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	29	797	13.77	-3147.78	6441.74	6308.27	0.00
Somewhat Disfavored	K_b, e_c, K_c, e_d, K_d, σ, γ	27	797	13.78	-3151.08	6434.99	6310.57	2.30
Ruled Out	K_b, K_c, e_d, K_d, σ, γ	25	797	16.86	-3366.15	6851.77	6736.43	428.16
	e_b, K_b, K_c, e_d, K_d, σ, γ	27	797	16.85	-3365.34	6863.52	6739.10	430.83
	e_b, K_b, e_c, K_c, K_d, σ, γ	27	797	19.32	-3475.90	7084.62	6960.20	651.93
	K_b, e_c, K_c, K_d, σ, γ	25	797	19.37	-3478.56	7076.58	6961.25	652.98
	K_b, K_c, K_d, σ, γ	23	797	21.90	-3593.46	7293.01	7186.78	878.51
	e_b, K_b, K_c, K_d, σ, γ	25	797	21.86	-3592.09	7303.65	7188.31	880.04
	K_b, e_d, K_d, σ, γ	22	797	39.39	-4136.59	8372.59	8270.92	1962.65
	e_b, K_b, e_d, K_d, σ, γ	24	797	39.38	-4136.00	8384.79	8274.00	1965.73
	e_b, K_b, e_c, K_c, e_d, K_d, γ	22	797	13.95	-4260.04	8619.50	8517.83	2209.56
	K_b, e_c, K_c, e_d, K_d, γ	20	797	13.91	-4278.45	8642.96	8550.43	2242.16
	K_b, e_c, K_c, σ, γ	22	797	44.11	-4292.03	8683.48	8581.81	2273.54
	e_b, K_b, e_c, K_c, σ, γ	24	797	44.11	-4291.90	8696.58	8585.79	2277.52
	K_b, K_d, σ, γ	20	797	45.10	-4342.89	8771.84	8679.31	2371.04
	e_b, K_b, K_d, σ, γ	22	797	45.07	-4341.26	8781.94	8680.27	2372.00
	K_b, K_c, σ, γ	20	797	45.40	-4345.05	8776.16	8683.62	2375.35
	e_b, K_b, K_c, σ, γ	22	797	45.37	-4343.92	8787.26	8685.59	2377.32
	e_c, K_c, e_d, K_d, σ, γ	24	797	52.16	-4623.81	9360.41	9249.63	2941.36
	K_c, e_d, K_d, σ, γ	22	797	53.10	-4664.96	9429.35	9327.68	3019.41
	e_c, K_c, K_d, σ, γ	22	797	54.55	-4728.38	9556.18	9454.50	3146.23
	K_c, K_d, σ, γ	20	797	55.54	-4773.82	9633.70	9541.16	3232.89
	K_b, σ, γ	17	797	57.17	-4853.28	9772.58	9693.79	3385.52
	e_b, K_b, σ, γ	19	797	57.18	-4853.47	9786.31	9698.36	3390.09
	e_d, K_d, σ, γ	19	797	63.34	-5170.20	10419.79	10331.83	4023.56
	e_c, K_c, σ, γ	19	797	65.50	-5279.80	10638.97	10551.01	4242.74
	K_c, σ, γ	17	797	66.39	-5328.99	10724.00	10645.21	4336.94
	K_d, σ, γ	17	797	67.68	-5411.61	10889.25	10810.46	4502.19
	σ, γ	14	797	74.84	-5833.02	11712.01	11647.01	5338.74
	e_b, K_b, K_c, e_d, K_d, γ	20	797	17.08	-6405.59	12897.25	12804.72	6496.45
	K_b, K_c, e_d, K_d, γ	18	797	17.07	-6410.47	12893.64	12810.27	6502.00
	e_b, K_b, e_c, K_c, K_d, γ	20	797	19.98	-7981.73	16049.52	15956.99	9648.72
	K_b, e_c, K_c, K_d, γ	18	797	20.00	-8019.76	16112.21	16028.83	9720.56
	e_b, K_b, K_c, K_d, γ	18	797	22.68	-10353.51	20779.71	20696.34	14388.07
	K_b, K_c, K_d, γ	16	797	22.71	-10383.31	20825.95	20751.75	14443.48
	e_b, K_b, e_d, K_d, γ	17	797	40.53	-31005.70	62077.42	61998.63	55690.36
	K_b, e_d, K_d, γ	15	797	40.57	-31120.04	62292.74	62223.14	55914.87
	K_b, e_c, K_c, γ	15	797	45.34	-38895.36	77843.38	77773.78	71465.51
	e_b, K_b, e_c, K_c, γ	17	797	45.39	-38893.45	77852.91	77774.12	71465.85
	e_b, K_b, K_d, γ	15	797	45.68	-42744.67	85541.99	85472.39	79164.12
	K_b, K_d, γ	13	797	45.74	-42959.02	85957.33	85896.95	79588.68
	e_b, K_b, K_c, γ	15	797	45.92	-43724.53	87501.72	87432.12	81123.85
	K_b, K_c, γ	13	797	45.90	-43760.99	87561.28	87500.89	81192.62
	e_c, K_c, e_d, K_d, γ	17	797	52.84	-54510.56	109087.14	109008.35	102700.08
	K_c, e_d, K_d, γ	15	797	53.60	-56786.08	113624.82	113555.22	107246.95
	e_c, K_c, K_d, γ	15	797	55.13	-59263.23	118579.11	118509.51	112201.24
	K_c, K_d, γ	13	797	56.18	-61590.88	123221.05	123160.67	116852.40
	e_b, K_b, γ	12	797	57.65	-63135.18	126302.97	126247.20	119938.93
	K_b, γ	10	797	57.63	-63187.96	126395.17	126348.64	120040.37
	e_d, K_d, γ	12	797	64.69	-87387.01	174806.64	174750.86	168442.59

TABLE 2
MCMC Posteriors

Parameter	Credible Interval	Maximum Likelihood	Units
Modified MCMC Step Parameters			
P_b	$4.61712 \pm 1e-05$	4.61712	days
$T\mathrm{conj_b}$	$2450006.946^{+0.017}_{-0.016}$	2450006.948	JD
$T\mathrm{peri_b}$	$2450007.22^{+0.34}_{-0.31}$	2450007.23	JD
e_b	$0.0183^{+0.0087}_{-0.0088}$	0.0197	
ω_b	$1.96^{+0.47}_{-0.42}$	1.97	radians
K_b	69.95 ± 0.56	69.96	m s^{-1}
P_c	$241.209^{+0.036}_{-0.035}$	241.209	days
$T\mathrm{conj_c}$	$2450068.8^{+1.4}_{-1.5}$	2450068.8	JD
$T\mathrm{peri_c}$	2450154.3 ± 1.7	2450154.3	JD
e_c	0.26 ± 0.01	0.26	
ω_c	$-2.148^{+0.046}_{-0.045}$	−2.149	radians
K_c	$54.92^{+0.67}_{-0.68}$	55.0	m s^{-1}
P_d	$1281.01^{+0.67}_{-0.64}$	1281.11	days
$T\mathrm{conj_d}$	$2450809.4^{+7.0}_{-4.2}$	2450809.7	JD
$T\mathrm{peri_d}$	$2451343.9^{+5.5}_{-5.8}$	2451343.8	JD
e_d	$0.3144^{+0.009}_{-0.0091}$	0.314	
ω_d	$-1.861^{+0.025}_{-0.03}$	−1.861	radians
K_d	$66.15^{+0.66}_{-0.67}$	66.17	m s^{-1}
Orbital Parameters			
P_b	$4.61712 \pm 1e-05$	4.61712	days
$T\mathrm{conj_b}$	$2450006.946^{+0.017}_{-0.016}$	2450006.948	JD
$T\mathrm{peri_b}$	$2450007.22^{+0.34}_{-0.31}$	2450007.23	JD
e_b	$0.0183^{+0.0087}_{-0.0088}$	0.0197	
ω_b	$1.96^{+0.47}_{-0.42}$	1.97	radians
K_b	69.95 ± 0.56	69.96	m s^{-1}
P_c	$241.209^{+0.036}_{-0.035}$	241.209	days
$T\mathrm{conj_c}$	$2450068.8^{+1.4}_{-1.5}$	2450068.8	JD
$T\mathrm{peri_c}$	2450154.3 ± 1.7	2450154.3	JD
e_c	0.26 ± 0.01	0.26	
ω_c	$-2.148^{+0.046}_{-0.045}$	−2.149	radians
K_c	$54.92^{+0.67}_{-0.68}$	55.0	m s^{-1}
P_d	$1281.01^{+0.67}_{-0.64}$	1281.11	days
$T\mathrm{conj_d}$	$2450809.4^{+7.0}_{-4.2}$	2450809.7	JD
$T\mathrm{peri_d}$	$2451343.9^{+5.5}_{-5.8}$	2451343.8	JD
e_d	$0.3144^{+0.009}_{-0.0091}$	0.314	
ω_d	$-1.861^{+0.025}_{-0.03}$	−1.861	radians
K_d	$66.15^{+0.66}_{-0.67}$	66.17	m s^{-1}
Other Parameters			
γ_{Levy}	$-13.76^{+0.71}_{-0.73}$	−13.77	m s−1
$\gamma_{\mathrm{Hamilton}}$	$5.99^{+0.88}_{-0.91}$	5.94	m s−1
γ_{HRS}	126 ± 1	126	m s−1
γ_{HJS}	-16.9 ± 2.2	−16.9	m s−1
$\gamma_{\mathrm{HIRES-pre}}$	8.58 ± 0.97	8.56	m s−1
γ_{ELODIE}	$-28659.0^{+2.6}_{-2.7}$	−28659.0	m s−1
γ_{AFOE}	9.6 ± 3.3	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_{Levy}	$9.02^{+0.55}_{-0.51}$	8.84	m s^{-1}
$\sigma_{\mathrm{Hamilton}}$	$12.8^{+0.73}_{-0.69}$	12.59	m s^{-1}
σ_{HRS}	4.3 ± 1.1	4.1	m s^{-1}
σ_{HJS}	$8.9^{+2.6}_{-2.3}$	8.2	m s^{-1}
$\sigma_{\mathrm{HIRES-pre}}$	$5.86^{+0.87}_{-0.75}$	5.42	m s^{-1}
σ_{ELODIE}	$18.0^{+2.2}_{-1.9}$	17.4	m s^{-1}
σ_{AFOE}	$19.0^{+3.0}_{-2.6}$	18.4	m s^{-1}

TABLE 3
Derived Posteriors

Parameter	Credible Interval	Maximum Likelihood	Units
a_b	$0.05908^{+0.0006}_{-0.00062}$	0.06	AU
$M_b \sin i$	0.68 ± 0.015	0.7	M_{Jup}
a_c	$0.8259^{+0.0084}_{-0.0086}$	0.8388	AU
$M_c \sin i$	1.927 ± 0.046	1.985	M_{Jup}
a_d	2.515 ± 0.026	2.555	AU
$M_d \sin i$	$3.981^{+0.091}_{-0.092}$	4.081	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: $0.0 < \sigma_{\mathrm{Levy}} < 30.0$

TABLE 5
Final Convergence Criterion

Criterion	Final Value
minAfactor	40.623
maxArchange	0.013
maxGR	1.003
minTz	8717.014

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 797 RVs are displayed in this table. Use `radvel table -t rv` to save the full LaTeX table as a separate file.

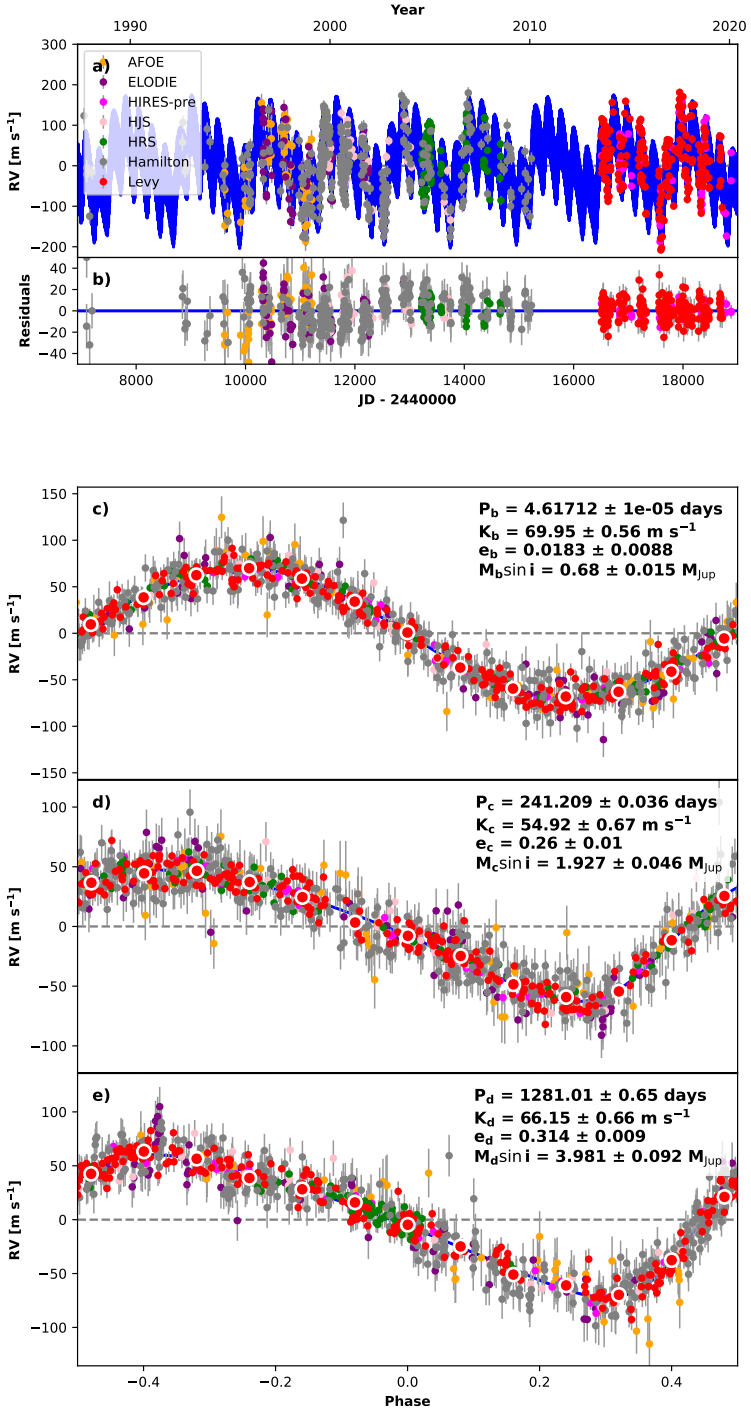

FIG. 1.— Best-fit 3-planet Keplerian orbital model for ups And (HD 9826). The maximum likelihood model is plotted while the orbital parameters listed in Table 2 are the median values of the posterior distributions. The thin blue line is the best fit 3-planet model. We add in quadrature the RV jitter 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.

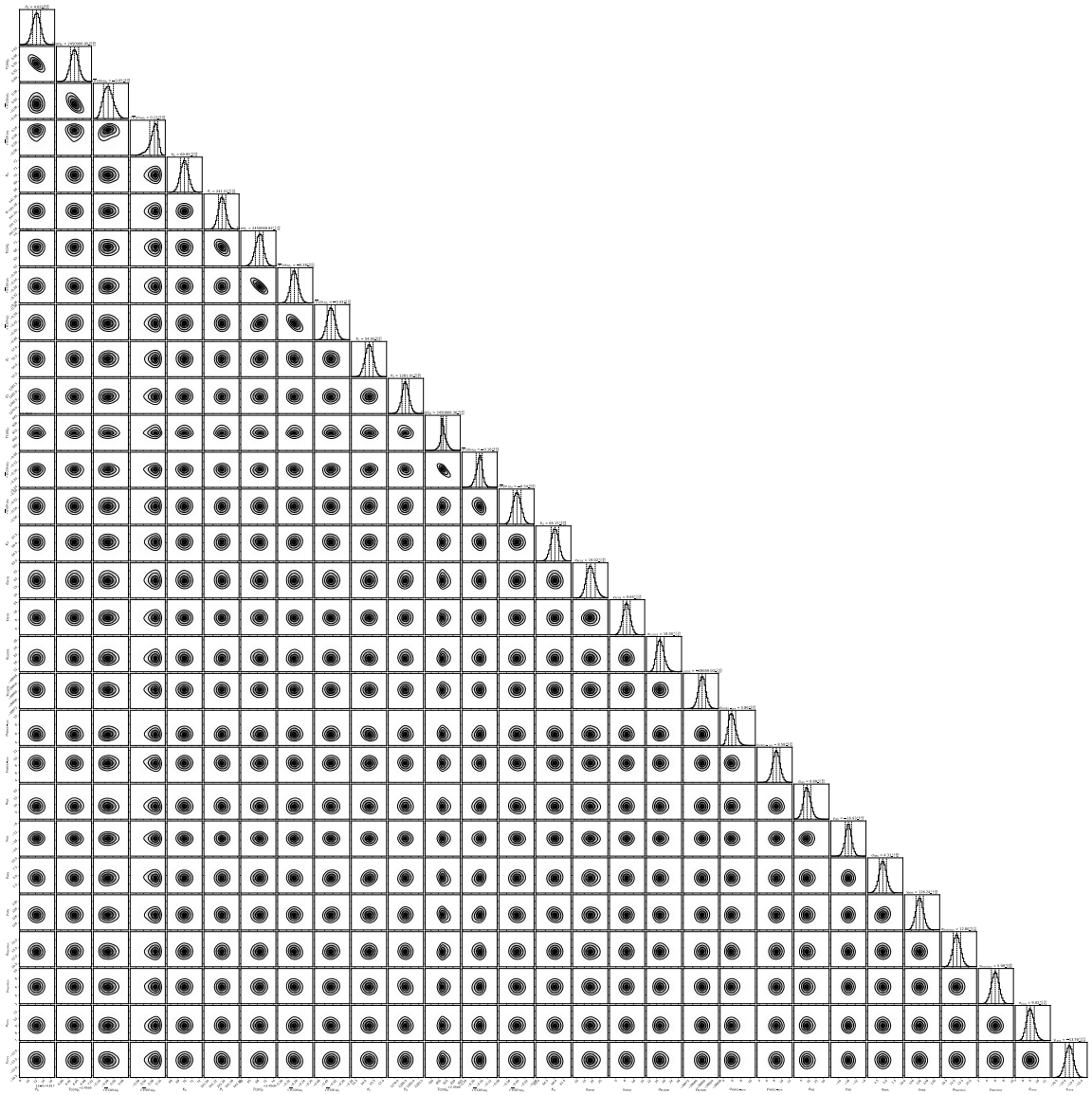

FIG. 2.— Posterior distributions for all free parameters.

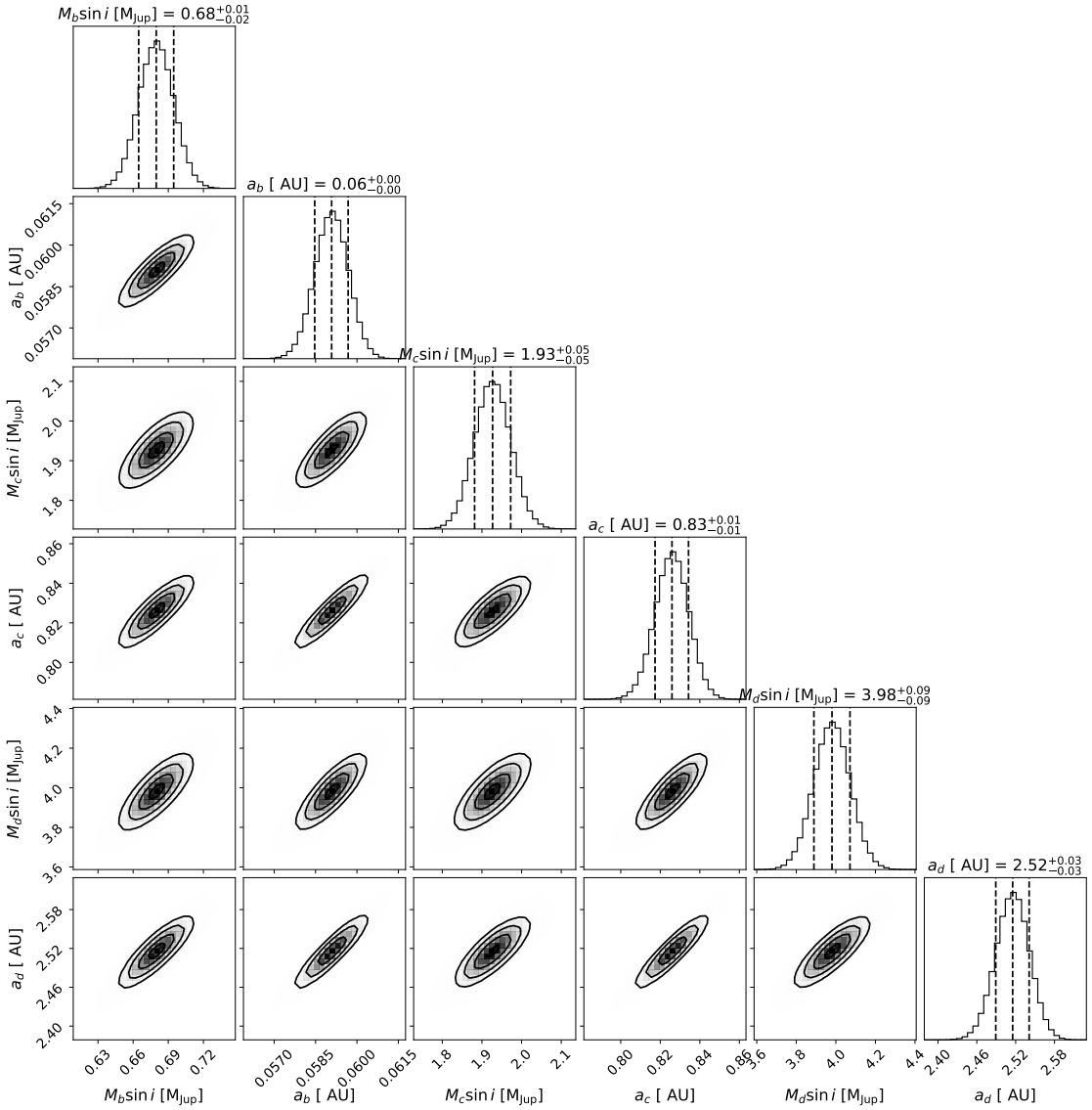

FIG. 3.— Posterior distributions for all derived parameters.