004)		X		
Zuckerman & Song (2004)	X	X	X	X
Scholz et al. (2005)			X	
Mamajek (2005)			X	
Torres et al. (2006)				X
Lopez-Santiago et al. (2006)		X		
Looper et al. (2007)			X	
Torres et al. (2008)	X	X	X	X
Fernandez et al. (2008)	X	X	X	X
da Silva et al. (2009)	X	X	X	X
Schlieder et al. (2010)		X		X
Looper et al. (2010a, 2010b)			X	
Rodriguez et al. (2011)			X	
Kiss et al. (2011)	X			X
Shkolnik et al. (2011)			X	
This paper	X	X		

Notes. In addition to the above major young stellar associations nearest to Earth, Zuckerman et al. (2006) proposed the somewhat older and sparser, but comparably nearby, "Carina-Near" moving group. The Carina Association proposed by Torres et al. (2008) has essentially nothing in common with the Carina-Near group; the latter is much nearer to Earth and much older than the former and has a much more negative *U* component of space motion. While the Carina, Columba, and Argus Associations possess some members close to Earth (see, e.g., Tables 3 and 4), as defined by Torres et al. (2008), stars in these three associations are, on average, substantially more distant from Earth than are stars in the four Table 1 Associations (see Table 2 in Torres et al.).

published *Spitzer* results for other stellar associations near Earth.

2. SAMPLE SELECTION

Memberships of the four most prominent young stellar associations closest to Earth—β Pic, TW Hya, AB Dor, and Tuc/Hor—are considered in papers listed in Table 1. In the present paper, we address the latter two; specifically, we search for new members and for dusty debris disks. Although stars of the Columba Association are generally more distant from Earth than those of the four Table 1 Associations (Torres et al. 2008), because of various similarities between Tuc/Hor and Columba stars we searched for Columba stars within 65 pc of Earth. The Argus Association, especially IC 2391, as proposed by Torres et al. (2008, their Tables 11 and 12) is on average much more distant from Earth than are the four Table 1 associations, but a few of their proposed Argus field members are within 70 pc of Earth. This inspired us to search for additional nearby Argus field stars. Proposed new members of AB Dor, Tuc/Hor & Columba, and Argus, all within ~70 pc of Earth, may be found in Tables 2–4.

Potential new members of these associations are identified by a match of ages and Galactic space motions *UVW*. These characteristics can be measured or estimated via optical spectroscopy and astrometry and also optical and X-ray photometry. Optical data for late-F through early-M-type stars come principally from our spectroscopic survey described in Section 3. For these spectral types, we generally observed only stars that appear in the *ROSAT* All Sky Survey (RASS; Voges et al. 1999, 2000). For earlier spectral types, an important source of data is the catalog of Gontcharov (2006) which includes accurate radial velocities for stars from late-B through early-F type.

For dusty debris disk studies with the *Spitzer Space Telescope*, MIPS photometry was obtained via our GO program no. 3600 "Disk Census of Nearby Stellar Groups," but also via the *Spitzer* archives. When poring through the *Spitzer* literature, we noticed that refereed papers had been devoted to most young and/or nearby stellar clusters and associations except that AB Dor and Tuc/Hor were conspicuous by their absence; we are now filling this void. Because some likely members of AB Dor and Tuc/Hor are identified in papers that post date the cold *Spitzer* mission (including some papers listed in Table 1 and also the present paper) infrared photometry for these two stellar associations is incomplete. Similar remarks pertain to Columba and Argus Association members. Perhaps WISE, Herschel, and SOFIA will help to complete the disk census for stars in young, nearby associations.

3. OBSERVATIONS AND ANALYSIS

For southern hemisphere stars, spectra were obtained with the 2.3 m telescope at the Siding Spring Observatory (SSO) of the Australian National University. Double-beam grating

Table 2
Proposed AB Doradus Moving Group Members

HIP	HD	R.A. (h/m)	Decl. (deg)	Spec. Type	*V* (mag)	Dist. (pc)	Rad. Vel. (km s^{-1})	(*U*,*V*,*W*) (km s^{-1})	*UVW* Error (km s^{-1})
13209	17573	02 49	+27	B8	3.6	49	4.0 ± 4.1	−8.5,−25.7,−15.6	3.2,1.9,2.0
15353	20888	03 17	−66	A3	6.0	58	26.0 ± 0.5	−6.8,−27.5,−11.5	0.4,0.5,0.4
93580	177178	19 03	+01	A4	5.8	55	−23.1 ± 2.3	−11.3,−24.3,−12.8	1.9,1.4,0.6
95347	181869	19 23	−40	B8	4.0	52	−0.7 ± 4.1	−8.1,−26.0,−14.6	3.8,1.4,1.8
109268	209952	22 08	−46	B6	1.7	31	10.9 ± 1.7	−7.0,−25.6,−15.5	1.1,0.7,1.4
115738	220825	23 26	+01	A0	4.9	50	−4.4 ± 0.6	−7.0,−26.4,−13.3	0.3,1.0,0.8
117452	223352	23 48	−28	A0	4.6	44	8.7 ± 2.0	−7.0,−27.5,−13.3	0.6,1.4,2.0

Notes. Input data (R.A., decl., distance, and proper motion) for the *UVW* calculations in Tables 2–4 are from the *Hipparcos* catalog. *UVW* are defined with respect to the Sun, with *U* positive toward the Galactic Center, *V* positive in the direction of Galactic rotation, and *W* positive toward the North Galactic pole. Characteristic mean *UVW* for AB Dor group stars are given in Zuckerman & Song (2004) as −8, −27, and −14 km s^{-1}, and in Torres et al. (2008) as −6.8 ± 1.3, −27.2 ± 1.2, and −13.3 ± 1.6 km s^{-1}. HIP 93580 and 117452 are considered in Section 5.1.

Table 3
Proposed Tucana/Horologium & Columba Association Members

HIP	HD	R.A. (h/m)	Decl. (deg)	Spec. Type	V (mag)	Dist. (pc)	Rad. Vel. (km s^{-1})	(U,V,W) (km s^{-1})	UVW Error (km s^{-1})	Li EW (mÅ)	f_x
1134	984	00 14	−07	F5*	7.3	46	−2.2 ± 1.2	−12.2,−23.2,−6.0	0.7,1.3,1.2	120	−4.26
12413	16754	02 39	−42	A1*	4.7	40	18.0 ± 4.2	−10.8,−21.2,−8.3	0.6,1.9,3.7		
12925	17250	02 46	+05	F8	7.9	63	4.3 ± 1.1	−10.8,−23.6,−0.6	1.0,1.8,0.9	145	−4.33
14551	19545	03 07	−27	A5	6.2	58	13.8 ± 0.8	−10.8,−20.4,−3.2	0.4,0.8,0.8		
14913	20121	03 12	−44	F6	5.9	44	13.5 ± 2.1	−10.8,−18.8,−2.3	0.5,1.2,1.8	65	−4.06
17248		03 41	+55	M0.5*	11.2	37	−3.2 ± 0.6	−12.0,−23.5,−6.5	1.2,1.7,0.6		−3.36
17764	24636	03 48	−74	F3	7.1	55	15.5 ± 1.3	−8.6,−21.8,−2.5	0.6,1.0,0.8	60	−5.4
17782	23524	03 48	+52	G8	8.8	51	−2.2 ± 0.6	−9.5,−20.1, −4.5	1.8,2.9,1.0	243	−3.16
17797	24071J	03 48	−37	A1	4.7	49	15.6 ± 0.4	−10.2,−21.5,−1.0	0.3,0.6,0.6		
23179	31647	04 59	+37	A1*	5.0	49	7.7 ± 2.5	−12.6,−22.2,−5.8	2.5,1.2,0.3		
23362	32309	05 01	−20	B9*	4.9	64	24.2 ± 2.8	−13.8,−22.6,−5.5	1.8,1.6,1.5		
	36869	05 34	−15	G3*	8.5	(59)	23.0 ± 1.0	−12, −21, −5		204	−3.53
26309	37286	05 36	−28	A2*	6.3	57	22.4 ± 1.2	−11.3,−20.0,−4.9	0.7,0.9,0.6		
26453	37484	05 37	−28	F3*	7.2	60	23.5 ± 0.4	−11.9,−20.9,−5.4	0.3,0.4,0.4	87	−5.0
26990	38397	05 43	−39	G0*	8.1	52	22.8 ± 0.6	−11.6,−20.3,−5.1	0.3,0.5,0.4	137	−4.05
28474	41071	06 00	−44	G8*	9.1	54	23.8 ± 0.4	−12.1,−21.1,−5.7	0.3,0.4,0.5	155	−4.41
32104	48097	06 42	+17	A2*	5.2	43	15.0 ± 4.2	−10.4,−20.1,−4.9	4.0,2.0,0.9		
83494	154431	17 03	+34	A5	6.1	54	−21.5 ± 1.4	−10.0,−24.3,−0.2	0.7,1.1,1.0		
84642	155915	17 18	−60	G8	9.5	55	1.3 ± 0.7	−12.6,−24.8,−1.1	1.2,1.9,0.3		
	**BD+44	21 00	+45	G2*	8.8	(65)	−23.2 ± 1.5	−11.0,−22.8,−8.2		196	−3.48
114189	218396	23 07	+21	A5*	6.0	40	−12.6 ± 1.4	−12.3,−21.5,−7.2	0.5,1.2,1.0		
116805	222439	23 40	+44	B9*	4.1	52	−12.7 ± 0.6	−11.7,−20.3,−5.9	0.6,0.8,0.4		

Notes. **BD+44 = BD+44 3670. In the fifth column, a * after a spectral type indicates a suggested Columba Association member. The listed distances to HD 36869 and BD+44 3670 are derived photometrically. *Tycho-2* proper motions are used in the calculation of UVW for these two stars. The UVW of HIP 14551 and 17782 appear to be a mixture of those of Columba and Tuc/Hor. Characteristic mean UVW for Tuc/Hor stars are given in Zuckerman & Song (2004) as −11, −21, and 0 km s^{-1}, and in Torres et al. (2008) as −9.9 ± 1.5, −20.9 ± 0.8, and −1.4 ± 0.9 km s^{-1}. Torres et al. give a mean UVW for Columba stars of −13.2 ± 1.3, −21.8 ± 0.8, and −5.9 ± 1.2 km s^{-1}. See Sections 4 and 5.2 for additional details regarding Table 3 stars. HIP 114189 (= HR 8799, see Section 5.3) is orbited by at least four giant planets.

Table 4
Proposed Argus Association Members

HIP	HD	R.A. (h/m)	Decl. (deg)	Spec. Type	V (mag)	Dist. (pc)	Rad. Vel. (km s^{-1})	(U,V,W) (km s^{-1})	UVW Error (km s^{-1})
50191	88955	10 14	−42	A2	3.8	31	7.4 ± 2.7	−22.0,−10.5,−4.9	0.5,2.6,0.6
57632	102647	11 49	+14	A3	2.1	11	−0.2 ± 0.5	−20.1,−16.2,−7.6	0.2,0.2,0.5
68994	123058	14 07	−61	F4	7.8	66	−5.2 ± 1.0	−21.2,−12.1,−2.5	1.4,1.4,0.3
79797	145689	16 17	−67	A4	6.0	55	−9.0 ± 4.3	−23.2,−12.0,−4.9	3.3,2.7,1.0
98495	188228	20 00	−72	A0	4.0	32	−6.7 ± 0.7	−21.8,−10.8,−4.5	0.6,0.5,0.4
99770	192640	20 14	+36	A2	5.0	41	−17.3 ± 2.8	−22.5,−11.7,−3.9	0.8,2.7,0.1

Notes. Additional information regarding the listed stars can be found in Section 5.4. Torres et al. (2008) give a mean UVW for Argus stars of −22.0 ± 0.3, −14.4 ± 1.3, and −5.0 ± 1.3 km s^{-1}.

(DBS) and echelle spectrographs were employed at the two Nasmyth foci. The red channel of the DBS covers the spectral range 6500–7450 Å at a measured resolution of 1.16 Å (0.55 Å pixel^{-1}). Eight orders of the echelle spectra cover portions of the wavelength range from 5800 to 7230 Å. We focus on orders that contain the Hα and Li λ6708 lines. In these orders, the measured resolution was 0.45 Å (0.17 Å pixel^{-1}). Radial velocities were determined by cross-correlating target and radial velocity standard spectra over five or six orders of the echelle that were chosen to produce strong correlations and have few atmospheric features. All spectra were reduced following a standard procedure (bad pixel and cosmic ray removal, flat fielding, source extraction, telluric correction, etc.) using IRAF. Equivalent widths (EWs) of Hα and Li λ6708 were measured with the IRAF task splot.

For northern hemisphere stars, we used the Hamilton echelle spectrograph at the coude focus of the 3 m telescope at Lick Observatory. Data reduction procedures were similar to those employed at Siding Spring.

As noted in Section 2, MIPS photometry was obtained via GO program no. 3600 and also via the *Spitzer* archives. For the MIPS 24 μm band, we performed aperture photometry on post-BCD images provided by the *Spitzer* archive using an aperture radius of 13″ and sky annuli of 20″ and 32″. An aperture correction of 1.17 was applied based on Table 4.13 of the MIPS Instrument Handbook version 2.0. In cases where the target is a binary object (e.g., HIP 116748), we used a larger aperture size to collect the combined *Spitzer* flux densities and compared them with combined optical and near-IR flux densities. For the MIPS 70 μm band, we first created a mosaic image by combining BCD images with the *Spitzer* MOPEX tool and performed aperture photometry on the mosaic image. For a few stars, *Spitzer* Infrared Spectrograph (IRS) data exist and we used these where appropriate to confirm or deny the existence of excess

Table 5
AB Doradus Stars Observed by *Spitzer*

HIP	HD	Name	Spect. Type	Dist. (pc)	ZS04	T08	*Spitzer* Program ID	AORKEY Archive ID	Date of Observation	Integ. Time (s) 24 μm	Integ. Time (s) 70 μm
	1405	PW And	K2	(28)	Y	Y	3600	11254784	2004 Dec 25	48	252
3589	4277		F8	49	Y	Y	3600	11255040	2005 Jan 28	48	252
5191	6569		K1	50	Y		3600	11255296	2004 Dec 25	48	378
6276		BD-12 243	G9	35	Y	Y	148	5346304	2004 Jul 11	96	252
10272	13482		K1	32	Y	Y	3600	11255808	2005 Jan 29	48	252
13027	17332		G0	33	Y	Y	3600	11256832	2005 Jan 26	48	252
14684	19668	IS Eri	G0	40		Y	148	5340928	2005 Jan 24	96	252
14807		BD+21 418B	K6	50	Y	Y	72	4541952	2004 Feb 24	332	630
14809		BD+21 418	G5	50	Y	Y	72	4541952	2004 Feb 24	332	630
15353	20888		A3	58			10	3697408	2004 Nov 7	48	126
16563	21845	V577 Per	G5	34	Y	Y	3600	11257600	2005 Feb 1	48	252
	21845B		M0	34	Y	Y					
17695		G80-21	M3	16	Y	Y	3600	11258368	2004 Sep 23	48	378
18859	25457	HR 1249	F5	19	Y	Y	148	5308672	2004 Sep 20	96	252
19183	25953		F5	55	Y	Y	20707	15009792	2006 Feb 21	96	252
25283	35650		K7	18	Y		3600	11260416	2005 Mar 7	48	252
25647	36705A	AB Dor	K0	15	Y	Y	80	4638720	2004 Feb 21	48	252
	36705B	AB DorB	M4	15	Y	Y					
26369			K7	24	Y	Y	148	6599680	2004 Sep 21	96	252
26373	37572	UY Pic	K0	24	Y	Y	148	6599680	2004 Sep 21	96	252
		CD-35 2722	M1	(24)		Y	731	26807552	2008 Nov 25	664	1260
30314	45270		G1	23	Y	Y	148	6599424	2004 Jun 22	96	252
		GSC 08894-0426	M3	(22)	Y	Y	3600	11262464	2004 Dec 25	48	378
31711	48189	AK Pic	G2	22	Y	Y	80	4639232	2204 Feb 21	48	252
31878		CD-61 1439	K7	22	Y	Y	3600	11262720	2004 Nov 8	48	252
		BD+20 1790	K5	(26)		Y	148	5348608	2004 Oct 14	96	1260
36349		V372 Pup	M2	15	Y	Y	3600	11264000	2004 Nov 7	48	252
51317		GJ 393	M2	7		Y	40454	22014720	2009 Jan 2	48	756
63742	113449	PX Vir	K1	22	Y	Y	80	4627968	2005 Jun 22	48	252
76768	139751		K5	42	Y	Y	3600	11265536	2005 Aug 26	48	252
81084		NLTT 43056	M0	32	Y	Y	3600	11265792	2005 Mar 10	48	378
82688	152555		G0	48	Y	Y	148	5330944	2005 Mar 10	96	252
	317617		K3	(56)		Y	30594	20485632	2006 Oct 7	30	15
86346	160934	GJ 4020A	K7	28	Y	Y	72	4554240	2004 Jan 29	192	630
93580	177178		A4	55			10	3724544	2004 Apr 11	48	126
106231		LO Peg	K7	25	Y	Y	80	4641024	2004 Jun 22	48	630
107948		GJ 4231	M2	30		Y	50356	26063616	2008 Jun 27	48	252
109268	209952		B6	31			713	7345152	2003 Nov 3	96	114
110526		GJ 856	M3	16	Y	Y	3600	11266560	2004 Dec 2	48	378
113579	217343		G4	32	Y	Y	148	5269760	2004 Jun 21	96	252
113597	217379		K8	31	Y	Y	123	5022976	2004 Nov 2	144	630
114066		GJ 9809	M1	25	Y	Y	3600	11266816	2004 Oct 15	48	378
114530	218860		G5	51	Y	Y	3600	11267072	2004 Oct 19	48	252
115738	220825		A0	50			171	3731456	2004 Jul 11	48	126
117452	220825		A0	44			173	3731968	2004 Dec 2	48	126
118008	224228	GJ 4377	K2	22	Y	Y	3600	11267584	2004 Nov 4	48	252

Note. Distances in parenthesis are estimated photometrically. ZS04 and T08 refer to AB Dor members listed in Zuckerman & Song (2004) and Torres et al. (2008), respectively.

IR emission. *Spitzer* results are summarized in Tables 5–11. Figures 1–7 display the spectral energy distributions (SEDs) of all AB Dor, Tuc/Hor, nearby Columba, and nearby Argus field stars that we deem to definitely or probably have excess infrared emission.

A fully automated SED-fitting technique employing a theoretical atmospheric model (Hauschildt et al. 1999) was used to predict stellar photospheric fluxes. A detailed description of our photospheric fitting procedure is given in Section 2 of Rhee et al. (2007b), so we do not repeat it here. To check whether our atmospheric model well reproduces actual stellar photospheres, in Figure 8 we compare the model predictions with MIPS measurements at 24 μm of a sample of nearby F-, G-, and K-type stars from a paper by Trilling et al. (2008). Stars plotted in Figure 8 do not include any stars deemed by Trilling et al. to have either 24 or 70 μm excess emission (their Tables 5 and 6). The plotted stars are all fifth magnitude or fainter at the *K* band as measured in the Two Micron All Sky Survey (2MASS) survey. We avoid brighter stars that may be too bright to be measured accurately by 2MASS in the *J* band. As may be seen in Figure 8 for K-, G-, and F-type stars the MIPS measured 24 μm fluxes are on average about 3% larger than the model predicted fluxes. While some of this offset may be due to small and previously unrecognized excess IR emission from some stars in the Trilling et al.

Table 6
Tucana/Horologium & Columba Stars Observed by *Spitzer*

HIP	HD	Name	Spect. Type	Dist. (pc)	ZS04	T08	*Spitzer* Program ID	AORKEY Archive ID	Date of Observation	Integ. Time (s) 24 μm	70 μm
490	105		G0	40	Y	Y	148	5295872	2003 Dec 10	96	252
1113	987		G7	44	Y	Y	102	9022976	2004 Nov 5	48	126
1481	1466		F8	41	Y	Y	72	4539648	2004 Dec 2	96	630
1910			M1	45	Y	Y	72	4539904	2004 Jun 22	332	630
1993		CT Tuc	M0	40	Y	Y	72	4540160	2004 Jun 22	332	630
2484	2884	beta1 Tuc	B9	43	Y	Y	72	4540416	2004 May 11	48	252
2487	2885	beta2 Tuc	A2	50	Y	Y	72	4540672	2004 May 5	48	252
2578	3003	beta3 Tuc	A0	46	Y	Y	72	4540928	2004 Jun 22	48	504
2729	3221		K5	46	Y	Y	72	4541184	2004 May 11	192	630
3556			M3	38	Y		102	9022720	2004 Nov 3	48	252
		CPD-64 120	K1	(73)	Y		102	9022464	2004 May 11	48	N/A
6485	8558		G6	49	Y	Y	148	4813568	2005 Jun 29	48	126
6856	9054	CC Phe	K1	37	Y	Y	149	4813824	2004 Nov 3	48	126
9141	12039	DK Cet	G4	42	Y	Y	148	5310976	2004 Jul 11	96	252
9685	12894		F3	47	Y		102	9022208	2004 Nov 7	48	126
9892	13183		G6	50	Y	Y	152	4814592	2004 Nov 7	48	126
9902	13246		F7	45	Y	Y	153	4814848	2004 Nov 7	48	126
		CD-60 416	K4	(48)	Y	Y	153	4814848	2004 Nov 7	48	126
10602	14228	phi Eri	B8	47	Y	Y	102	9021952	2004 Nov 8	48	252
12394	16978	eps Hyi	B9	47	Y	Y	102	9021184	2005 Jun 19	48	252
12413	16754		A1	40			10	3694848	2005 Jul 30	48	126
		CD-53 544	K6	(30)	Y	Y	154	4815104	2004 Nov 7	48	126
		AF Hor	M2	(27)	Y	Y	154	4815104	2004 Nov 7	48	12
		CD-58 553	K5	(50)	Y?	Y	155	4815360	2004 Nov 7	48	126
14551	19545		A5	58			10	3696896	2006 Jan 13	48	126
15247	20385		F5	50	Y		3600	11257088	2005 Jan 31	48	252
		CD-46 1064	K3	50		Y	3600	11257344	2004 Oct 14	48	252
16449	21997	HR 1082	A3	73		Y*	10	3698432	2004 Sep 24	48	126
16853	22705		G2	42	Y	Y	3600	11258112	2004 Oct 14	48	252
17764	24636		F3	55			40566	23051520	2008 May 16	96	504
		BD-15 705	K3	(63)	Y	Y*	3600	11258880	2005 Feb 1	48	278
21632	29615		G3	55	Y	Y	3600	11259392	2005 Mar 4	48	252
21965	30051		F2	58	Y	Y	3600	11259648	2005 Jan 28	48	252
22295	32195		F7	60	Y		20707	15009536	2005 Aug 31	96	252
24947	35114	AS Col	F6	46	Y	Y*	3600	11260160	2004 Dec 5	48	252
23179	31647		A1	49			10	3699712	2004 Feb 25	48	126
	36869		G3	(59)			3600	11260672	2005 Mar 4	48	126
26309	37286		A2	57			10	3700992	2004 Feb 21	48	126
		AT Col	K1	(57)	Y	Y*	3600	11260928	2005 Feb 28	48	278
26453	37484		F3	60			148	5307136	2004 Nov 5	96	252
		CD-34 2406	K4	(60)	Y		3600	11261440	2005 Feb 28	48	278
26966	38206	HR 1975	A0	69		Y*	40	3983872	2004 Feb 21	48	252
28036	40216		F7	54	Y	Y*	3600	11261952	2005 Mar 7	48	252
30030	43989	V1358 Ori	G0	50	Y		148	6598912	2004 Oct 13	96	252
30034	44627	AB Pic	K2	45	Y		3600	11262208	2004 Dec 25	48	252
32104	48097		A2	43			10	3702784	2004 Mar 15	48	126
32235	49855		G6	56	Y	Y*	3600	11263488	2004 Nov 8	48	252
32435	53842		F5	57	Y		20707	15003648	2005 Aug 31	96	76
33737	55279		K2	64	Y	Y*	3600	11263744	2005 Mar 8	48	278
83494	154431		A5	54			10	3721472	2004 Feb 22	48	126
84642	155915		G8	55			3600	11266048	2005 Apr 6	48	278
100751	193924	Peacock	B2	56	Y		72	4557312	2004 Apr 9	48	126
104308	200798		A5	66	Y		72	4558592	2004 Sep 23	96	630
105388	202917		G7	46	Y	Y	72	4558848	2004 Sep 24	192	630
105404	202947	BS Ind	K0	46	Y		72	4559104	2004 Sep 24	192	630
107345			M0	42	Y	Y	72	4559360	2004 Sep 23	498	630
107947	207575		F6	45	Y	Y	72	4560128	2004 Sep 23	498	630
108195	207964	HR 8352	F1	46	Y	Y	72	4560384	2004 Sep 23	498	630
108422	208233		G9	55	Y		3600	11266304	2004 Nov 6	48	252
116748	222259	DS Tuc	G6	46	Y		72	4561920	2204 May 5	192	630
118121	224392	eta Tuc	A1	49	Y		72	4562176	2004 Jun 22	48	630

Notes. Distances in parenthesis are estimated photometrically. Y* in the T08 column indicates that Torres et al. (2008) place the star in what they designate as either the Columba or Carina Association. Because these associations have the same age and nearly the same *UVW* space motions as Tucana/Horologium, for the purposes of Table 11 of the present paper we consider as a single age group the stars in all of these associations. *Spitzer* observations of HIP 114189 (= HR 8799, Table 3) have been analyzed in detail by Su et al. (2009) and we have therefore not included this star in Table 6.

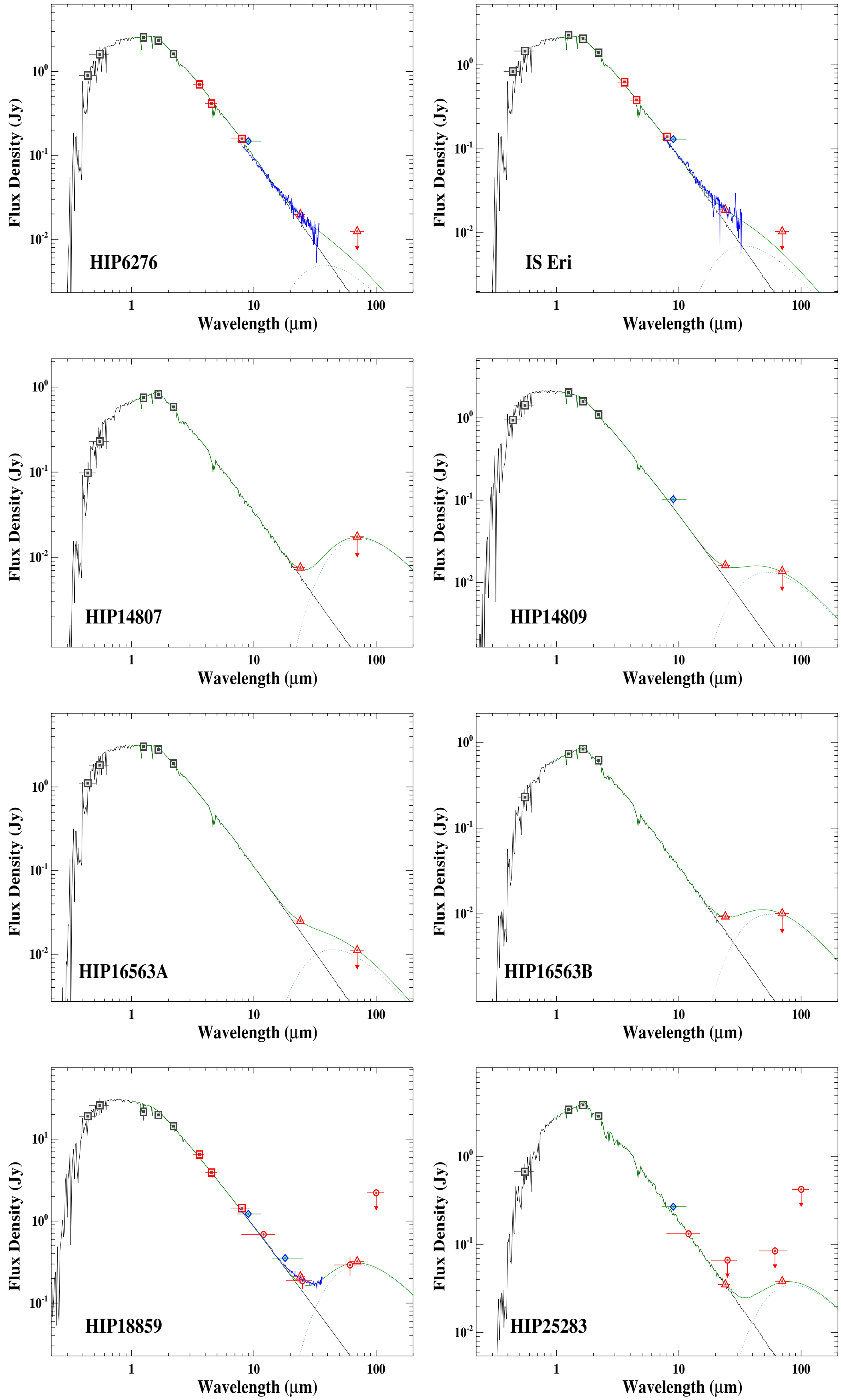

Figure 1. SEDs for AB Dor stars in Table 8 with probable or definite infrared excess emission. Near infrared JHK data points are from the 2MASS catalog. Square data points between 3.5 and 8 μm are from the IRAC camera on *Spitzer*. Diamonds at 9 and 18 μm are from AKARI. Triangles at 24 and 70 μm are from the MIPS camera on *Spitzer*. Circles between 12 and 100 μm are from *IRAS*. The IRS spectrum from *Spitzer* is plotted at mid-IR wavelengths.

(A color version of this figure is available in the online journal.)

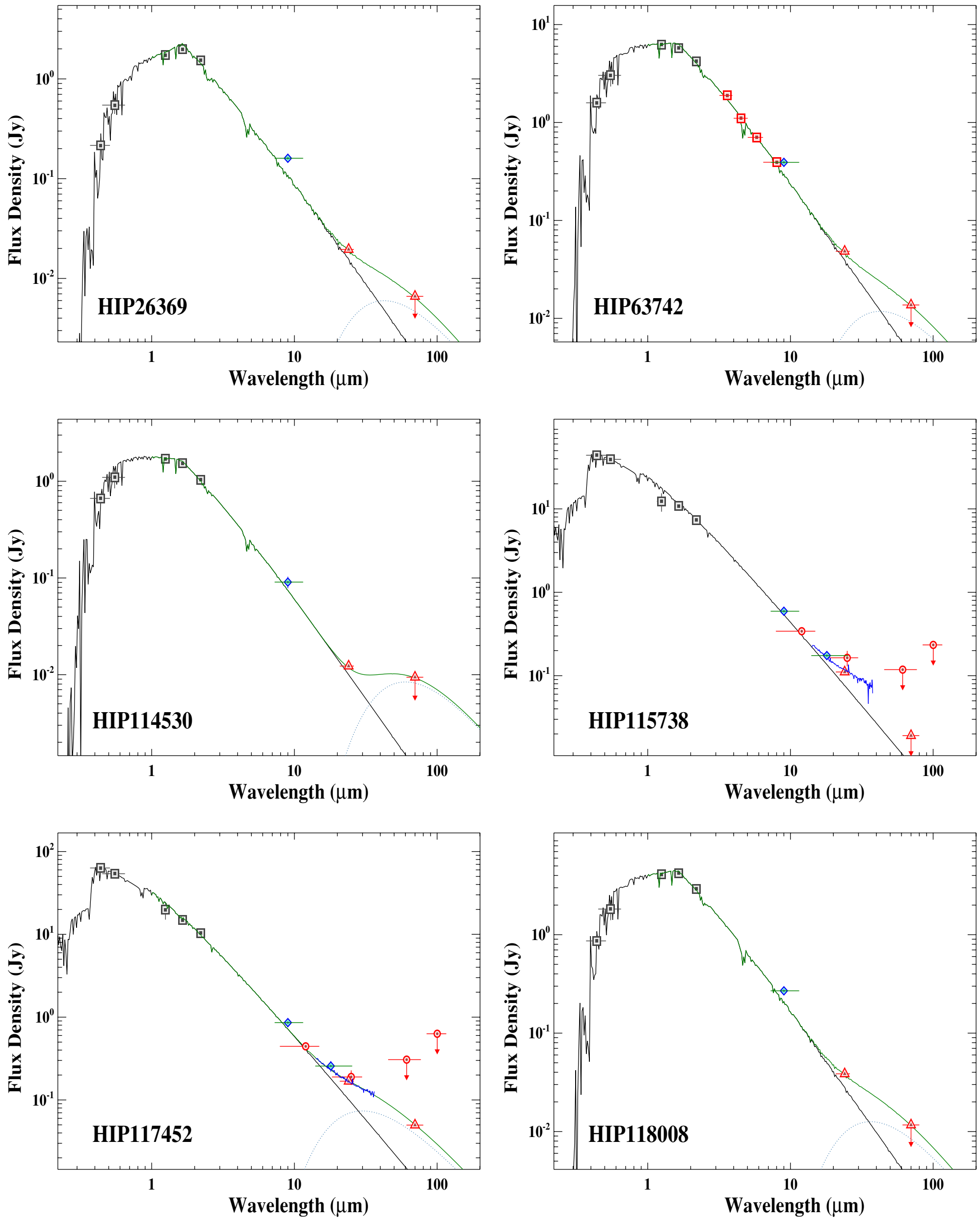

Figure 2. SEDs for AB Dor stars in Table 8 with probable or definite infrared excess emission.
(A color version of this figure is available in the online journal.)

sample, conservatively, we ignore this possibility and treat the 3% as an effective error in the photospheric model predictions. Therefore, in Tables 8–10 the listed 24 and 70 μm photospheric fluxes are those predicted from the theoretical atmospheric model but multiplied by a factor of 1.03. In addition to this small mean offset, the Figure 8 histogram indicates a ±7% uncertainty in the individual 24 μm flux densities due to some combination of model uncertainties, measurement error, and perhaps other factors.

The MIPS Handbook lists 4% as the systematic 24 μm absolute flux calibration uncertainty (see also Engelbracht et al. 2007). This 4% is negligible when added in quadrature with the measurement uncertainty estimated just below.

We checked the 7% flux density uncertainty deduced from Figure 8 in the following fashion. For stars in Tables 8–10 with measured 24 μm flux density less than the model photo-

Table 7
Spitzer Observational Programs That Include Nearby Argus Stars

Star	*Spitzer* Program ID	AORKEY Archive ID	Date of Observation	Integ. Time (s) 24 μm	70 μm
HD 84075	72	4545280	2004 Feb 23	288	630
HIP 50191	10	3707136	2005 May 18	48	126
CD-74 673	148	5355520	2004 Aug 23	288	756
HIP 68994	20597	15591424	2006 Apr 8	30	15
HIP 79797	10	3720448	2004 Mar 17	48	126
HIP 98495	10	3725824	2004 Apr 8	48	126
HIP 99770	10	3726848	2004 Oct 16	48	126

Note. The infrared spectrum of HIP 57632 (= β Leo, Table 4) has been extensively studied (beginning with *IRAS*; Rhee et al. 2007b) and we therefore have not included this star in Table 7.

Table 8
AB Dor Stars: MIPS Flux Densities

Star	Photosph. Meas.		Excess?	Photosph. Meas.		Excess?	IRS?	$T_{\rm star}$	$R_{\rm star}$	$T_{\rm dust}$	$L_{\rm dust}/L_*$
	24 μm (mJy)			70 μm (mJy)				(K)	($R_\odot$)	(K)	($\times10^{-5}$)
PW And	20.6	21.8	N	2.3		N		4700	0.54		
HIP 3589	19.9	21.9	N	2.2		N		6000	1.19		
HIP 5191	8.4	8.62	N	0.9		N		4900	0.87		
HIP 6276	16.3	19.8	Y	1.8		N	Y	5200	0.84	135	5.2
HIP 10272	35.7	37.0	N	3.9		N		5200	1.14		
HIP 13027A	46.0	26.7	N	5.0		N		5200	1.31		
HIP 13027B	39.2	26.7	N	4.3		N		5000	1.23		
IS Eri	13.7	18.8	Y	1.5		N	Y	5200	0.88	150	9.9
HIP 14807	6.2	7.57	Y	0.7		N		4600	0.79	>70	<37
HIP 14809	11.5	16.1	Y	1.3		N		5900	0.91	>97	<10
HIP 15353	37.1	35.8	N	4.3		N		8100	1.62		
HIP 16563A	19.1	25.0	Y?[a]	2.1		N		5400	0.86	>115	<7.9
HIP 16563B	6.6	9.31	Y?[a]	0.7		N		4400	0.54	>93	<32
HIP 17695	19.6	17.6	N	2.3		N		3400	0.49		
HIP 18859	154	210	Y	18.0	323	Y	Y	6200	1.24	70	11
HIP 19183	16.1	14.5	N	1.9		N	Y	6400	1.13		
HIP 25283	37.5	35.3	N	4.3	38.3	Y		4000	0.70	60	17.5
AB DorA	101	111	N	11.1		N		4800	0.90		
AB DorB	7.2	7.01	N	0.8		N					
HIP 26369	16.0	19.5	Y	1.8		N		4500	0.60	>120	<9.5
HIP 26373	31.5	33.3	N	3.4		N	Y	5200	0.79		
CD-35 2722	16.6	14.4	N	2.0		N		3600	0.65		
HIP 30314	63.3	70.9	N	6.9		N	Y	6000	1.02		
GSC8894-0426	17.6	13.6	N	2.1		N		3200	0.58		
HIP 31711	108	117	N	11.6		N		5700	1.27		
HIP 31878	19.2	20.2	N	2.2		N		4300	0.60		
HIP 36349	65.0	49.8	N	7.7		N		3400	0.85		
HIP 51317	86.3	73.7	N	10.1		N		3500	0.45		
BD+20 1790	13.1	12.2	N	1.5		N	Y	4400	0.58		
HIP 63742	41.6	48.4	Y	4.4		N		5200	0.83	>120	<4.5
HIP 76768	13.7	13.6	N	1.6		N		4100	1.00		
HIP 81084	9.9	8.15	N	1.2		N		3700	0.66		
HIP 82688	19.2	20.9	N	2.1		N	Y	6000	1.14		
HD 317617	6.2	5.49	N	0.7		N		4700	0.83		
HIP 86346	15.0	16.7	N	1.7		N		4200	0.60		
HIP 93580	52.6	55.7	N	6.1		N		7700	1.88		
HIP 106231	21.5	23.5	N	2.4		N		4500	0.71		
HIP 107948	14.7	12.6	N	1.7		N		3300	0.84		
HIP 109268	951	970	N	104		N		12500	3.77		
HIP 110526	48.8	40.9	N	5.8		N		3200	0.78		
HIP 113579	29.0	31.4	N	3.2		N	Y	5900	0.94		
HIP 113597	31.2	26.2	N	3.6		N		3800	1.09		
HIP 114066	12.3	11.1	N	1.4		N		4100	0.56		
HIP 114530	10.3	12.3	Y	1.1		N		5600	0.92	>85	<7.2
HIP 115738[a]	78.2	111	Y	8.9		N	Y	9000	1.93		
HIP 117452	104	168	Y	11.8	49.7	Y	Y	9200	1.96	170	2.9
HIP 118008	28.9	38.6	Y	3.2		N		5000	0.71	>140	<8.9

Notes. [a] See the discussion in Section 5.5.1. For stars in Figures 1 and 2 where MIPS measured only an upper limit to the 70 μm flux density, the above tabulated $L_{\rm dust}/L_*$ is an upper limit and $T_{\rm dust}$ is a lower limit. The second and fifth columns give the expected photospheric fluxes (see Section 3) and the third and sixth columns give the MIPS measured fluxes.

sphere (corrected upward by the factor of 1.03 mentioned just above), we calculate a percentage deficit given by the ratio of photosphere to measured 24 μm flux density and then minus unity. For K8 to M3 stars in the AB Dor group (Tables 5 and 8), this flux deficit often falls between 14% and 33%, but for earlier-type AB Dor stars, the largest flux deficits are more modest; only HIP 19183 (14%) and HD 317617 (15.5%) have flux deficits >11%. (HD 317617 is the faintest 24 μm star in Table 8.) In Table 9 (Tuc/Hor and Columba stars), the only non-M-type stars with flux deficits >11% are HIP 2484 (14%), HIP 2487 (15.5%), and CD-34 2406 (23%). (The latter star is by far the faintest 24 μm star listed in Table 9.)

The preceding paragraph indicates that while ±11% appears to be an appropriate 24 μm flux density uncertainty for most non-M-type stars in Tables 8–10, adaptation of 16% for this uncertainty should encompass just about all such stars. This choice also encompasses the 7% flux uncertainty at 24 μm for stars in Figure 8, as mentioned above.

Thus, when a MIPS measured 24 μm flux is a factor 1.16 larger than a photospheric flux listed in Tables 8–10, we deem

Table 9
Tuc/Hor & Columba Stars: MIPS Flux Densities

Star	Photosph. 24 μm (mJy)	Meas. 24 μm (mJy)	Excess?	Photosph. 70 μm (mJy)	Meas. 70 μm (mJy)	Excess?	IRS?	$T_{\rm star}$ (K)	$R_{\rm star}$ ($R_\odot$)	$T_{\rm dust}$ (K)	$L_{\rm dust}/L_*$ ($\times 10^{-5}$)
HIP 490	25.3	27.5	N	3.0	162	Y	Y	6100	1.06	50	34.0
HIP 1113	10.8	12.7	Y	1.1	18.7	Y		5600	0.82	70	11.9
HIP 1481	24.9	35.2	Y	2.9	14.3	Y	Y	6200	1.06	132	7.1
HIP 1910	9.8	9.03	N	1.1		N		3800	0.94		
HIP 1993	8.2	7.68	N	0.96		N		3700	0.70		
HIP 2484	97.3	87.8	N	10.4		N	Y	11500	1.72		
HIP 2487	158	140	N	18.3		N		8200			
HIP 2578	68.3	231	Y	7.7	59.9	Y	Y	9300	1.67	200	9.4
HIP 2729	18.1	17.1	N	2.1		N		4400	1.21		
HIP 3556	9.6	7.71	N	1.1		N		3500	0.80		
CPD-64 120	4.1	5.28	Y	0.44				5200	0.88		
HD 8558	12.0	14.3	Y	1.3		N		5800	0.95	>75	< 9.0
HD 9054	12.7	14.1	N	1.4		N		4900	0.80		
HIP 9141	17.3	24.7	Y	1.9		N	Y	5800	0.98	160	7.9
HD 12894	47.0	48.6	N	5.5		N		6800	1.61		
HD 13183	12.5	14.1	Y?	1.35		N		5400	1.03		
HD 13246	23.7	47.3	Y	2.76	31.7	Y	Y	6200	1.13	125	17.0
CD-60 416	6.8	8.30	N	0.76		N	Y	4600	0.77		
HD 14228	176	188	N	19.1		N		12000	2.53		
HIP 12394	129	132	N	14.0		N		10500	2.23		
HIP 12413	114	117	N	13.2		N		8300	1.93		
CD-53 544	15.1	15.0	N	1.7		N		4200	0.74		
AF Hor	9.77	7.94	N	1.14		N		3500	0.57		
CD-58 553	5.7	5.35	N	0.65		N		4400	0.74		
HIP 14451	34.0	34.2	N	3.9		N		8000	1.54		
HIP 15247	25.4	27.5	N	3.0		N		6200	1.10		
CD-46 1064	10.2	11.8	Y?	1.1		N		4800	0.95		
HD 21997	27.0	54.6	Y	2.9	70.5	Y	Y	8200	1.74	60	57.6
HIP 16853	23.3	27.2	Y	2.5		N		6000	1.10	>95	<2.8
HIP 17764	24.8	42.6	Y	2.9	36.0	Y	Y	6700	1.37	110	11.4
BD-15 705	7.3	7.43	N	0.83		N		4600	1.05		
HIP 21632	12.2	12.5	N	1.3		N		5900	1.03		
HIP 21965	28.1	29.7	N	3.3	25.4	Y		6600	1.55	80	4.4
HIP 22295	12.6	16.4	Y	1.5	11.3	Y		6300	1.10	100	7.2
HIP 23179[a]	??	92.6	N	~10		N	Y	8000	2.30		
HIP 24947	25.4	32.6	Y	2.9	11.0	Y		6300	1.18	135	4.9
HD 36869	13.6	14.0	N	1.5		N		5800	1.21		
HIP 26309	31.3	67.9	Y	3.6		N	Y	8000	1.46	160	8.2
AT Col	7.7	9.54	Y	0.84		N		5100	0.95		
HIP 26453	22.3	56.1	Y	2.6	116	Y	Y	6700	1.40	90	32.5
CD-34 2406	2.05	1.70	N	0.23		N		4800	0.52		
HD 38206	32.5	114	Y	3.6	388	Y	Y	9900	1.68	85	19.1
HIP 28036	23.8	23.7	N	2.8		N		6300	1.36		
HIP 30030	17.3	20.4	Y	2.0		N	Y	6100	1.08	160	3.2
HIP 30034[b]	10.4	13.1	Y	1.1		N		5200	0.87		
HIP 32104	67.4	66.7	N	7.8		N		8600	1.57		
HIP 32235	7.9	9.81	Y	0.86		N		5800	0.89	>75	<13.2
HIP 32435[b]	21.5	33.2	Y	2.5			Y	6500	1.35	140	7.4
HIP 33737	5.9	6.29	N	0.66		N		4900	0.94		
HIP 83494	41.5	47.3	Y?	4.8		N		7700	1.63		
HIP 84642	6.75	7.87	Y	0.73		N		5200	0.84		
HIP 100751	680	656	N	78.4		N		15000	5.25		
HIP 104308	26.4	25.7	N	3.1		N		7600	1.61		
HIP 105388	11.1	20.1	Y	1.2	36.3	Y	Y	5700	0.86	86	27.7
HIP 105404	15.2	19.5	Y	1.7		N		5100	1.07	>120	<8.6
HIP 107345	6.5	6.44	N	0.76		N		3900	0.69		
HIP 107947	27.2	31.0	Y?	3.2	9.6	Y		6400	1.20	110	2.4
HIP 108195	80.5	77.3	N	9.4		N		6600	2.1		
HIP 108422	13.2	17.3	Y	1.4		N		5200	1.18	>100	<12
HIP 116748[a]	25.0	24.8	N	2.7		N		5200	1.37		
HIP 118121	78.7	77.8	N	9.0		N		9000	1.90		

Notes.
[a] HIP 23179 and 116748 are each 5″ binary stars. Flux densities for HIP 116748 pertain to the sum of the primary and secondary. Due to relatively large errors for the 2MASS near-IR magnitudes for the HIP 23179 secondary, an accurate estimate of the total 24 μm photospheric flux density of this binary system is not now possible. However, there is no indication of excess mid-IR emission in the IRS spectrum out to ~35 μm wavelength. *Spitzer* observations of HIP 114189 (=HR 8799, Table 3) have been analyzed in detail by Su et al. (2009); therefore, we have not included this star in Table 9. HIP 114189 has excess emission at both 24 and 70 μm and it is included in the statistics in Table 11. For stars in Figures 3–6 where MIPS measured only an upper limit to the 70 μm flux density, $L_{\rm dust}/L_*$ tabulated in Table 9 is an upper limit and $T_{\rm dust}$ is a lower limit.
[b] See the discussion of HIP 30034 and HIP 32435 in Section 5.5.1.

Table 10
Argus Stars: MIPS Flux Densities

Star	Photosph. 24 μm (mJy)	Meas. 24 μm (mJy)	Excess?	Photosph. 70 μm (mJy)	Meas. 70 μm (mJy)	Excess?	IRS?	T_{star} (K)	R_{star} ($R_{\odot}$)	T_{dust} (K)	L_{dust}/L_{*} ($\times 10^{-5}$)
HD 84075	9.0	12.6	Y	1.0	35.8	Y	Y	6000	1.03	170	25.1
HIP 50191	215	266	Y	24.4	46.2	Y		9000	2.03	180	1.0
CD-74 673	4.6	4.85	N	0.51		N	Y	4800	0.64		
HIP 68994[a]	14.8	24.7	Y	1.7				6600	1.28		
HIP 79797	38.4	52.6	Y	4.4	39.3	Y	Y	8200	1.56	220	5.1
HIP 98495	175	173	N	19.7	57.8	Y	Y	9600	1.85	90	0.44
HIP 99770	121	125	N	13.9	[b]	N?		7600	2.12		

Notes.
[a] See the discussion of HIP 68994 in Section 5.5.1.
[b] HIP 99770 is located only 1° from the Galactic plane and the MIPS 70 μm image is messy, containing widespread extended emission. Therefore, although our formal aperture photometry indicates a 70 μm flux density of 192 mJy, we regard this "detection" as uncertain. The infrared spectrum of HIP 57632 (=β Leo, Table 4) has been extensively studied (beginning with *IRAS*; e.g., Rhee et al. 2007b) and we therefore have not included this star in Table 10. HIP 57632 has excess emission at both 24 and 70 μm and it is included in the statistics in Table 11.

Table 11
Infrared Excess Fractions in Clusters/Associations

Cluster/Association	Age (Myr)	24 μm Excess (No.)	24 μm Excess (%)	70 μm Excess (No.)	70 μm Excess (%)	Reference
η Cha	6[a]	9/16	56	5/15	>33	Rebull et al. (2008)
TW Hya Assoc.	8	7/23	30	6/20	>30	Rebull et al. (2008)
UCL/LCC	10	10/35	34	7/35	>20	Rebull et al. (2008)
β Pic MG	12	7/30	23	11/30	>37	Rebull et al. (2008)
NGC 2547	30	16/38	42			Gaspar et al. (2009)
Tuc/Hor/Columba	30	27/62	43.5	15/60	>25	This paper
IC 2391	40[a]	6/26	23			Rebull et al. (2008); Gaspar et al. (2009)
Argus Assoc.	40[a]	5/8	62.5	5/7	>71	This paper
NGC 2451	60	12/38	32			Balog et al. (2009)
AB Dor MG	70	12/47	25.5	3/47	>6.4	This paper
Pleiades	100	10/73	14			Gorlova et al. (2006)
M47	100	8/63	13			Rebull et al. (2008)
Hyades	650	2/78	2.5			Gaspar et al. (2009)
Praesepe	750	1/135	0.7			Gaspar et al. (2009)

Note. [a] Age from Torres et al. (2008).

a non-M-type star to have excess flux at 24 μm. If the apparent 24 μm MIPS excess lies between 12% and 16%, then in the fourth column of Tables 8–10 we enter Y? indicating possible excess emission. In fact, only three stars in Table 9 have entries of Y?, and only the binary star HIP 16563 (considered in Section 5.5.1) has a Y? entry in Table 8.

At 70 μm, the procedure is similar, except that we use 7% as the calibration uncertainty as recommended in the MIPS Handbook.

4. RESULTS

Tables 2–4 present stars we propose as new members of the AB Doradus, Tucana/Horologium, Columba, and field Argus Associations within ~70 pc of Earth. Based on their survey of southern hemisphere stars, Torres et al. (2008) introduced the Columba and Argus Associations. In addition to location in the southern hemisphere, all Columba members listed by Torres et al. lie in the R.A. range between about 2 hr and 8 hr. In our study we have placed no a priori restriction on R.A. or decl. for stars in any moving group. Proposed membership is based on *UVW* and standard age indicators (see below and Section 5). Future observations and traceback analysis can confirm or deny membership of each star.

According to Torres et al. (2008), the *U* and *W* components of Columba's space motions are more negative than those of Tuc/Hor (see Section 5.2 and the notes to Table 3). Also, according to Table 2 of Torres et al., Columba stars are more distant, on average, than stars in Tuc/Hor. The listed *UVW* of a few stars in our Table 3 make it difficult to place them cleanly into either Tuc/Hor or Columba. Only a few Columba stars in Table 5 of Torres et al. are as close to Earth as stars listed in our Table 3. Nine stars in our Table 3 lie in the northern hemisphere, whereas all but one of the Tuc/Hor and Columba stars in Zuckerman & Song (2004) and Torres et al. (2008) lie in the southern hemisphere. Since Tuc/Hor and Columba have similar ages (30 Myr; Torres et al. 2008), for the purposes of understanding the evolution of dusty debris disks as a function of time, in Table 11 and Section 5.5.2 we consider members of these two associations together.

As in our previous papers on these and other young, nearby, moving groups (e.g., Song et al. 2003; Zuckerman et al. 2001a, 2001b, 2004), we rely on a combination of techniques—including Galactic space motions *UVW*, location on color–magnitude diagrams, lithium abundance, and X-ray luminosity—to establish age and membership.

Tables 5 and 6 list Tuc/Hor and AB Dor stars observed by *Spitzer* as part of our GO program no. 3600 or as part of

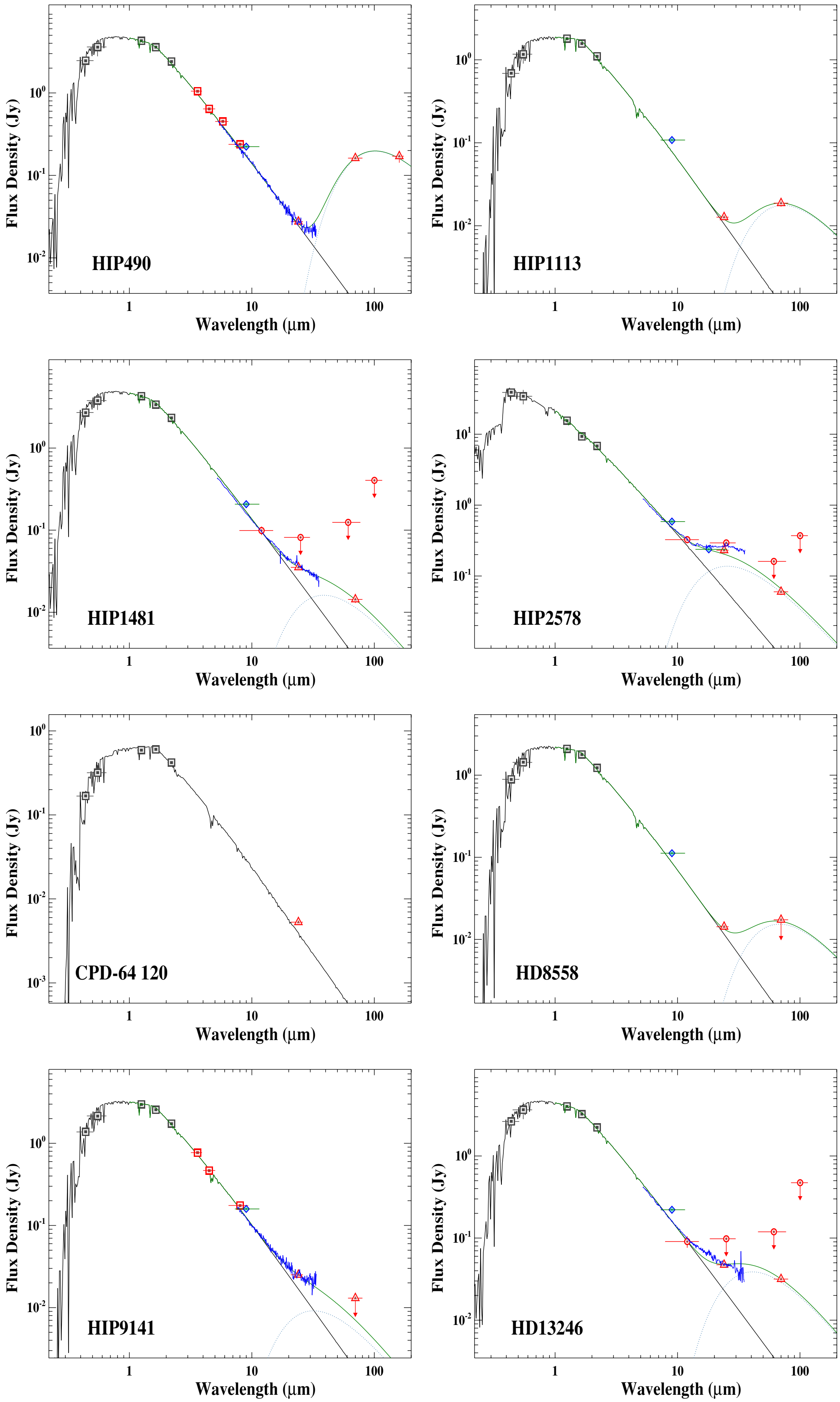

Figure 3. SEDs for Tuc/Hor stars in Table 9 with probable or definite infrared excess emission.
(A color version of this figure is available in the online journal.)

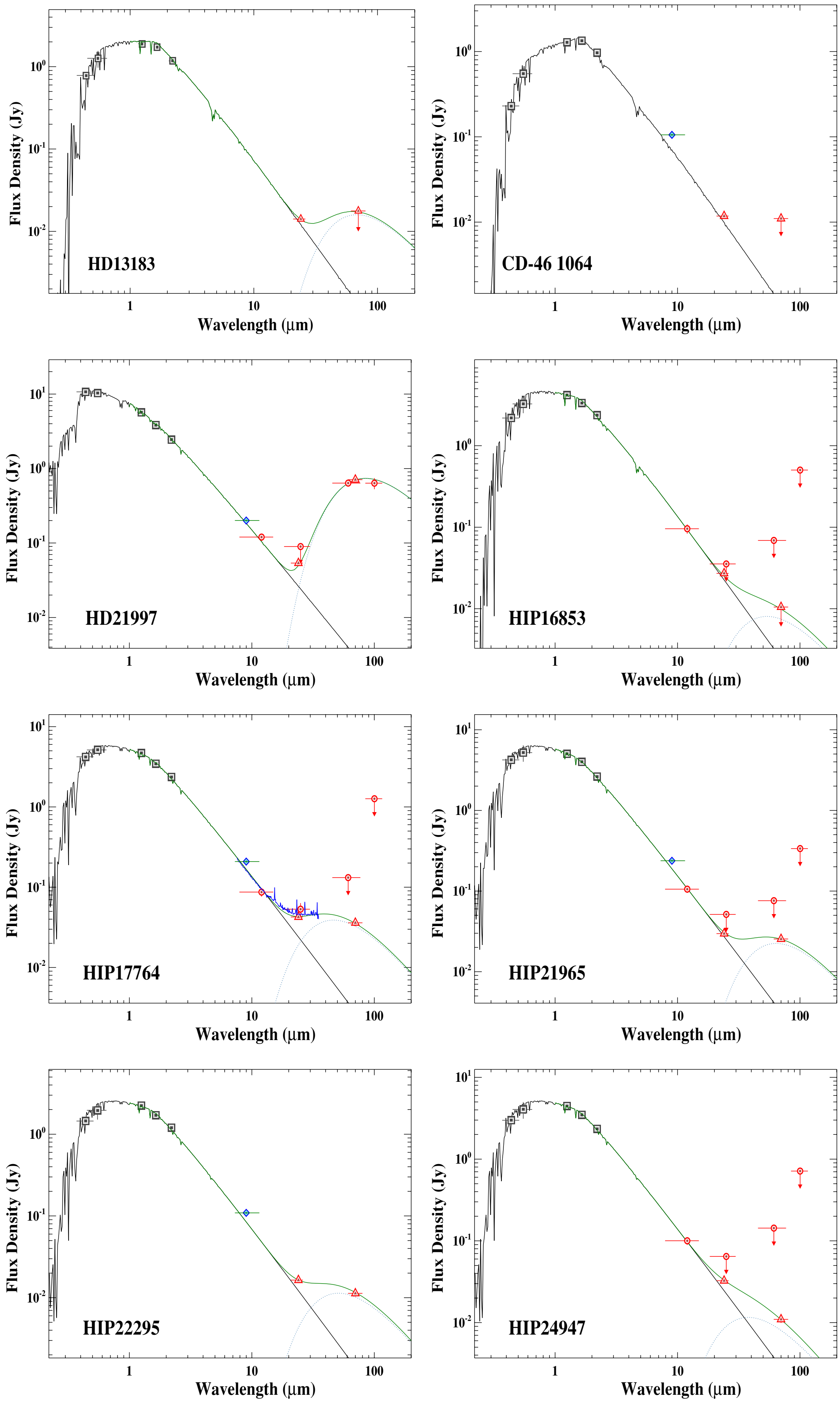

Figure 4. SEDs for Tuc/Hor stars in Table 9 with probable or definite infrared excess emission.

(A color version of this figure is available in the online journal.)

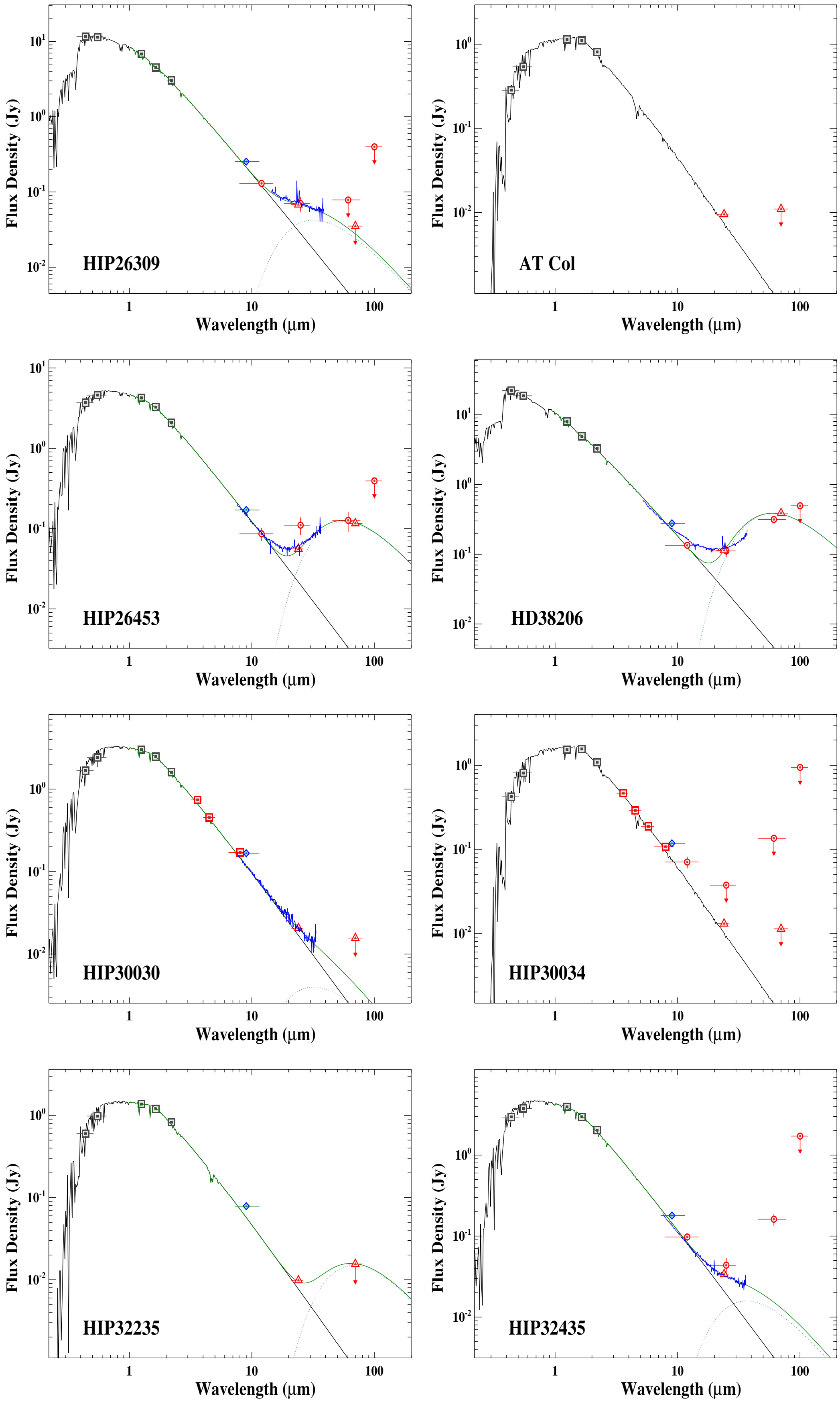

Figure 5. SEDs for Tuc/Hor stars in Table 9 with probable or definite infrared excess emission.
(A color version of this figure is available in the online journal.)

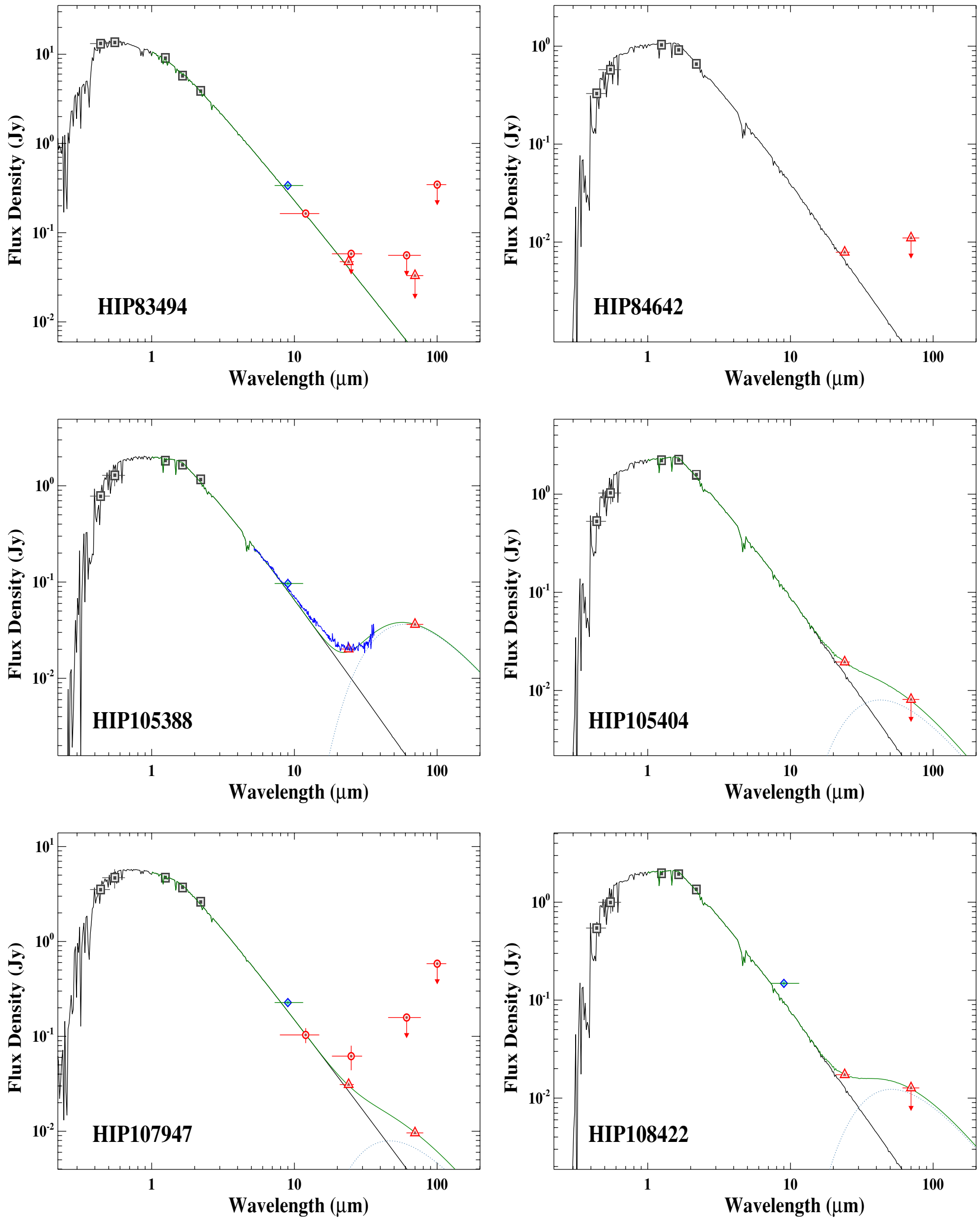

Figure 6. SEDs for Tuc/Hor stars in Table 9 with probable or definite infrared excess emission.

(A color version of this figure is available in the online journal.)

Spitzer programs by other groups; Table 7 lists these various programs for the proposed Argus Association members within 70 pc of Earth. Tables 8–10 present MIPS photometry while Table 11 compares the frequency of dusty debris disks in the four moving groups considered in the present paper with that of other stellar associations with previously published *Spitzer* results.

5. DISCUSSION

5.1. AB Doradus

While published compendia of members of the nearby Tucana/Horologium and β Pictoris kinematic groups include stars of A-type or late-B-type or both, no stars earlier than mid-F spectral class are listed previously for the AB Doradus moving group (Zuckerman et al. 2004; Zuckerman & Song 2004; Torres et al. 2008; da Silva et al. 2009). Stars proposed in Table 2 as AB Dor members are either of A- or late-B type. Given that AB Dor stars appear to be about as numerous as Tucana and β Pictoris stars, identification of these early-type AB Dor members while belated, is not unexpected. All Table 2 stars lie near the location of a typical Pleiades star on an A-star color–magnitude diagram (Figure 5 in Zuckerman 2001) consistent with the age of the AB Dor moving group.

HIP 22845 (HD 31295) is a well-studied λ Boo and *Spitzer* and *IRAS* infrared excess star. Its *UVW* of −4.3, −23.6, −10.1 ± (1.1, 0.8, 0.5) km s^{-1} is, at best, in marginal agreement with published *UVW* for the AB Dor group (see the note to Table 2). HIP 22845 lies near typical Pleiades stars on an A-star color–magnitude diagram. We have not included it as a proposed AB Dor member.

HIP 117452 (Table 2) is a member of a triple system. The A0 primary is a close binary and the tertiary, HD 223340, is an early-K-type star about 75″ to the NW. Both the (binary)

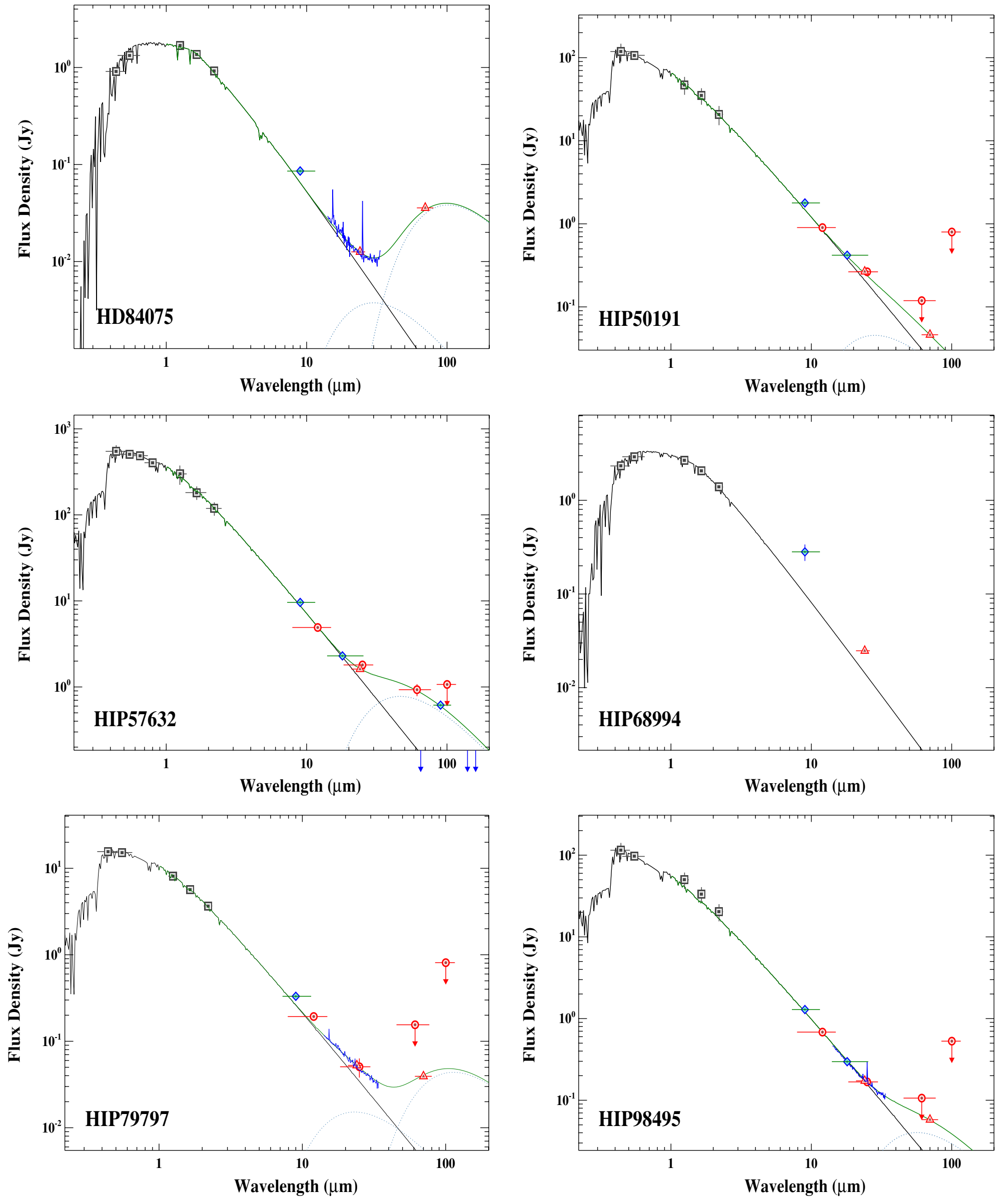

Figure 7. SEDs for Argus stars in Table 10 with probable or definite infrared excess emission.
(A color version of this figure is available in the online journal.)

primary and HD 223340 are X-ray sources. In the K star, the lithium line EW = 148 mÅ.

We regard HIP 93580 (Table 2) as only a possible member of the AB Dor group because the stellar *UVW* is somewhat discordant with that of the mean *UVW* for the group (as may be seen from the entry in Table 2 and the note to the table).

In addition to the proposed Table 2 early-type additions to the AB Dor group, our spectroscopic studies at SSO indicate that solar-type stars HD 293857, UX Col, and HD 178085 are also members (as noted independently by Torres et al. 2008 and da Silva et al. 2009).

5.2. Tucana/Horologium and Columba

The Tucana and Horologium Associations were proposed independently by Zuckerman & Webb (2000) and Torres et al. (2000), respectively. Zuckerman et al. (2001b) suggested that these two moving groups are really just two adjacent regions that contain a coeval (∼30 Myr old) stream of stars with common space motion, but that the greatest concentration of stars, the "nucleus" of the overall group, is located in Tucana. Subsequently, Torres et al. (2008) introduced the notion that there are three 30 Myr old associations, Tuc/Hor, "Columba," and "Carina." As defined by Torres et al. (2008), these three differ principally in location in space—both in the plane of the sky and in their distance from Earth—and, to a lesser degree, probably in Galactic space motions *UVW* (see also Section 4 and the note to Table 1).

Some stars in Table 3 that are likely Columba members represent a major departure from the characteristics of the Columba stars listed by Torres et al. (2008); their listed stars all fall in the R.A. range between about 2 hr and 8 hr and, with but one exception at +4°, all have negative declinations. (The latter regularity should not come as a surprise since the Torres et al. study focused on the southern hemisphere.) Also, only 5 of the 41 Columba stars they list are within 65 pc of Earth. By contrast, all 14 of the likely Columba members of our Table 3 (based on their large negative *W* component) are within 65 pc.

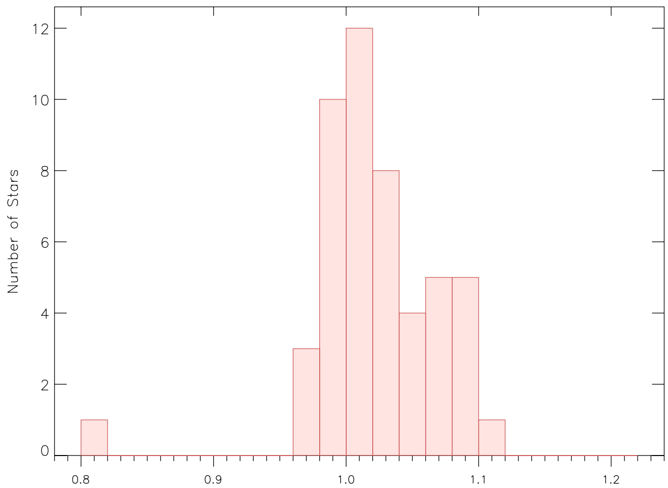

Figure 8. Histogram of the ratio of MIPS measured to model photospheric 24 μm flux densities for a sample of the fainter FGK type stars from Trilling et al. (2008) without known MIPS measured excess emission. See Section 3 for details.

(A color version of this figure is available in the online journal.)

In addition, 7 of these 14 lie well outside of the plane of the sky boundaries (in R.A. and decl.) that encompass all 41 of the proposed Torres et al. members.

While the Columba Association stars proposed by Torres et al. (2008) lie primarily between about 2 hr and 7 hr in R.A. and in the southern hemisphere, they are only weakly constrained in distance from Earth, including even a star 189 pc away. We suggest that it would be preferable to constrain the membership to lie much closer to Earth, say out to ∼80 pc, and at all plane of the sky locations. An 80 pc radius includes most of the members of the β Pic, Tuc/Hor, and AB Dor groups as proposed by Torres et al. (2008) and by Zuckerman & Song (2004). Based on Table 5 of Torres et al. (2008) and our Table 3, the nucleus of such a Columba moving group would lie between 5 hr and 6 hr R.A. and would be about 50 pc from Earth (cf. all the stars in Table 3 from HIP 23179 to 32104, inclusive).

The F0 star HIP 17675 (HD 23384) does not appear in Table 3 although it is young and has a *UVW* consistent with that of Columba stars. With a radial velocity of -1.6 ± 0.7 km s^{-1} (a weighted average of our echelle measurement and that given in Gontcharov 2006), the *UVW* of HIP 17675 is -11.3, -21.8, $-5.7 \pm (0.9, 1.1, 0.4)$ km s^{-1}. On an A-star color–magnitude diagram (Figure 5 in Zuckerman 2001), the F0-type primary lies low thus suggesting a young age. However, our measurement of the EW of the 6708 Å line of lithium is only 50 mÅ and the fractional X-ray luminosity, $\log(L_x/L_{\rm bol})$ based on the RASS, is about -6.0. Together the lithium EW and the X-ray luminosity may be too small to be consistent with an age as young as 30 Myr.

Another interesting F0 star that did not find its way into Table 3 is HIP 82587 (HD 152598). The *UVW* of -10.7, -22.9, $-3.6 \pm (0.4, 0.5, 0.5)$ km s^{-1} is similar to those of the Tuc/Hor and Columba Associations. The star has MIPS measured excess emission at both 24 and 70 μm (Moor et al. 2009). Moor et al. give an age of 210 ±70 Myr based on the star's *UVW*, X-ray flux, and 6708 Å lithium line strength. Our interpretation of these characteristics is consistent with an age younger than 210 Myr, although perhaps not as young as 30 Myr. Also, like HIP 17675 above, HIP 82587 lies quite low on the A-star color–magnitude diagram, suggestive of a young age. Hence, membership in the Tuc/Hor or Columba Association remains a possibility.

In addition to stars listed in Table 3, based on our independent analysis, we concur with the classification by Torres et al. (2008) of HD 38206 (HIP 26966) as a member of the Columba association. And we note that, consistent with the fact that our Table 3 stars are generally closer to Earth than the Columba stars proposed by Torres et al., HD 38206 at 69 pc from Earth is one of their nearer members.

Comments on some of the stars in Table 3 follow next. The quantity f_x is the fractional X-ray luminosity, $\log(L_x/L_{\rm bol})$ based on the RASS. The quoted lithium line EWs are those of the 6708 Å line.

HIP 12413. This is a young, multiple star system that is probably a Columba member, notwithstanding that its *W* component of -8.3 ± 3.7 km s^{-1} may be quite different from the mean *W* of Columba stars as estimated by Torres et al. (2008; see the note to our Table 3). On an A-star color–magnitude diagram (Zuckerman 2001) the A1-type primary is positioned in the vicinity of Pleiades stars. A *ROSAT* HRI image presented by Schroder & Schmitt (2007) indicates that the primary and its M-type companion ∼25″ to the north are both strong X-ray sources; no doubt the primary has a close (spatially unresolved) companion of spectral-type intermediate between it and the M-type star. The optical secondary is probably of mid-M type, although it is difficult to deduce the exact M subclass because of apparent disagreement between comments in Schroder & Schmitt (2007) and data in VizieR. In any event, the absolute *K* mag (5.4) of the M star is such that on a color–magnitude diagram it lies well above old mid-M-type stars (e.g., Figure 2 in Zuckerman & Song 2004) and thus is consistent with the 30 Myr age of Columba.

HIP 14551. This is a ∼70″ binary star. The M4.5 secondary (based on its $I - K = 2.5$) is located 70″ to the SSW of the primary. On an A-star color–magnitude diagram, the A5 primary lies near the very young star β Pictoris. On a color–magnitude diagram, the absolute *K* magnitude (6.3) of the secondary places it well above old, M4.5, Gliese stars (e.g., Figure 2 in Zuckerman & Song 2004).

HIP 14913. Like HIP 12413 discussed above, HIP 14913 is a triple star system; the AB separation is about 0.″7 and AC are separated by about 3.″7. C is a K-type star. Concerning entries in Table 3, the lithium line EW in the F6 primary = 65 mÅ while $f_x = -4.06$ for the entire triple system considered as a single star. Our SSO spectra indicate that two nearby K-type stars CD-46 1064 (TYC 8060-1673-1) and CD-44 1173 (TYC 7574-803-1) are also Tuc/Hor members and were so identified by Torres et al. (2008). In addition, the *Hipparcos* measured parallax for HIP 14913 is in good agreement with the photometric parallax of the two K-type *Tycho* stars calculated independently by us and by Torres et al. (2008).

HIP 17248. The lithium line is too weak to be measured and $f_x = -3.36$; both measurements are consistent with a 30 Myr old M0.5 star. On a color–magnitude diagram, its absolute *K* mag (4.64) places HIP 17248 above the main sequence. Thus, all age indicators and *UVW* are consistent with membership in the Columba Association although—because of the negative value of *W*—probably not with membership in Tuc/Hor.

HIP 17782. The star is a ∼equal brightness 0.″36 binary. The lithium and f_x entries in Table 3 pertain to the two stars considered together.

HIP 17797. This is an 8″ binary composed of an A1 and an A2 star. The stars lie near and below the location of a typical Pleiades star on an A-star color–magnitude diagram. The system is a weak X-ray source, suggesting the presence of a third star.

HIP 23179. This is a 5″ binary composed of an A1 and a G0 star. In the secondary the lithium line EW = 165 mÅ. The system is a strong RASS X-ray source.

HIP 23362. The star lies near the location of a typical Pleiades star on an A-star color–magnitude diagram.

HD 36869. This star is AH Lep. The spectrum of the star has been measured previously by Cutispoto et al. (2002), Wichmann et al. (2003), and Lopez-Santiago et al. (2010).

HIP 26309. On an A-star color–magnitude diagram, the star lies near the very young star β Pictoris.

HIP 26990. The spectrum of the star has been measured previously by Cutispoto et al. (2002), Wichmann et al. (2003), and Waite et al. (2005).

HIP 28474. The lithium EW and f_x are both somewhat too small for a typical Tuc/Hor or Columba star, but because of the essentially perfect agreement of the *UVW* of HIP 28474 with that of the mean Columba *UVW* given in Torres et al. (2008) along with the very plausible space location of HIP 28474 with respect to other Columba stars, we deem the star to be a likely Columba member.

HIP 32104. On an A-star color–magnitude diagram, the star lies near the very young star HD 141569. HIP 32104 is a RASS source, suggesting the presence of a second star.

HIP 83494. On an A-star color–magnitude diagram, the star lies near the very young star β Pictoris. In both R.A. and decl., HIP 83494 lies far from any Tuc/Hor or Columba star proposed by either Zuckerman & Song (2004) or Torres et al. (2008).

HIP 84642. Chauvin et al. (2010) resolve the star as a 0.″22 binary with delta $K_s = 2.5$ mag. As noted by Chauvin et al., probably because of the large flux contrast and small angular separation between the primary and secondary, HIP 84642 does not appear in the *Hipparcos* double star catalog. They deem the secondary to be of spectral type ∼M5 and the system age to be ∼40 Myr.

The *UVW* of HIP 84642 is in only fair agreement with the mean *UVW* of the Tuc/Hor Association given by Zuckerman & Song (2004) and by Torres et al. (2008) and HIP 84642 is located in a sky position that contains no (other) members of Tuc/Hor listed in either of these review articles. Therefore, we regard HIP 84642 as a possible rather than likely member of Tuc/Hor.

BD+44 3670. Guillout et al. (2009) and P. Guillout (2010, private communication) present data for this star including a lithium line EW = 196 mÅ. The photometric distance, radial velocity, and *UVW* in Table 3 are from P. Guillout (2010, private communication).

HIP 116805. The star lies near the location of a typical Pleiades star on an A-star color–magnitude diagram.

5.3. HR 8799

HIP 114189 (=HR 8799) is known to be orbited by a multiple system of massive planets imaged by Marois et al. (2008, 2010) and by a massive dusty debris disk (Rhee et al. 2007b; Su et al. 2009). In Table 3, we place the star in the Columba Association based on its Galactic space motion and other age indicators mentioned below. If, as we suggest in Section 5.2, the nucleus of the Columba Association lies near $5^{\rm h}30^{\rm m}$ R. A. and is ∼50 pc from Earth, then currently HR 8799 is ∼70 pc from the nucleus. A peculiar velocity of 2 km^{-1} over a period of 30 Myr would produce this separation. Based on their Bayesian statistical analysis, Doyon et al. (2010) independently deduce that HR 8799 is a member of the Columba Association.

Recently, Currie et al. (2011) also deduce a young age for HR 8799; models of dynamical stability and planet evolution (cooling) lead them a preferred age near 30 Myr. The near-IR colors of the planets of HR 8799 differ from those of conventional (old) L- and T-type substellar objects, but are similar to that of the ∼6 Jupiter mass 2M1207b (Marois et al. 2008; Patience et al. 2010; Currie et al. 2011). As noted by Marois et al. (2010), evolutionary models for cooling 30 Myr old planets suggest masses about six times that of Jupiter for the four known planets of HR 8799. Given the well-established age of 2M1207b (∼10 Myr), its unusual near-IR spectrum can most readily be attributed to atmospheric properties engendered by its low mass.

HR 8799 lies below the position of a typical Pleiades star on an A-star color–magnitude diagram; see HR 8799 plotted in Figure 5 of Zuckerman (2001). Because HR 8799 is a λ Boo-type star with a peculiar surface composition, it probably should be plotted slightly to the right of where it appears in Zuckerman's Figure 5, but still below the Pleiades line in the figure. For example, with the $T_{\rm eff} = 7430$ K derived by Gray & Kaye (1999), the star would plot near $B - V = 0.31$. Relative to the locus of A-type Pleiades stars, HR 8799 plots as low or lower than all members of a sample of ∼20 λ Boo stars with *Hipparcos* measured parallaxes identified by R. Gray (2010, private communication). Again this is consistent with a young age.

HR 8799 has one of the most massive dusty debris disks known for any main-sequence star (Rhee et al. 2007b). The range of dust temperatures is extensive (Su et al. 2009); in their preferred model, an inner warm dust belt with temperature ∼150 K extends between 6 and 15 AU from the star. Marois et al. (2010) note that the inner edge of such a dust belt could be in a 4:1 mean motion resonance with planet HR 8799e while the outer edge must be closer to the star than 15 AU to avoid planet e's chaotic region. The location of the inner edge is determined only by a fit to the shorter wavelength portion of the *Spitzer* IRS spectrum combined with the assumption that the grains radiate like blackbodies at the relevant wavelengths (see Figures 3 and 4 in Su et al. 2009). Because the radius of a typical grain must be at least a few microns to avoid radiative blowout, this assumption is valid. Since the longer wavelength IRS emission is due to a blend of emission from the warm dust belt and cooler dust in an outer belt, the outer radius of the inner belt is not so well determined. It remains to be seen whether yet a fifth planet can be squeezed in between the warm dust belt and planet e (Hinkley et al. 2011).

5.4. Argus

Torres et al. (2008) proposed a new association comprising more than 60 stars of which somewhat more than half are members of the open cluster IC 2391, located ∼140 pc from Earth. Torres et al. dub the non-IC 2391 stars "field Argus members" and, of these, ∼half are more than 100 pc from Earth. Indeed, only six of their field Argus stars are within the 70 pc radius sphere surrounding Earth that constrains our proposed Table 4 additions to Argus. In addition, whereas none of the 29 Argus field members proposed by Torres et al. are of spectral type earlier than F0, five of the Argus stars in Table 4 are A type. We therefore expect that many additional A-type Argus members will be identified beyond 66 pc from Earth. Previously, Eggen (1991) proposed an IC 2391 Supercluster containing many early-type stars, including Table 2 stars HIP 98495 and HIP 57632 (β Leo, only 11 pc from Earth). In the future, some A-type members of Eggen's Supercluster more distant than 66 pc are likely to be joined to the Argus Association defined by Torres et al. (2008).

In addition to early-type Argus field stars more distant from Earth than ∼65 pc, IC 2391 contains some A- and B-type stars (e.g., Siegler et al. 2007). Siegler et al. consider 34 members of IC 2391 ranging among spectral types B through M. Only 12 stars in the Siegler sample are included among the 35 IC 2391 stars considered by Torres et al. (2008) to be "high probability members" of the Argus Association. Neither of these two papers cites the other which is understandable given that their submissions may have been nearly simultaneous. However, the Siegler et al. (2007) paper is also not cited in a 2009 paper by the Torres group (da Silva et al. 2009). In any event, we consider the Argus Association and IC 2391 in Section 5.5.2 in conjunction with Table 11.

Torres et al. (2008) suggest an age of 40 Myr for the Argus Association. Its large negative U component of space motion distinguishes Argus from other young nearby moving groups. While Argus members listed by Torres et al. (2008) are deep in the southern hemisphere, Table 2 stars HIP 57632 and HIP 99770 are in the northern hemisphere.

The A-type stars HIP 50191, 57632, and 99770 all lie near the typical Pleiades star on an A-star color–magnitude diagram, while HIP 79797 and 98595 lie substantially below Pleiades stars. The F-type star HIP 68994 also lies well below Pleiades stars; for it, $f_x = -5.1$.

5.5. *Spitzer* Observations

Unveiling the evolution of dusty debris disks as a function of stellar age has been a major focus of *Spitzer* studies of main-sequence stars. Rebull et al. (2008) and Gaspar et al. (2009) each present tables listing stellar associations and clusters of known age and the fraction of such stars with *Spitzer* detected IR excess emission. Neither listing contains stars in the AB Dor Association although a few such stars appear in *Spitzer* papers by Plavchan et al. (2009), Carpenter et al. (2009), and Hillenbrand et al. (2008). The Rebull et al. paper does include an entry for Tuc/Hor based on a few stars from her paper and from Smith et al. (2006), but many more Tuc/Hor stars are included in tables in the present paper.

5.5.1. *Individual SEDs*

Figures 1–7 display the SED for all stars in Tables 8–10 with definite or probable IR excess emission. MIPS fluxes presented in this paper are color corrected. The tables give stellar and dust parameters derived from our SED-fitting routine. When only an upper limit to the 70 μm flux density is plotted, then an indicated dust temperature is a lower limit and the indicated dust luminosity is an upper limit. We consider here a few of the more difficult and interesting SEDs.

CD-60 416 (Table 9). The 24 μm MIPS flux density and the IRS spectrum both lie slightly above the estimated photospheric flux. However, the IRS is noisy and is not rising toward long wavelengths, so we regard the apparent excess emission at 24 μm as questionable.

HIP 16563 (Table 8, Figure 1). This is ∼10″ binary. The M0 secondary appears to have 24 μm emission that is 40% in excess of the photosphere. If so, then HIP 16563B is one of only a handful of M-type stars with measurable excess IR emission. The primary is about a magnitude brighter than the secondary and appears to have a 24 μm excess of about 30%. Lestrade et al. (2006) found no evidence for cold dust at these stars. Because the binary nature of the star introduces additional complexities into the analysis, we regard as tentative the excesses at both stars.

HIP 30034 (Table 9, Figure 5). This is AB Pic, a star that has a companion, imaged with adaptive optics (AO), with mass (∼13.5 Jupiter masses) that straddles the planet/brown dwarf boundary (Chauvin et al. 2005). Although the 8 μm flux density measured with IRAC on *Spitzer* is on or very near the photosphere, there is evidence for excess emission in both the 12 μm *IRAS* and 24 μm MIPS channels. The MIPS excess is ∼25%. The color-corrected *IRAS* 12 μm flux density is 70 ±11 mJy while the photosphere is ∼40 mJy.

HIP 32435 (Table 9, Figure 5). The shape of the IRS spectrum seems difficult to reconcile with the elevated 60 μm *IRAS* point.

HIP 68994 (Table 10, Figure 7). This star lies precisely in the Galactic plane so that contamination by background IR sources is always a possibility. That said, we note the elevated AKARI 9 μm flux density that, along with the 24 μm MIPS measurement, suggests the presence of substantial quantities of warm dust particles.

HIP 114189 (Note to Table 9). The SED has been analyzed in great detail by Su et al. (2009), thus we do not present it here.

HIP 115738 (Table 8, Figure 2). The IRS spectrum of this A0 star indicates a rising SED from 10 to 30 μm, but with the MIPS 70 μm flux density essentially back on the photosphere. We have not tried to fit a dust temperature.

5.5.2. *Evolution of Dusty Debris Disks with Time*

As mentioned in Section 4, because the Columba Association is about the same age as Tuc/Hor (30 Myr) we combine *Spitzer* observed stars from these associations into a single entry in Table 11. Both Rebull et al. (2008) and Gaspar et al. (2009) tabulate the percentage of stars with excess emission found by *Spitzer* in various nearby clusters and associations. For the five associations/clusters for which we agree with the fraction of members with excess 24 and 70 μm emission given in Table 5 in Rebull et al. (2008), we cite their paper and adopt their quoted values in the right-hand column of Table 11; and similarly for the three clusters where we cite Gaspar et al. For the 24 μm excess fraction in IC 2391, we follow both Gaspar et al. and Rebull et al. (who agree). For the Pleiades and for NGC 2451, we take excess fractions from the original (cited) *Spitzer* papers.

At 24 μm wavelength *Spitzer* was sufficiently sensitive to detect the stellar photospheres. The entries in the third and fourth columns of Table 11 indicate that the fraction of stars that possess excess 24 μm emission above the photosphere is rather constant at about 1/3 between 8 and ∼50 Myr. Subsequently, this fraction declines to ∼15% at ∼100 Myr and then to only a percent or two at ∼700 Myr.

At 70 μm, because the photospheric flux level is usually not reached in *Spitzer* observations, only lower limits to the percentage of stars with excess emission can be derived. This lower limit is about 1/3 for ages between 8 and 50 Myr, i.e., comparable to the percentage of stars with excess 24 μm at similar ages. For cluster stars of age 100 Myr and greater the fraction that possess 70 μm excess emission is much smaller than 1/3.

6. CONCLUSIONS

We propose 35 star systems within ∼70 pc of Earth as new members of previously identified young, moving groups. With but one exception, these 35 stars are brighter than 10th magnitude at the V band. Thus, they should generally be excellent targets for extreme-AO and space-based, near-infrared, imaging searches for warm planets.

Among the 35 star systems are some that appear to have the same Galactic space motions and ages as stars in the previously proposed Columba and Argus field associations (Torres et al. 2008), but over a much wider range of right ascension and/or declination. It remains to be seen whether all such stars belong to these already defined kinematic groups or if additional young moving groups will need to be defined. Our unpublished optical spectroscopic observations of X-ray bright stars from Siding Spring and Lick observatories indicate that many young stars near Earth have space motions that differ from those of all moving groups and associations listed in Zuckerman & Song (2004) and Torres et al. (2008).

We comment on many of the 35 star systems and also on some other stars that clearly are young but that do not seem to quite fit into known moving groups. One of the more interesting of the 35 stars is HR 8799 that is orbited by at least four giant planets at wide separations. The Galactic space motion of HR 8799 is in excellent agreement with that of the 30 Myr old Columba Association and we present it as one of six northern hemisphere stars we are proposing as members of this association.

We present the first comprehensive consideration of *Spitzer* data for stars in the AB Doradus and Tucana/Horologium Associations. We also consider *Spitzer* results for nearby stars in the Columba and field Argus Associations. As young stars are wont to do, many of these stars display excess IR emission at 24 and/or 70 μm wavelength. For a few stars, 24 μm emission appears to dominate, thus suggesting the presence of warm dust particles. One such warm dust, solar-like star may be AB Pic which is known to be orbited by a distant companion with a mass that straddles the planet/brown dwarf mass boundary.

Combination of our *Spitzer* results with those for 11 other nearby clusters and associations illustrates the decay of dusty debris with time over the age range 8–750 Myr. For cluster/association stars of ages 8 to ~50 Myr about 1/3 display excess 24 and 70 μm emission above the photosphere. The percentage with excess 24 μm emission drops to ~15% at 100 Myr and then to only a few percent at ~700 Myr. Similarly, the percentage of stars with *Spitzer* detected excess emission at 70 μm and age >100 Myr is much smaller than 1/3.

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