TABLE 1
Model Comparison

AICc Qualitative Comparison	Free Parameters	$N_{\rm free}$	$N_{\rm data}$	RMS	$\ln \mathcal{L}$	BIC	AICc	ΔAICc
AICc Favored Model	e_b, K_b, e_c, K_c, e_d, K_d, σ, γ	31	850	13.95	-3374.54	6903.83	6759.15	0.00
Somewhat Disfavored	K_b, e_c, K_c, e_d, K_d, σ, γ	29	850	13.97	-3378.19	6897.63	6762.14	2.99
Ruled Out	K_b, K_c, e_d, K_d, σ, γ	27	850	17.21	-3608.76	7345.29	7219.01	459.86
	e_b, K_b, K_c, e_d, K_d, σ, γ	29	850	17.19	-3607.70	7356.65	7221.16	462.01
	e_b, K_b, e_c, K_c, K_d, σ, γ	29	850	19.24	-3709.24	7559.74	7424.25	665.10
	K_b, e_c, K_c, K_d, σ, γ	27	850	19.28	-3711.65	7551.07	7424.78	665.63
	K_b, K_c, K_d, σ, γ	25	850	21.87	-3835.08	7784.42	7667.37	908.22
	e_b, K_b, K_c, K_d, σ, γ	27	850	21.83	-3833.21	7794.17	7667.89	908.74
	K_b, e_d, K_d, σ, γ	24	850	39.88	-4432.91	8973.34	8860.91	2101.76
	e_b, K_b, e_d, K_d, σ, γ	26	850	39.85	-4431.31	8983.63	8861.96	2102.81
	K_b, e_c, K_c, σ, γ	24	850	43.89	-4573.22	9253.96	9141.53	2382.38
	e_b, K_b, e_c, K_c, σ, γ	26	850	43.86	-4571.26	9263.55	9141.88	2382.73
	K_b, K_c, σ, γ	22	850	45.29	-4633.46	9360.95	9257.78	2498.63
	e_b, K_b, K_c, σ, γ	24	850	45.25	-4631.46	9370.46	9258.02	2498.87
	K_b, K_d, σ, γ	22	850	45.14	-4636.65	9367.34	9264.17	2505.02
	e_b, K_b, K_d, σ, γ	24	850	45.10	-4634.98	9377.49	9265.06	2505.91
	e_c, K_c, e_d, K_d, σ, γ	26	850	52.05	-4931.06	9983.14	9861.46	3102.31
	K_c, e_d, K_d, σ, γ	24	850	52.93	-4971.84	10051.21	9938.78	3179.63
	e_c, K_c, K_d, σ, γ	24	850	54.53	-5047.28	10202.08	10089.65	3330.50
	K_c, K_d, σ, γ	22	850	55.42	-5091.02	10276.08	10172.91	3413.76
	K_b, σ, γ	19	850	56.95	-5170.20	10414.20	10324.96	3565.81
	e_b, K_b, σ, γ	21	850	56.96	-5170.14	10427.57	10329.04	3569.89
	e_d, K_d, σ, γ	21	850	63.21	-5512.78	11112.85	11014.31	4255.16
	e_c, K_c, σ, γ	21	850	65.66	-5647.74	11382.77	11284.24	4525.09
	K_c, σ, γ	19	850	66.45	-5695.16	11464.13	11374.89	4615.74
	K_d, σ, γ	19	850	67.32	-5756.39	11586.58	11497.34	4738.19
	σ, γ	16	850	74.60	-6213.19	12479.95	12404.68	5645.53
	e_b, K_b, e_c, K_c, e_d, K_d, γ	23	850	16.34	-17955.82	36012.43	35904.62	29145.47
	K_b, e_c, K_c, e_d, K_d, γ	21	850	16.41	-18504.53	37096.35	36997.82	30238.67
	e_b, K_b, e_c, K_c, K_d, γ	21	850	21.09	-29960.88	60009.05	59910.52	53151.37
	K_b, e_c, K_c, K_d, γ	19	850	21.58	-30288.53	60650.87	60561.62	53802.47
	e_b, K_b, K_c, e_d, K_d, γ	21	850	20.05	-34882.99	69853.27	69754.74	62995.59
	K_b, K_c, e_d, K_d, γ	19	850	19.99	-37606.85	75287.50	75198.26	68439.11
	e_b, K_b, K_c, K_d, γ	19	850	23.62	-44065.33	88204.46	88115.21	81356.06
	K_b, K_c, K_d, γ	17	850	24.08	-46163.60	92387.50	92307.57	85548.42
	e_b, K_b, e_c, K_c, γ	18	850	46.48	-118197.94	236462.93	236378.33	229619.18
	K_b, e_c, K_c, γ	16	850	45.68	-123471.92	246997.41	246922.14	240162.99
	e_b, K_b, K_c, γ	16	850	47.16	-148458.90	296971.37	296896.09	290136.94
	K_b, K_c, γ	14	850	46.35	-155576.09	311192.25	311126.32	304367.17
	e_b, K_b, e_d, K_d, γ	18	850	44.89	-173218.45	346503.95	346419.36	339660.21
	K_b, e_d, K_d, γ	16	850	49.11	-194799.84	389653.24	389577.97	382818.82
	e_b, K_b, K_d, γ	16	850	49.87	-202780.75	405615.06	405539.79	398780.64
	K_b, K_d, γ	14	850	50.45	-212287.30	424614.67	424548.74	417789.59
	e_c, K_c, e_d, K_d, γ	18	850	56.83	-218152.23	436371.51	436286.92	429527.77
	K_c, e_d, K_d, γ	16	850	58.44	-245622.31	491298.19	491222.92	484463.77
	e_b, K_b, γ	13	850	58.14	-246598.70	493230.73	493169.47	486410.32
	e_c, K_c, K_d, γ	16	850	58.43	-246820.39	493694.35	493619.08	486859.93
	K_b, γ	11	850	57.24	-261025.47	522070.78	522018.90	515259.75
	K_c, K_d, γ	14	850	59.42	-275018.38	550076.83	550010.90	543251.75
	e_d, K_d, γ	13	850	65.72	-353064.51	706162.35	706101.09	699341.94

TABLE 2
MCMC Posteriors

Parameter	Credible Interval	Maximum Likelihood	Units
Modified MCMC Step Parameters			
P_b	$4.61712 \pm 1e-05$	4.61712	days
$T\mathrm{conj}_\mathrm{b}$	2450006.946 ± 0.016	2450006.947	JD
$T\mathrm{peri}_\mathrm{b}$	2450007.2 ± 0.3	2450007.2	JD
e_b	$0.0194^{+0.0083}_{-0.0086}$	0.0209	
ω_b	$1.96^{+0.42}_{-0.4}$	1.93	radians
K_b	$69.94^{+0.57}_{-0.56}$	69.94	m s^{-1}
P_c	$241.21^{+0.035}_{-0.033}$	241.209	days
$T\mathrm{conj}_\mathrm{c}$	$2450069.4^{+1.2}_{-1.6}$	2450069.3	JD
$T\mathrm{peri}_\mathrm{c}$	2450154.3 ± 1.6	2450154.2	JD
e_c	$0.264^{+0.0099}_{-0.01}$	0.26	
ω_c	$-2.153^{+0.044}_{-0.042}$	-2.154	radians
K_c	$55.21^{+0.66}_{-0.64}$	55.28	m s^{-1}
P_d	$1281.05^{+0.54}_{-0.59}$	1281.09	days
$T\mathrm{conj}_\mathrm{d}$	$2450812.5^{+5.8}_{-3.7}$	2450812.8	JD
$T\mathrm{peri}_\mathrm{d}$	$2451340.4^{+5.0}_{-5.3}$	2451340.4	JD
e_d	$0.313^{+0.0089}_{-0.0088}$	0.313	
ω_d	$-1.881^{+0.023}_{-0.026}$	-1.88	radians
K_d	$66.06^{+0.66}_{-0.67}$	66.06	m s^{-1}
Orbital Parameters			
P_b	$4.61712 \pm 1e-05$	4.61712	days
$T\mathrm{conj}_\mathrm{b}$	2450006.946 ± 0.016	2450006.947	JD
$T\mathrm{peri}_\mathrm{b}$	2450007.2 ± 0.3	2450007.2	JD
e_b	$0.0194^{+0.0083}_{-0.0086}$	0.0209	
ω_b	$1.96^{+0.42}_{-0.4}$	1.93	radians
K_b	$69.94^{+0.57}_{-0.56}$	69.94	m s^{-1}
P_c	$241.21^{+0.035}_{-0.033}$	241.209	days
$T\mathrm{conj}_\mathrm{c}$	$2450069.4^{+1.2}_{-1.6}$	2450069.3	JD
$T\mathrm{peri}_\mathrm{c}$	2450154.3 ± 1.6	2450154.2	JD
e_c	$0.264^{+0.0099}_{-0.01}$	0.26	
ω_c	$-2.153^{+0.044}_{-0.042}$	-2.154	radians
K_c	$55.21^{+0.66}_{-0.64}$	55.28	m s^{-1}
P_d	$1281.05^{+0.54}_{-0.59}$	1281.09	days
$T\mathrm{conj}_\mathrm{d}$	$2450812.5^{+5.8}_{-3.7}$	2450812.8	JD
$T\mathrm{peri}_\mathrm{d}$	$2451340.4^{+5.0}_{-5.3}$	2451340.4	JD
e_d	$0.313^{+0.0089}_{-0.0088}$	0.313	
ω_d	$-1.881^{+0.023}_{-0.026}$	-1.88	radians
K_d	$66.06^{+0.66}_{-0.67}$	66.06	m s^{-1}
Other Parameters			
γ_SOPHIE	-28635.9 ± 2.4	-28635.9	m s−1
γ_Levy	$-13.79^{+0.75}_{-0.74}$	-13.81	m s−1
γ_Hamilton	$5.91^{+0.91}_{-0.89}$	5.9	m s−1
γ_HRS	126 ± 1	126	m s−1
γ_HJS	-16.9 ± 2.2	-16.9	m s−1
$\gamma_\mathrm{HIRES-pre}$	$8.57^{+0.97}_{-0.99}$	8.54	m s−1
γ_ELODIE	$-28658.8^{+2.6}_{-2.7}$	-28658.8	m s−1
γ_AFOE	9.6 ± 3.2	9.7	m s−1
$\dot{\gamma}$	$\equiv 0.0$	$\equiv 0.0$	m s^{-1} d^{-1}
$\ddot{\gamma}$	$\equiv 0.0$	$\equiv 0.0$	m s^{-1} d^{-2}
σ_SOPHIE	$16.7^{+2.0}_{-1.6}$	16.2	m s^{-1}
σ_Levy	$9.08^{+0.56}_{-0.52}$	8.88	m s^{-1}
σ_Hamilton	$12.81^{+0.73}_{-0.7}$	12.65	m s^{-1}
σ_HRS	4 ± 1	4	m s^{-1}
σ_HJS	$8.7^{+2.5}_{-2.4}$	8.0	m s^{-1}
$\sigma_\mathrm{HIRES-pre}$	$5.72^{+0.87}_{-0.72}$	5.3	m s^{-1}
σ_ELODIE	$17.9^{+2.2}_{-1.9}$	17.3	m s^{-1}
σ_AFOE	$19.2^{+3.1}_{-2.7}$	18.6	m s^{-1}

TABLE 3
Derived Posteriors

Parameter	Credible Interval	Maximum Likelihood	Units
a_b	$0.05908^{+0.0006}_{-0.00062}$	0.05756	AU
$M_b \sin i$	0.68 ± 0.015	0.647	M_{Jup}
a_c	$0.8259^{+0.0084}_{-0.0086}$	0.8047	AU
$M_c \sin i$	1.935 ± 0.046	1.84	M_{Jup}
a_d	2.515 ± 0.026	2.451	AU
$M_d \sin i$	3.977 ± 0.092	3.777	M_{Jup}

TABLE 4
Summary of Priors

e_b constrained to be < 0.99
e_c constrained to be < 0.99
e_d constrained to be < 0.99
K constrained to be > 0
Bounded prior: $0.0 < \sigma_{\mathrm{AFOE}} < 30.0$
Bounded prior: $0.0 < \sigma_{\mathrm{ELODIE}} < 30.0$
Bounded prior: $0.0 < \sigma_{\mathrm{HIRES-pre}} < 30.0$
Bounded prior: $0.0 < \sigma_{\mathrm{HJS}} < 30.0$
Bounded prior: $0.0 < \sigma_{\mathrm{HRS}} < 30.0$
Bounded prior: $0.0 < \sigma_{\mathrm{Hamilton}} < 30.0$
Bounded prior: $0.0 < \sigma_{\mathrm{Levy}} < 30.0$
Bounded prior: $0.0 < \sigma_{\mathrm{SOPHIE}} < 30.0$

TABLE 5
Final Convergence Criterion

Criterion	Final Value
minAfactor	40.723
maxArchange	0.016
maxGR	1.005
minTz	5585.831

TABLE 6
Radial Velocities

Time (JD)	RV (m s^{-1})	RV Unc. (m s^{-1})	Inst.
2449617.92100	-7.36	7.68	AFOE
2449620.82800	-138.01	11.40	AFOE
2449621.87500	-49.31	12.83	AFOE
2449671.67400	-108.00	19.12	AFOE
2449909.99000	-129.87	14.57	AFOE
2449972.94600	5.33	10.05	AFOE
2449994.95600	-76.46	9.76	AFOE
2449997.98800	-89.85	10.42	AFOE
2450053.69700	-83.41	11.56	AFOE
2450054.76400	-89.32	9.82	AFOE
2450055.68500	-17.12	13.08	AFOE
2450056.75400	4.31	15.58	AFOE
2450057.68500	-12.20	17.96	AFOE
2450291.93300	165.16	12.38	AFOE
2450294.95200	16.87	11.96	AFOE
2450413.79300	25.42	11.78	AFOE
2450418.64500	22.23	9.52	AFOE
2450419.64100	19.14	12.09	AFOE
2450420.68500	114.07	10.66	AFOE
2450465.59700	35.39	10.35	AFOE
2450468.60600	112.51	5.46	AFOE
2450470.65800	76.66	9.03	AFOE
2450647.96800	95.36	8.47	AFOE
2450708.99100	41.79	6.55	AFOE
2450711.01100	80.46	8.21	AFOE
2450711.83800	134.52	8.69	AFOE
2450732.83700	-12.21	15.49	AFOE
2450734.86200	114.47	13.01	AFOE
2450735.92800	97.05	15.76	AFOE
2450738.69500	60.57	9.99	AFOE
2450760.79500	-28.08	9.08	AFOE
2450761.83800	64.52	10.65	AFOE
2450767.76200	124.40	19.89	AFOE
2450769.81700	-15.92	21.72	AFOE
2450831.64500	8.29	9.49	AFOE
2450850.58000	58.61	13.07	AFOE
2451061.88800	-70.25	12.66	AFOE
2451063.92100	-43.32	16.75	AFOE
2451065.96700	-97.18	14.72	AFOE
2451093.93600	-141.33	15.73	AFOE
2451095.83800	-39.77	22.90	AFOE
2451097.84800	-176.76	15.38	AFOE
2451099.86800	-25.74	15.25	AFOE
2451125.81200	-135.65	14.93	AFOE
2451126.71400	-60.96	17.08	AFOE
2451127.77600	8.97	15.47	AFOE
2451155.64400	61.05	12.44	AFOE
2451156.72500	-37.24	14.58	AFOE
2451180.64100	-96.65	25.42	AFOE
2451181.58700	-46.62	10.19	AFOE

Note. — Only the first 50 of 850 RVs are displayed in this table. Use `radvel table -t rv` to save the full LaTeX table as a separate file.

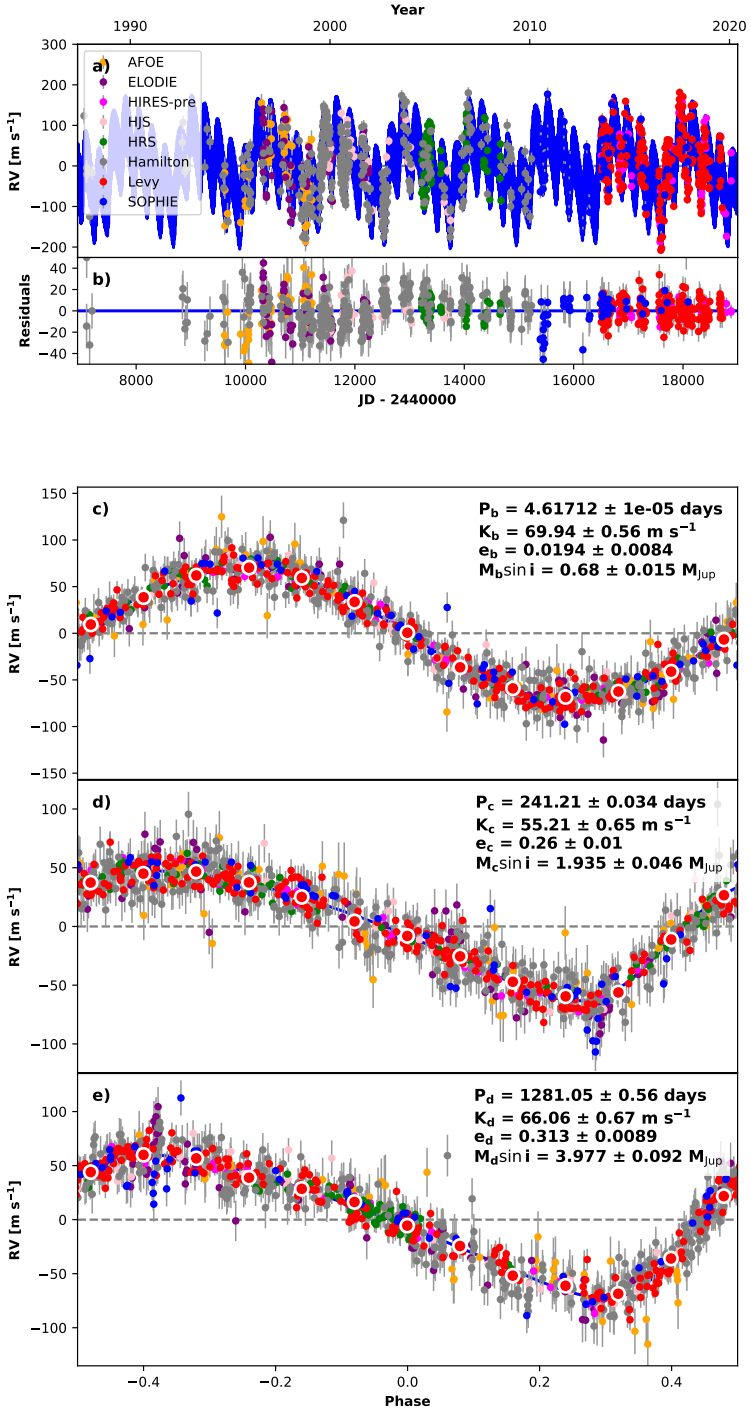

FIG. 1.— Best-fit 3-planet Keplerian orbital model for ups And (HD 9826). The maximum likelihood model is plotted while the orbital parameters listed in Table 2 are the median values of the posterior distributions. The thin blue line is the best fit 3-planet model. We add in quadrature the RV jitter term(s) listed in Table 2 with the measurement uncertainties for all RVs. **b)** Residuals to the best fit 3-planet model. **c)** RVs phase-folded to the ephemeris of planet b. The Keplerian orbital models for all other planets (if any) have been subtracted. The small point colors and symbols are the same as in panel **a**. Red circles (if present) are the same velocities binned in 0.08 units of orbital phase. The phase-folded model for planet b is shown as the blue line.

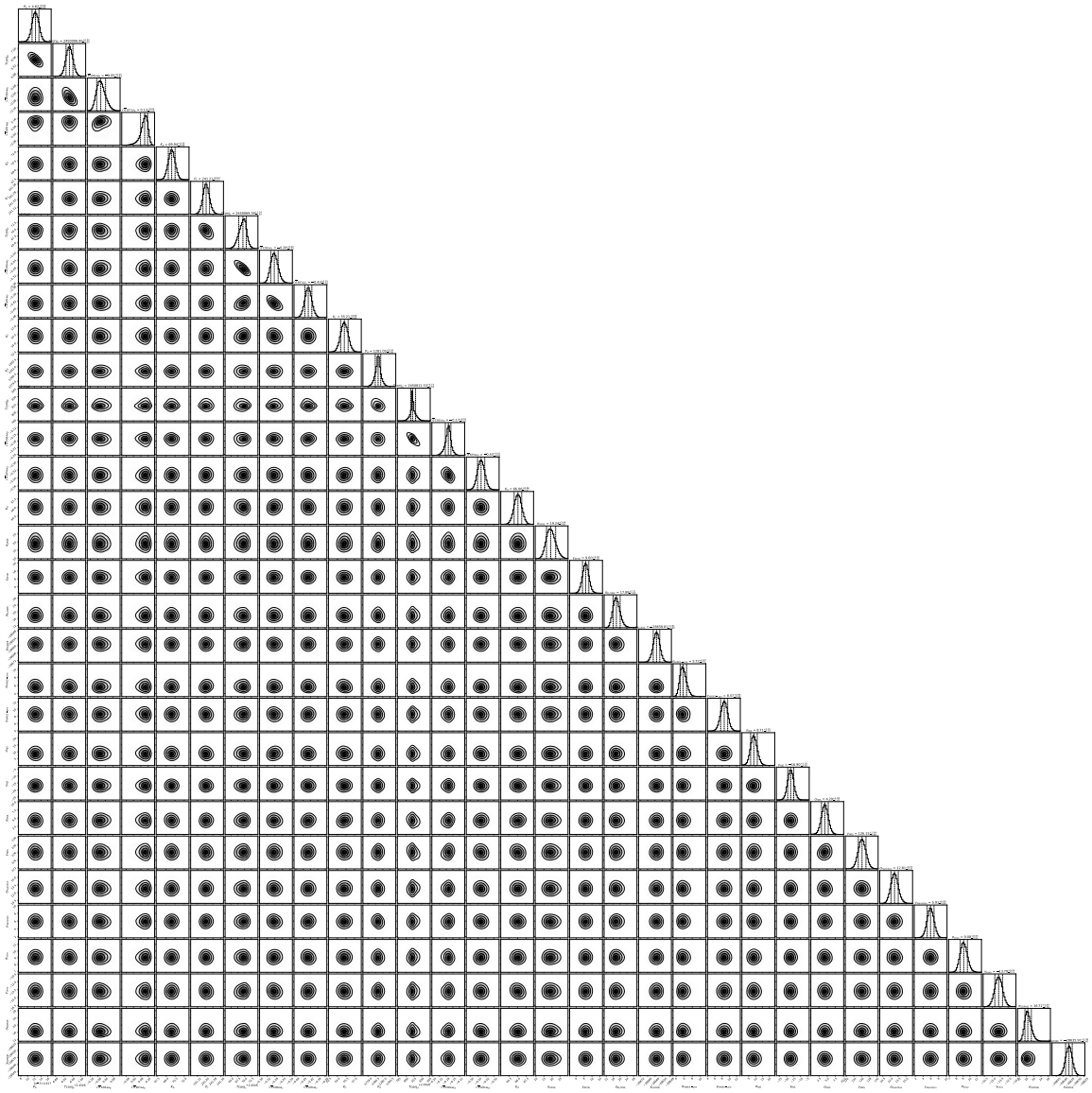

FIG. 2.— Posterior distributions for all free parameters.

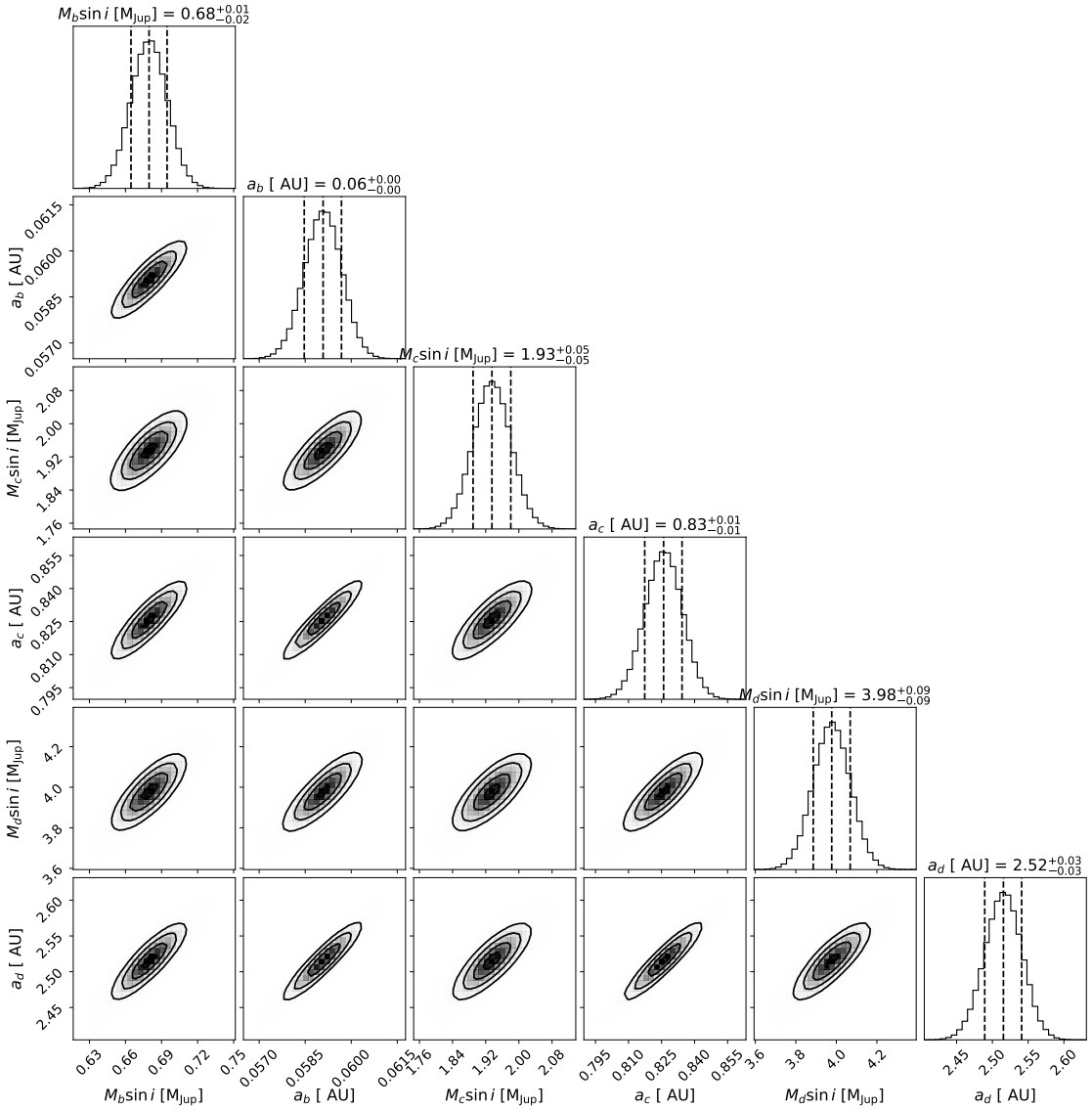

FIG. 3.— Posterior distributions for all derived parameters.