

THE EXPANSION OF PLUTO'S ATMOSPHERE

by

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Table 1 includes summaries of all occultation observations attempted by our group.

Table 1 Summary of Observations

Site: Telescope (aperture, m)	East Longitude (° ' ")	Latitude (° ' ")	Instrument	Wave- length	Recording interval (21 Aug. 2002 UT)	Cycle time (s)	Integration time (s)	SNR*	Observers
Haleakala AEOS (3.6)	-156 15 24	20 42 24	VisIm ¹	Bessel I	06:51:10- 07:04:44	1.4– 2.4‡	1.0–2.0	105	LCR, DTH
Lick Shane (3.0)	-121 38 14	37 20 34	PCCD ²	visible†	06:34:00- 07:03:58	1.0	1.0	16	EWD, CBO
Lowell Perkins (1.8)	-111 32 9	35 05 49	PCCD ²	visible†	06:40:00- 06:47:59	1.5	1.5	53	MWB, BWT, SDK
Mauna Kea IRTF (3.0)	-155 28 19	19 49 34	SpeX ^{3,4}	0.8-2.5 μm	06:29:09- 07:11:20	12.7– 15.5‡	10.0	57	JLE, KBC, JTR
UH (0.6)	-155 28 16	19 49 18	PCCD ^{2,5}	visible†	06:34:26- 07:11:25	7.0– 8.0‡	5.0	24	MJP, SQ
UH (2.2)	-155 28 10	19 49 23	Williams CCD	visible†	06:39:49- 06:59:49	0.5	0.5	103	JMP, BAB, DRT
UKIRT (3.8)	-155 28 13	19 49 21	IRCAM ⁶	H	06:41:12- 06:57:03	3.3– 4.8‡	1.5	39	DJT, DJO, SKL
Palomar Hale (5.1)	-116 51 47	33 21 22	CHISDAS ⁷	visible†	04:58:41- 06:55:21	0.0001	0.0001	57	ASB, SSE, DSM, SEL

Table Mountain

Pomona (1.0)	-117 40 50 34 22 55	Apogee AP47p	visible†	06:14:37- 07:06:14	60.0§	40.0§	2§	BEP, AA
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*"SNR" is the signal-to-noise ratio for the signal from the unocculted star integrated over a time interval corresponding to 60 km (about a scale height) of shadow motion⁸. The SNR for the Lick data was lower than expected from the size of the telescope aperture compared with other sites due to poor observing conditions (5 arc-sec images compared with 0.5 arc-sec images at MKO).

†"visible" means an unfiltered CCD was used, except for CHISDAS, which used an unfiltered PMT with a GaAs photocathode response.

‡Variable cycle times occur for a variety of reasons that will be discussed in a later publication.

§Due to the long cycle and integration times (and low SNR) from this data set we have learned only that the occultation did occur at Table Mountain.

Table 2 includes the astrometric results use to calculate the circular half-light solution from the Mauna Kea and Lick Observatory occultation chords.

Table 2 Astrometric Results

Light Curve	Full Aperture* (arcsec)	Synthetic Aperture† (arcsec)	Mid-time‡ (mm:ss.s ± s.s)	Event	Half-Light Time‡ (mm:ss.s ± s.s)	Sub-Occultation East Longitude§ (deg)	Sub-Occultation Latitude§ (deg)
UH 2.2m	77 □ 58	4.0†	50:33.9 ± 0.3	Im.	47:59.3 ± 0.5	+60.2	-57.0
				Em.	53:08.4 ± 0.5	-76.3	+21.1
UH 0.6m	42 □ 60	3.4†	50:33.3 ± 1.1	Im.	47:57.6 ± 1.6	+60.2	-57.0
				Em.	53:09.0 ± 1.6	-76.3	+21.1
Lick	61 □ 138	4.8‡	45:48.0 ± 1.8	Im.	43:10.9 ± 2.8	+105.2	-18.5
				Em.	48:25.1 ± 2.8	-124.4	+58.4

*The "Full Aperture" is the size of the subframe on the CCD that was recorded.

†"Synthetic Aperture" here denotes either the diameter of the circular region (for the UH telescopes) or side of the square region (for Lick)

centered on the merged image of Pluto-Charon and the star that was summed to generate the occultation light curve.

‡After 06 hours on 21 August 2002 (UT)

§The International Astronomical Union (IAU) coordinate system is used, and the sub-occultation coordinates refer to points on Pluto's limb. At 06:50 the point at the center of Pluto's disk as seen from Earth had sub-Earth Latitude and East Longitude were -28.1° and 38.1° , respectively. The sub-solar Latitude and East Longitude were -29.7° and 39.8° . The closest approach to the center of Pluto's shadow was 597 km for the MKO telescopes and 600 km for Lick; the velocities of Pluto's shadow were 6.8489 km s^{-1} and 6.7293 km s^{-1} for the two sites, respectively. For this astrometric solution, the half-light radius in the shadow is $1213 \pm$

16 km, which compares with 1154 ± 20 km determined from the 1988 data. Assuming no extinction above the half-light levels, these correspond respectively to 1283 ± 9 km and 1214 ± 20 km in Pluto's atmosphere, after correcting for the smaller size of the shadow, due to refraction⁹.

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