ON THE AGE AND BINARITY OF FOMALHAUT

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ABSTRACT

The nearby ($d = 7.7$ pc) A3V star Fomalhaut is orbited by a resolved dusty debris disk and a controversial candidate extrasolar planet. The commonly cited age for the system (200 ± 100 Myr) from Barrado y Navascues et al. relied on a combination of isochronal age plus youth indicators for the K4V common proper-motion system TW PsA. TW PsA is $1°96$ away from Fomalhaut and was first proposed as a companion by Luyten, but the physicality of the binarity is worth testing with modern data. I demonstrate that TW PsA is unequivocally a physical stellar companion to Fomalhaut, with true separation $0.280^{+0.019}_{-0.012}$ pc ($57.4^{+3.9}_{-2.5}$ kAU) and sharing velocities within 0.1 ± 0.5 km s^{-1}—consistent with being a bound system. Hence, TW PsA should be considered "Fomalhaut B." Combining modern H-R diagram constraints with four sets of evolutionary tracks, and assuming the star was born with protosolar composition, I estimate a new isochronal age for Fomalhaut of 450 ± 40 Myr and mass of 1.92 ± 0.02 $M_\odot$. Various stellar youth diagnostics are re-examined for TW PsA. The star's rotation, X-ray emission, and Li abundances are consistent with approximate ages of 410, 380, and 360 Myr, respectively, yielding a weighted mean age of 400 ± 70 Myr. Combining the independent ages, I estimate a mean age for the Fomalhaut–TW PsA binary of 440 ± 40 Myr. The older age implies that substellar companions of a given mass are approximately 1 mag fainter at IR wavelengths than previously assumed.

Key words: binaries: visual – circumstellar matter – planetary systems – stars: activity – stars: fundamental parameters – stars: individual (Fomalhaut, TW PsA)

1. INTRODUCTION

Fomalhaut (α PsA, HD 216956, HIP 113368) is a famous nearby A3V star with a large resolved dusty debris disk (e.g., Holland et al. 2003) and an imaged candidate extrasolar planet (Kalas et al. 2008). The age of Fomalhaut is mainly of interest for predicting the infrared brightnesses of substellar companions (Kenworthy et al. 2009; Janson et al. 2012), calculations of the total mass of the parent bodies generating the dust (Chiang et al. 2009), and placing the dusty debris disk in evolutionary context with other stars (e.g., Rieke et al. 2005). In general, accurate ages for host stars of substellar objects are useful for constraining not only the masses of the companions, but accurate ages for the youngest stars may help constrain the initial conditions for the substellar objects (Spiegel & Burrows 2012). Kalas et al. (2008) recently announced the discovery of a faint optical companion (likely $\lesssim 3$ $M_{\rm Jup}$) at separation $12''.7$ (96 AU) from Fomalhaut. While the companion has been imaged multiple times at optical wavelengths (Kalas et al. 2008; P. Kalas et al. 2012, in preparation), it has eluded detection in the infrared (Janson et al. 2012).

Given the importance of Fomalhaut as a benchmark resolved debris disk system and possible planetary system, a detailed reassessment of its age is long overdue. This Letter is split into the following sections: (1) a review of published age estimates for Fomalhaut, (2) estimation of a modern isochronal age for Fomalhaut, (3) demonstration of the physicality of the Fomalhaut–TW PsA binary system, (4) age estimates for TW PsA based on multiple calibrations, and (5) estimation of a consensus age for the Fomalhaut–TW PsA system. These results supersede the age analysis for the Fomalhaut–TW PsA system presented at the 2010 Spirit of Lyot meeting in Paris (Mamajek 2010).

2. REVIEW OF PREVIOUS AGE ESTIMATES

Previously published ages for Fomalhaut and TW PsA are listed in Table 1, and span a factor of three, from 156 Myr (Song et al. 2001) to 480 Myr (Rieke et al. 2005). The most often cited age for Fomalhaut is 200 ± 100 Myr from Barrado y Navascues et al. (1997) and Barrado y Navascues (1998). The Barrado y Navascues et al. (1997) estimate comes from multiple age indicators (including Li abundance, rotation, H-R diagram position, and X-ray emission) for its purported common proper-motion companion TW PsA. Later, Barrado y Navascues (1998) assigned the same age to Fomalhaut based on its purported membership to the Castor Moving Group (CMG; which included Castor, Vega, and roughly a dozen other systems). These analyses relied heavily on a few assumptions, worth re-examining—namely that Fomalhaut and TW PsA are physically related, that the Castor group is physical (i.e., useful for age dating), and that Fomalhaut and TW PsA belong to the Castor group. The question of whether the CMG is actually useful for age dating will await a future investigation. For this study, I focus solely on the ages of Fomalhaut and TW PsA, and assess the physicality of that binary.

3. ANALYSIS

3.1. Isochronal Age for Fomalhaut

An isochronal age for Fomalhaut can be estimated through comparing its $T_{\rm eff}$ and luminosity to modern evolutionary tracks. The stellar parameters for Fomalhaut are fairly well determined due to its brightness and proximity, which has enabled the star to have its diameter measured interferometrically. Here I estimate refined H-R diagram parameters for Fomalhaut and estimate an isochronal age.

Basic stellar parameters for Fomalhaut are listed in Table 2. Davis et al. (2005) estimated the bolometric flux of Fomalhaut to be $8.96 \pm 0.25 \times 10^{-9}$ W m^{-2}, which I adopt. Combining this with the revised *Hipparcos* parallax from van Leeuwen (2007)

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Table 1
Previous Ages for Fomalhaut

Age (Myr)	Ref.	Method
200 ± 100	1	Isochrones (Fom), Li, X-ray, rotation (TW)
224^{+115}_{-119}	2	Isochrones (Fom)
156^{+188}_{-106}	3	Isochrones (Fom)
290	4	Isochrones (Fom)
480	5	Isochrones (Fom)
220	6	"Fomalhaut"
419 ± 31	7	Isochrones (Fom)

Notes. "TW" = TW PsA, "Fom" = Fomalhaut.
References: (1) Barrado y Navascues et al. 1997, Barrado y Navascues 1998; (2) Lachaume et al. 1999; (3) Song et al. 2001; (4) Di Folco et al. 2004; (5) Rieke et al. 2005; (6) Rhee et al. 2007; (7) Zorec & Royer 2012.

of $\varpi = 129.81 \pm 0.47$ mas ($d = 7.704 \pm 0.028$ pc), this results in a bolometric luminosity for Fomalhaut of $16.63 \pm 0.48\ L_\odot$ or $\log(L/L_\odot) = 1.221 \pm 0.013$ dex.[2] Absil et al. (2009) resolved a small amount of K band excess due to circumstellar dust and reported a revised limb-darkened diameter taking into account all the available VLTI data: $\theta_{LD} = 2.223 \pm 0.022$ mas. Using the relation from van Belle et al. (1999) ($T_{eff} = (2341\ \text{K}) \times (f_{bol}/\theta_{LD}^2)^{(1/4)}$, where f_{bol} is in units of 10^{-8} erg cm^{-2} s^{-1} and θ_{LD} is in mas) with the bolometric flux from Davis et al. (2005) and the limb-darkened diameter from Absil et al. (2009), I derive a new T_{eff} of 8590 ± 73 K and radius $1.842 \pm 0.019\ R_\odot$. The T_{eff} is only slightly lower than recent estimates (e.g., Davis et al. 2005).

To calculate an isochronal age, I overlay the new H-R diagram point for Fomalhaut on the evolutionary tracks of Bertelli et al. (2008) (Figure 1, top). I assume that Fomalhaut has a chemical composition similar to the proto-Sun, with an astero-seismologically motivated (and diffusion corrected) composition of $Y = 0.27$ and $Z = 0.017$ (see Serenelli & Basu 2010 and references therein).[3] I generate H-R diagram positions by Monte Carlo sampling the bolometric flux, parallax, and limb-darkened radius values from their quoted values and uncertainties (assuming a normal distribution), and interpolating within the Bertelli et al. (2008) tracks. The T_{eff} and luminosity of Fomalhaut are consistent with a mass of $1.95 \pm 0.02\ M_\odot$ and age of 433 ± 36 Myr. The uncertainties only take into account observational errors and not systematic uncertainties in chemical composition and input physics. To estimate systematic uncertainties due to different assumed solar composition and input physics, I estimate calculate ages and masses for three more sets of tracks (see Table 3). The expectation ages for the four sets of tracks are very similar,[4] and the mean of the ages from the four tracks is

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[2] I adopt a revised solar luminosity of $L_\odot = 3.8270\ (\pm 0.0014) \times 10^{33}$ erg s^{-1} based on the total solar irradiance (TSI) of $S_\odot = 1360.8\ (\pm 0.5)$ W m^{-2} (Kopp & Lean 2011) calibrated to the NIST radiant power scale, and the IAU 2009 value for the astronomical unit (149597870700 ± 3 m). Using the bolometric magnitude zero point proposed by IAU Commissions 25 and 36 of $L = 3.055 \times 10^{28}$ W, this translates to a solar absolute bolometric magnitude of $M_{bol} = 4.7554\ (\pm 0.0004)$ mag on that scale. To force the recent TSI measurement to a scale where $M_{bol} = 4.75$ (a commonly adopted value; Torres 2010), the zero-point luminosity could be adjusted to 3.040×10^{28} W. One can calculate a modern T_{eff} for the Sun by combining the new luminosity with the solar radius (695660 km) from Haberreiter et al. (2008, where I adopt ± 100 km error based on their discussion). The resultant solar T_{eff} is 5771.8 ± 0.7 K.
[3] This is motivated by approximately solar metallicity of the companion TW PsA (Barrado y Navascues 1998; Casagrande et al. 2011).
[4] Independently, the TYCHO evolutionary tracks yield an age of 476 Myr (P. Young, 2012, private communication).
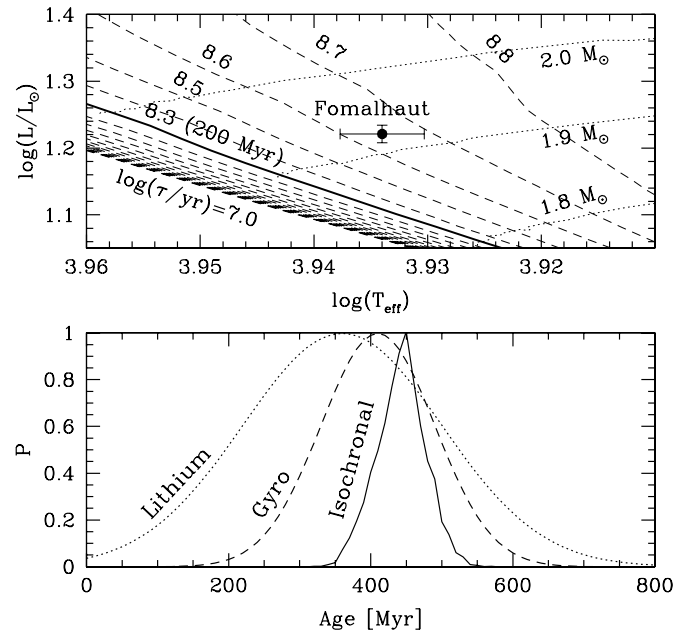

Figure 1. Top: theoretical H-R diagram for Fomalhaut, with isochrones and evolutionary tracks from Bertelli et al. (2008; assuming protosolar composition of $Y = 0.27$ and $Z = 0.017$). Isochrones are in steps of 0.1 dex starting at $\log(\text{age yr}^{-1}) = 7.0$. A 200 Myr ($\log(\text{age yr}^{-1}) = 8.3$) is plotted as a thick solid line. Bottom: normalized age probability distributions: solid line is isochronal age for Fomalhaut using Bertelli et al. (2008) tracks, dashed line is gyrochronology age for TW PsA, and dotted line is an approximate Li age through comparing TW PsA to open clusters (Section 3.3).

Table 2
Stellar Parameters

(1) Value	(2) α PsA	(3) TW PsA	(4) Units	(5) Ref.
α_{ICRS}	344.411773	344.099277	deg	1
δ_{ICRS}	-29.621837	-31.565179	deg	1
Parallax	129.81 ± 0.47	131.42 ± 0.62	mas	1
Distance	7.704 ± 0.028	7.609 ± 0.036	pc	1
$\mu_{\alpha*}$	329.95 ± 0.50	331.11 ± 0.65	mas yr^{-1}	1
μ_δ	-164.67 ± 0.35	-158.98 ± 0.48	mas yr^{-1}	1
v_R	6.5 ± 0.5	6.6 ± 0.1	km s^{-1}	2,3
m_V	1.155 ± 0.005	6.488 ± 0.012	mag	4
Period	$\ldots$	10.3	days	5
Spec. type	A3 Va	K4 Ve	$\ldots$	6,7
T_{eff}	8590 ± 73 K	4594 ± 80	K	8,9
f_{bol}	8.96 ± 0.25	0.10075	nW m^{-2}	10,9
U	-5.71 ± 0.16	-5.69 ± 0.06	km s^{-1}	8
V	-8.26 ± 0.28	-8.16 ± 0.07	km s^{-1}	8
W	-11.04 ± 0.38	-10.96 ± 0.08	km s^{-1}	8
S_{tot}	14.92 ± 0.33	14.80 ± 0.07	km s^{-1}	8
X_{gal}	3.06	3.14	pc	8
Y_{gal}	1.14	0.90	pc	8
Z_{gal}	-6.98	-6.88	pc	8
Mass	1.92 ± 0.02	$0.73^{+0.02}_{-0.01}$	$M_\odot$	8,9
M_V	1.722 ± 0.009	7.081 ± 0.016	mag	8
Luminosity	16.63 ± 0.48	0.189 ± 0.013	$L_\odot$	8
$\log(L/L_\odot)$	1.221 ± 0.013	-0.723 ± 0.029	dex	8
Radius	1.842 ± 0.019	0.688 ± 0.034	$R_\odot$	8

References: (1) van Leeuwen 2007; (2) Gontcharov 2006; (3) Nordström et al. 2004; (4) Mermilliod & Mermilliod 1994; (5) Busko & Torres 1978; (6) Gray & Garrison 1989 (standard), (7) Keenan & McNeil 1989; (8) this Letter (derived quantities discussed in Section 3, using other values in the table), (9) Casagrande et al. 2011; (10) Davis et al. 2005. S_{tot} is the barycentric speed. I assume $L_\odot = 3.827 \times 10^{33}$ erg s^{-1} (see footnote 1) and $R_\odot = 695,660$ km (Haberreiter et al. 2008).

Table 3
Age and Mass Estimates for Fomalhaut

Tracks	Y	Z	Age (Myr)	Mass
Bertelli et al. (2009)	0.270	0.017	444^{+32}_{-37}	1.922 ± 0.016
Marigo et al. (2008)	0.273	0.019	427^{+27}_{-32}	$1.911^{+0.014}_{-0.016}$
Dotter et al. (2008)	0.274	0.0189	478[a]	1.92[a]
Yi et al. (2001)	0.264	0.017	453^{+38}_{-32}	$1.943^{+0.017}_{-0.014}$

Note. [a] I was unable to derive reliable uncertainties using these tracks.

450 Myr with a 22 Myr (5%) rms scatter (which is a reasonable estimate of the systematic error considering slightly different assumed protosolar abundances and input physics). Considering the typical observational error in age (± 33 Myr; 7%), this suggests a total isochronal age uncertainty of ± 40 Myr (9%). For the four sets of tracks, the average mass is 1.923 $M_\odot$, with $\pm 0.014\ M_\odot$ rms (systematic error component) and $\pm 0.016\ M_\odot$ scatter due to the observational errors. Note that this new mass ($1.92 \pm 0.02\ M_\odot$) is similar to previous estimates (e.g., Kalas et al. 2008), but 16% lower than the 2.3 $M_\odot$ quoted by Chiang et al. (2009). The new estimated mass is in line with observed trends in $T_{\rm eff}$ and $\log(L/L_\odot)$ versus mass for main-sequence (MS) stars in eclipsing binaries (Malkov 2007), which empirically predict $\sim$1.9–2.0 $M_\odot$.

3.2. Fomalhaut and TW PsA: A Physical Binary?

Although overlooked in most recent literature on Fomalhaut, the star has a likely stellar companion: TW PsA (GJ 879, HIP 113283). That TW PsA and Fomalhaut appear to share proper motion and parallax appears to have been first noticed by Luyten (1938). TW PsA is an active K4Ve star (Keenan & McNeil 1989), at a projected separation of $1°96$ ($\sim$7100″), and has been listed as among the widest ($\sim$50,000 AU) candidate binaries known (Gliese & Jahreiß 1991). The proximity of TW PsA and its approximate co-motion with Fomalhaut led to Barrado y Navascues et al. (1997) using TW PsA to age-date Fomalhaut. Shaya & Olling (2011) included Fomalhaut and TW PsA as a wide binary in their Bayesian search for multiple systems in the *Hipparcos* catalog, and the system was one of only two binaries with separations >0.25 pc identified within 10 pc.

Given the utility of TW PsA to age-dating Fomalhaut, we should test the physicality of the purported binary system using the best available astrometry. The best available astrometric and radial velocity data for Fomalhaut and TW PsA are listed in Table 2, and their degree of similarity is striking. I adopt the literature mean v_R for Fomalhaut from Gontcharov (2006; 6.5 ± 0.5 km s^{-1}). This should reflect center-of-mass motion, as the revised *Hipparcos* astrometric analysis was able to statistically fit an unperturbed single-star solution for Fomalhaut's astrometry (van Leeuwen 2007). The astrometric acceleration from the original *Hipparcos* reduction reported by Chiang et al. (2009) is statistically insignificant (1.7σ) and likely spurious. For TW PsA, I adopt the v_R from Nordström et al. (2004), who reported a mean v_R for TW PsA of 6.6 km s^{-1} over seven epochs over 3794 days. The star apparently showed remarkable stability, with a quoted rms of ± 0.1 km s^{-1}.

I calculate the Galactic velocity vectors U, V, and W (in the direction of Galactic center, rotation, and North Galactic pole, respectively) from the astrometry and radial velocities of Fomalhaut and TW PsA. The three-dimensional (3D) velocities

are listed in Table 2. The degree of similarity is embarrassingly good, as their velocities agree within ± 0.1 km s^{-1} in all three directions. The barycentric speeds of the star differ by only 0.1 ± 0.5 km s^{-1}. Just how remarkable is the agreement in velocities? I generated a catalog of 3D velocities for 34,817 stars with updated *Hipparcos* astrometry from van Leeuwen (2007; those with positive parallaxes) and literature mean radial velocities from Gontcharov (2006). The only stars with 3D velocities within 1 km s^{-1} of Fomalhaut are TW PsA and HIP 3800 (0.99 km s^{-1} different). This suggests that $<10^{-4}$ of field stars have velocities within 1 km s^{-1} of Fomalhaut's, and that the similarity in velocities between Fomalhaut and TW PsA (separated by only $\sim$0.3 pc) is more than just a coincidence.

What is the 3D separation of Fomalhaut and TW PsA? Taking the parallax values and uncertainties from van Leeuwen (2007), I generate 10^4 Monte Carlo realizations of the distances to Fomalhaut and TW PsA (assuming $d = 1/$parallax). Fomalhaut has a parallax distance of 7.704 ± 0.028 pc, while TW PsA is at 7.609 ± 0.036 pc. The 3D separations in the simulations have a median separation of $0.280^{+0.019}_{-0.012}$ pc ($57.4^{+3.9}_{-2.5}$ kAU; 68%CL range quoted). Many plausible binary systems are known with larger separations (e.g., Shaya & Olling 2011). Assuming that the census of the nearest 100 star systems is complete,[5] the local density of star systems is 0.085 pc^{-3}. The chances of having an unrelated star (system) within 0.28 pc of a nearby star is approximately 1 in 130.

So the proximity in space and velocity between Fomalhaut and TW PsA appear to be more than coincidental, but are they bound? The escape velocity from Fomalhaut (1.92 $M_\odot$) at the separation of TW PsA is 0.21 km s^{-1}, suggesting that the observed difference in velocities (0.1 ± 0.5 km s^{-1}) is statistically consistent with the hypothesis of TW PsA and Fomalhaut constituting a bound pair. If one sets the semimajor axis of TW PsA's orbit to be equal to the observed 3D separation, and adopt a TW PsA mass of 0.73 $M_\odot$ (Casagrande et al. 2011), then one estimates an orbital period of $\sim$8 Myr. The predicted amplitude of the orbital velocities would be 0.06 km s^{-1} for Fomalhaut and 0.15 km s^{-1} for TW PsA.

3.3. Age of TW PsA

Rotation rates among late-F through early-M dwarfs appear to spin-down as they age through magnetically braking, approximately as rotation period $\propto$ age$^{1/2}$ (Skumanich 1972). Using the rotation period from Busko & Torres (1978; 10.3 days) and the gyrochronology curves from Mamajek & Hillenbrand (2008), and assuming ± 1.1 days rms fit to the gyro relation, I estimate a gyrochronology age of 410 ± 80 Myr.

Attempts to derive an isochronal age for TW PsA were discussed by Barrado y Navascues et al. (1997). Here I use the $T_{\rm eff}$ and luminosity from Table 2 to derive new estimates of isochronal ages from evolutionary tracks. Using the pre-MS evolutionary tracks of D'Antona & Mazzitelli (1997), TW PsA is consistent with having a mass of 0.71 $M_\odot$ and an age of 52 Myr. Using the Baraffe et al. (1998) pre-MS tracks, TW PsA is consistent with having a mass of 0.72 $M_\odot$ and 66 Myr. As discussed by Barrado y Navascues et al. (1997) in their review of TW PsA's other youth diagnostics (Li, activity), it is unlikely that the star is <100 Myr. The spectroscopic surface gravity appears to be $\log(g) \simeq 4.5$–4.7 (e.g., Dall et al. 2005), again consistent with an MS star. In light of those findings, I consider the star to be a young MS star, rather than pre-MS. Hence,

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[5] http://www.recons.org/TOP100.posted.htm

I consider the pre-MS isochronal age estimates to represent strict lower limits to TW PsA's age (i.e., >50 Myr), rather than useful age estimates themselves.

TW PsA is also a coronal X-ray source, with $L_X = 10^{28.33}$ erg s^{-1}, and fractional X-ray luminosity of $\log(L_X/L_{bol}) = -4.57$ (Wright et al. 2011). Although the star's color is slightly redder ($B - V = 1.1$) than the range probed by the calibrations in Mamajek & Hillenbrand (2008), using the X-ray age relation from Equation (A3) of that paper, this $\log(L_X/L_{bol})$ value would be consistent with an age of $\sim$380 Myr. Given the scatter in X-ray luminosities among stars in clusters of similar mass ($\sim$0.4 dex; Mamajek & Hillenbrand 2008), the age uncertainty is approximately $^{+470}_{-220}$ Myr.

As pointed out by Barrado y Navascues et al. (1997), TW PsA shows detectable Li (EW(Li I λ6707) = 33 ± 2 mÅ) consistent with an abundance of $\log N$(Li) = 0.6. The recent photometric T_{eff} from Casagrande et al. (2011) that I adopt ($T_{eff} = 4594 \pm 80$ K) is not far from the T_{eff} originally adopted by Barrado y Navascues et al. (1997) (4500 K). Barrado y Navascues et al. (1997) plotted the Li I abundances for members of four clusters of different ages (their Figure 2; Pleiades, M34, UMa, Hyades), and given its completeness, there is little reason to repeat the plot here. What *has* changed in the past 15 years is the age scale for these benchmark clusters. Barrado y Navascues et al. (1997) adopted the following age scale: Pleiades, 85 Myr; M34, 200 Myr; UMa, 300 Myr; and Hyades, 700 Myr. More recent evolutionary tracks are leading to slightly older ages among the younger clusters. I adopt the following age scale: Pleiades, 130 Myr (Barrado y Navascués et al. 2004), 220 Myr (Meibom et al. 2011); UMa, 500 Myr (King et al. 2003), and Hyades, 625 Myr (Perryman et al. 1998). The Li abundance for TW PsA appears to be intermediate between the Hyades and Pleiades, and M34 and UMa. It is more Li-poor than the Pleiades and M34 stars (hence >220 Myr), but more Li-rich than the UMa stars and Hyades (hence <500 Myr). Based on the Li abundances alone, I adopt an estimate of 360 ± 140 Myr.

The three independent age estimates for TW PsA listed in Table 1 are consistent with a weighted mean age of 400 ± 70 Myr. This age estimate for TW PsA is independent of any genetic association with Fomalhaut.

4. DISCUSSION

The kinematic data are consistent with Fomalhaut and TW PsA comoving within 0.1 ± 0.5 km s^{-1} and separated by only 0.28 pc. Given their coincidence in position, velocity, and statistical agreement in velocities expected for a wide bound binary, and remarkable agreement among independent age estimates ($\sim$10% agreement), I conclude that Fomalhaut and TW PsA constitute a physical binary. Therefore, a cross-comparison of their ages is useful.

The new age estimates for Fomalhaut and TW PsA are listed in Table 4. The new isochronal age for Fomalhaut (450 ± 40 Myr) is in good agreement with two recent isochronal estimates: 480 Myr (Rieke et al. 2005) and 419 ± 31 Myr (Zorec & Royer 2012). It is clear that more modern evolutionary tracks and constraints on the H-R diagram position of Fomalhaut are leading to an age twice as old as the classic age (200 Myr; Barrado y Navascues et al. 1997). Figure 1 (bottom) shows a pleasing overlap between the inferred age probability distribution for Fomalhaut (using the Bertelli et al. 2008 tracks) and the gyrochronology and Li ages for TW PsA (the two estimates with the smallest uncertainties). Based on the four independent ages in Table 4, the rounded weighted mean age

Table 4
New Age Estimates for Fomalhaut and TW PsA

Age (Myr)	Method
450 ± 40	Isochrones (Fomalhaut)
410 ± 80	Rotation (TW PsA)
>50	Isochrones (TW PsA)
$\sim 380^{+470}_{-220}$	X-ray (TW PsA)
360 ± 140	Lithium (TW PsA)
440 ± 40	**Final (both)**

for the Fomalhaut–TW PsA system is 440 ± 40 Myr. This new estimate has relative uncertainties $\sim$5$\times$ smaller than the age quoted by Barrado y Navascues et al. (1997) and Barrado y Navascues (1998; 200 ± 100 Myr) and is tied to the contemporary open cluster age scale and modern evolutionary tracks.

A factor of 2$\times$ older age for Fomalhaut has consequences for the predicted brightnesses of substellar companions. Using the Spiegel & Burrows (2012) evolutionary tracks, it appears that a factor of 2$\times$ older age indicates that a given brightness limit at 4.5 μm (or M band) corresponds to thermal emission from a planet roughly 2$\times$ as massive if it were 200 Myr. A 1 M_{Jup} planet of age 200 Myr has absolute magnitude $M_M = 20.4$, but at 440 Myr is approximately 1.2 mag fainter ($M_M = 21.6$). Future searches for thermal emission from exoplanets orbiting Fomalhaut should take into account this older age.

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