

Photometry of Uranus and Neptune, 1972-2016

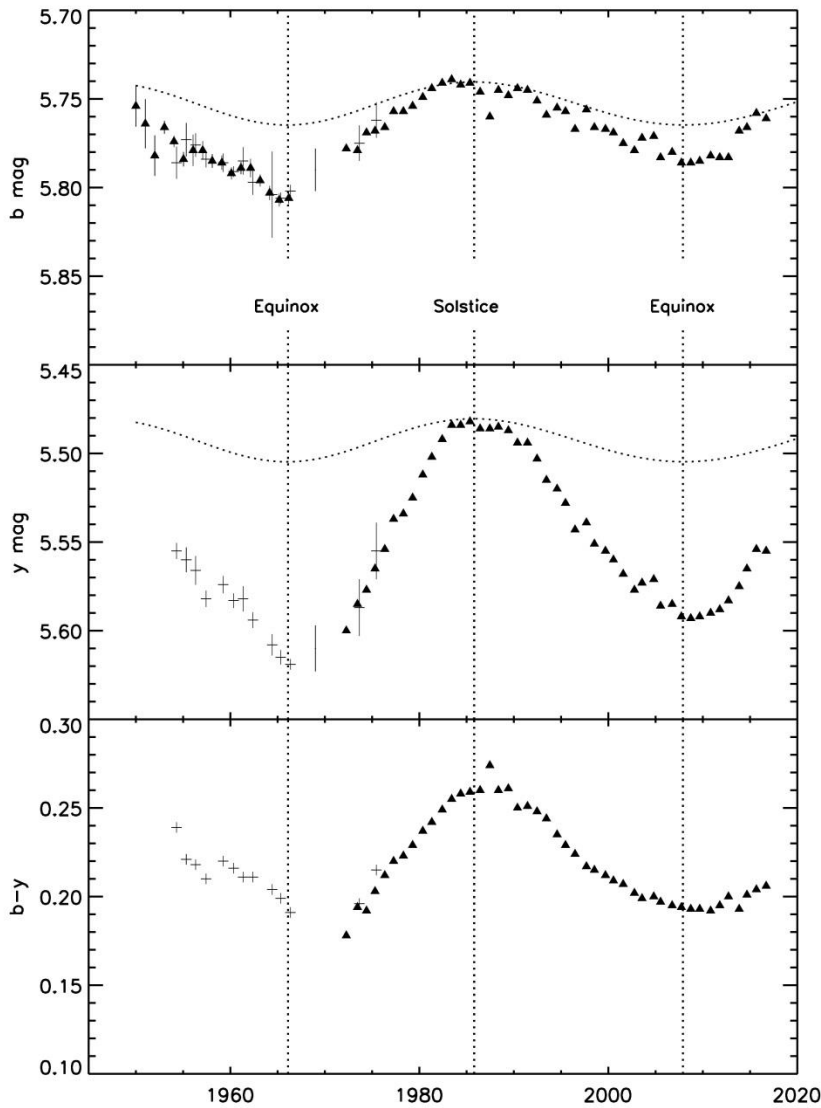
At Lowell Observatory, we have made b (472 nm) and y (551 nm) photometric measurements of Uranus and Neptune at every opposition from 1972 to 2016 (Lockwood 1977, 1978; Lockwood and Thompson 1999, 2002; Lockwood and Jerzykiewicz 2006; Hammel and Lockwood 2007). Each year we observe these planets on at least a few (and sometimes a dozen or more) nights, comparing their brightness with that of two nearby comparison stars of roughly solar color. We adjust the differential magnitudes to a solar phase angle of zero and to standard epoch 1950 heliocentric opposition distances of 19.191 and 30.071 AU, respectively.

Separate observations of a running 5-year string of comparison star pairs including those for a particular apparition tie the system of comparison star magnitudes into our local standard b , y photometric system.

The figures show the light curves in b , y , and $b-y$ color and the tables list the mean opposition magnitudes updated through the 2016 apparition.

References

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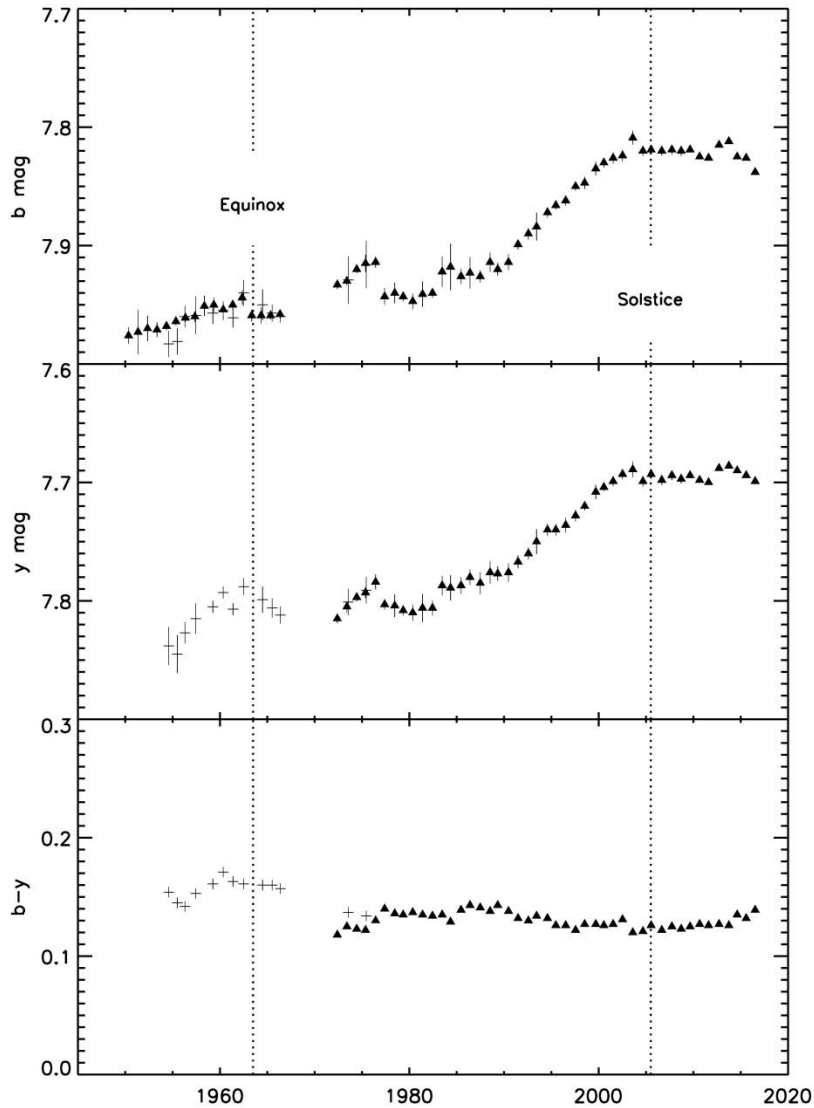
Lightcurve of Uranus. (top) b magnitude. Triangles – differential B magnitudes transformed to b , 1950–1966, and b magnitudes 1972–2016; crosses – B magnitudes from two-color photometry, 1954–1966, 1973, 1975, converted to b (offset by +0.15 year for clarity). (center) y magnitude. Triangles – differential y magnitudes; crosses – V magnitudes 1954–1966, 1973, and 1975 converted to y (offset by +0.15 year for clarity). (bottom) $b-y$ color. Triangles – $b-y$ color; crosses – $B-V$ converted to $b-y$. The dotted line indicates the “geometrical lightcurve” variation due to oblateness and apparent area on the sky as Uranus circles the Sun. All error bars are 2

***b, y* Photometry of Uranus**

Year	J. D. 2,443,000+	n	y mag	Std.dev.	b mag	Std.dev.
1972.27	11414.6	9	5.597	0.006	5.774	0.002
1973.45	11846.2	4	5.580	0.003	5.771	0.003
1974.41*	12196.7	4	5.576	0.003	5.767	0.001
1975.31	12526.5	13	5.564	0.002	5.765	0.004
1976.34	12902.9	10	5.553	0.001	5.763	0.003
1977.27	13242.9	13	5.541	0.004	5.754	0.003
1978.31	13621.8	30	5.533	0.002	5.756	0.003
1979.29	13979.1	22	5.523	0.003	5.753	0.003
1980.36	14372.3	12	5.513	0.003	5.748	0.003
1981.32	14720.8	12	5.504	0.004	5.745	0.002
1982.42	15123.4	7	5.493	0.003	5.742	0.002
1983.42*	15488.4	7	5.484	0.003	5.739	0.005
1984.37	15836.7	8	5.485	0.003	5.740	0.002
1985.36	16197.4	6	5.482	0.002	5.741	0.003
1986.43	16588.8	8	5.485	0.004	5.745	0.004
1987.46*	16964.7	7	5.487	0.009	5.755	0.010
1988.37	17295.3	5	5.483	0.004	5.742	0.002
1989.42	17679.2	6	5.487	0.001	5.747	0.003
1990.39	18032.2	3	5.487	0.126	5.752	0.002
1991.45	18420.9	6	5.493	0.004	5.744	0.004
1992.46	18788.6	7	5.504	0.003	5.751	0.002
1993.45	19151.3	10	5.516	0.005	5.759	0.007
1994.58	19563.8	10	5.520	0.004	5.754	0.004
1995.47	19888.5	10	5.527	0.002	5.756	0.003
1996.48	20257.2	4	5.542	0.007	5.767	0.001
1997.68	20697.4	6	5.539	0.003	5.757	0.002
1998.52	21004.7	7	5.551	0.004	5.766	0.004
1999.70*	21433.5	8	5.555	0.017	5.767	0.019
2000.54	21741.4	9	5.560	0.003	5.769	0.002
2001.57	22119.0	7	5.568	0.002	5.775	0.003
2002.76	22553.2	6	5.577	0.004	5.779	0.003
2003.57	22846.7	7	5.573	0.002	5.772	0.003

2004.81*	23299.7	9	5.571	0.003	5.7771	0.004
2005.53	23563.6	6	5.586	0.003	5.783	0.005
2006.75	24010.4	7	5.585	0.004	5.780	0.004
2007.73	24368.9	6	5.592	0.001	5.786	0.002
2008.73	24731.9	7	5.593	0.003	5.786	0.003
2009.67	25075.8	6	5.592	0.003	5.785	0.003
2010.83	25498.4	6	5.590	0.003	5.782	0.001
2011.79	25851.7	6	5.588	0.001	5.783	0.005
2012.72	26189.2	8	5.583	0.001	5.783	0.002
2013.85	26602.2	4	5.575	0.001	5.768	0.002
2014.62	26902.1	4	5.565	0.002	5.766	0.004
2015.67	27268.1	4	5.554	0.002	5.758	0.002
2016.58	27645.6	4	5.555	0.003	5.761	0.001

*Only one comparison star used for this year



Lightcurve of Neptune. (top) *b* magnitude. Triangles – differential *B* magnitudes transformed to *b*, 1950–1966, and *b* magnitudes 1972–2016; crosses – *B* magnitudes from two-color photometry, 1954–1966, 1973, 1975, converted to *b* (offset by +0.15 year for clarity). (center) *y* magnitude. Triangles – differential *y* magnitudes; crosses – *V* magnitudes 1954–1966, 1973, and 1975 converted to *y* (offset by +0.15 year for clarity). (bottom) *b*-*y* color. Triangles – *b*-*y* color; crosses – *B*-*V* converted to *b*-*y*. All error bars are 2σ

***b, y* Photometry of Neptune**

Year	J. D. 2,443,000+	n	y mag	Std.dev.	b mag	Std.dev.
1972.39	11461.0	12	7.815	0.002	7.933	0.002
1973.40	11829.8	18	7.802	0.004	7.928	0.004
1974.44	12209.5	20	7.797	0.004	7.921	0.003
1975.37	12549.2	8	7.793	0.005	7.915	0.004
1976.44	12937.5	9	7.784	0.005	7.914	0.004
1977.39	13286.2	11	7.803	0.002	7.943	0.004
1978.46	13675.9	20	7.804	0.003	7.940	0.004
1979.35	14001.9	15	7.808	0.005	7.943	0.004
1980.36*	14369.8	9	7.810	0.007	7.947	0.006
1981.40	14749.5	10	7.811	0.004	7.946	0.003
1982.44	15132.0	6	7.806	0.006	7.939	0.002
1983.47	15506.2	7	7.787	0.004	7.921	0.004
1984.35	15828.6	7	7.796	0.003	7.927	0.004
1985.46*	16233.5	7	7.787	0.007	7.925	0.007
1986.41	16580.0	11	7.780	0.009	7.923	0.007
1987.49	16975.3	9	7.785	0.007	7.926	0.006
1988.53*	17354.4	11	7.776	0.011	7.914	0.009
1989.34	17649.8	7	7.777	0.006	7.920	0.004
1990.47	18064.3	39	7.776	0.006	7.915	0.005
1991.48	18432.7	9	7.768	0.005	7.899	0.004
1992.57	18832.0	9	7.760	0.004	7.889	0.004
1993.44	19148.0	8	7.754	0.006	7.884	0.008
1994.59	19568.8	8	7.740	0.005	7.871	0.004
1995.47	19890.6	11	7.740	0.004	7.867	0.003
1996.52	20272.0	9	7.735	0.005	7.862	0.004
1997.56	20651.6	10	7.728	0.004	7.851	0.003
1998.52	21003.1	10	7.721	0.003	7.847	0.004
1999.69	21431.4	8	7.707	0.005	7.835	0.003
2000.55	21743.2	9	7.704	0.003	7.830	0.005
2001.52	22100.7	11	7.699	0.005	7.826	0.003
2002.52	22463.6	7	7.693	0.004	7.824	0.004
2003.60*	22858.2	7	7.689	0.013	7.809	0.012
2004.67	23250.3	9	7.699	0.005	7.820	0.003

2005.54	23566.9	8	7.693	0.003	7.819	0.003
2006.67	23978.6	8	7.698	0.004	7.820	0.003
2007.73	24368.4	6	7.694	0.005	7.819	0.001
2008.71	24725.9	6	7.697	0.002	7.820	0.004
2009.65	25068.5	6	7.694	0.004	7.819	0.003
2010.66	25438.3	7	7.698	0.003	7.825	0.002
2011.60	25782.7	7	7.700	0.005	7.826	0.005
2012.71	26187.7	6	7.688	0.004	7.815	0.004
2013.75	26567.0	4	7.686	0.003	7.812	0.003
2014.62	26886.3	4	7.690	0.005	7.825	0.002
2015.63	27233.5	5	7.694	0.004	7.826	0.005
2016.53	27580.7	5	7.699	0.004	7.838	0.001

*Only one comparison star used for this year

Updated April 2017. Some values from recent years may have changed slightly from those published