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Five Millennium Catalog of Lunar Eclipses

2001 to 2100 (2001 CE to 2100 CE)

Introduction

Eclipses of the Moon can only occur during the Full Moon phase. It is then possible for the Moon to pass through Earth's penumbral or umbral shadows thereby producing an eclipse. There are three types of lunar eclipses:

1. **Penumbral** - Moon traverses Earth's penumbral shadow (Moon misses Earth's umbral shadow)
2. **Partial** - Moon traverses Earth's penumbral and umbral shadows (Moon does not pass completely into Earth's umbra)
3. **Total** - Moon traverses Earth's penumbral and umbral shadows (Moon passes completely into Earth's umbra)

The [visual appearance](#) of these eclipse types differs dramatically from each other.

Lunar Eclipses: 2001 to 2100

During the 21st century CE[1], Earth will experience 228 lunar eclipses. The following table shows the number of eclipses of each type over this period.

Lunar Eclipses: 2001 - 2100

Eclipse Type	Symbol	Number	Percent
All Eclipses	-	228	100.0%
Penumbral	N	86	37.7%
Partial	P	57	25.0%
Total	T	85	37.3%

Total eclipses can be further classified as either *central* or *non-central*:

- **Central** - Some portion of the Moon passes directly through the center of Earth's umbral shadow. These are the deepest and longest type of lunar eclipse.
- **Non-Central** - The Moon passes completely within Earth's umbral shadow but misses the center of the umbra.

The statistical distribution of these classes during the 21st century CE appears in the following table.

Total Eclipses		
Classification	Number	Percent
All	85	100.0%
Central	24	28.2%
Non-Central	61	71.8%

There are a minimum of two and a maximum of five lunar eclipses in every calendar year. Statistics for the number of eclipses each year during the century are listed below.

Number of Years with 2 Eclipses: 78
Number of Years with 3 Eclipses: 16
Number of Years with 4 Eclipses: 6

When four consecutive lunar eclipses are all *total* eclipses, the group is known as a tetrad. The following tetrads occur during this century:

1. **Tetrad: 2003 - 2004**
2. **Tetrad: 2014 - 2015**
3. **Tetrad: 2032 - 2033**
4. **Tetrad: 2043 - 2044**
5. **Tetrad: 2050 - 2051**
6. **Tetrad: 2061 - 2062**
7. **Tetrad: 2072 - 2073**
8. **Tetrad: 2090 - 2091**

During any given century, old [Saros series](#) end while new ones begin. The year and Saros number of these events are as follows:

2 Saros Series' begin (Year/Saros): 2013/150 2096/151
2 Saros Series' end (Year/Saros): 2027/110 2092/111

For more information, see [Catalog of Lunar Eclipse Saros Series](#).

The longest and shortest lunar eclipses of the century and other eclipse extrema are listed below.

Longest Total Lunar Eclipse:	2018 Jul 27	Duration = 01h42m57s
Shortest Total Lunar Eclipse:	2015 Apr 04	Duration = 00h04m43s
Longest Partial Lunar Eclipse:	2021 Nov 19	Duration = 03h28m23s
Shortest Partial Lunar Eclipse:	2082 Feb 13	Duration = 00h25m30s
Largest Total Lunar Eclipse:	2029 Jun 26	Umbra Magnitude = 1.8436
Smallest Total Lunar Eclipse:	2015 Apr 04	Umbra Magnitude = 1.0008
Largest Partial Lunar Eclipse:	2086 Nov 20	Umbra Magnitude = 0.9865
Smallest Partial Lunar Eclipse:	2082 Feb 13	Umbra Magnitude = 0.0134
Largest Penumbral Lunar Eclipse:	2070 Apr 25	Pen. Magnitude = 1.0515
Smallest Penumbral Lunar Eclipse:	2027 Jul 18	Pen. Magnitude = 0.0014

A *total* penumbral eclipse is one in which the entire Moon passes through the penumbra but misses the umbral shadow. During the century, there are 86 penumbral eclipses of which 5 (5.8%) are total penumbral eclipses:

1. Total Penumbral Eclipse:	2006 Mar 14	Pen. Magnitude = 1.0300
2. Total Penumbral Eclipse:	2053 Aug 29	Pen. Magnitude = 1.0191
3. Total Penumbral Eclipse:	2070 Apr 25	Pen. Magnitude = 1.0515
4. Total Penumbral Eclipse:	2082 Aug 08	Pen. Magnitude = 1.0011
5. Total Penumbral Eclipse:	2099 Sep 29	Pen. Magnitude = 1.0340

The concise details at greatest eclipse^[2] for every lunar eclipse during the century are presented below. [Key to Catalog of Lunar Eclipses](#) contains a detailed description and explanation of every item listed in the catalog. The Catalog Number in the first column links to a [figure](#) showing the eclipse geometry and geographic visibility map of each phase of an eclipse.

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[Five Millennium Catalog of Lunar Eclipses](#)

Footnotes

[1] The terms BCE and CE are abbreviations for "Before Common Era" and "Common Era," respectively. They are the secular equivalents to the BC and AD dating conventions. (See: [Year Dating Conventions](#))

[2] Greatest eclipse is defined as the instant when the Moon passes closest to the axis of Earth's umbral shadow cone.

Catalog of Lunar Eclipses: 2001 to 2100 (2001 CE to 2100 CE)

of Cat	Calendar Date	Greatest Eclipse	Greatest Luna Saros Ecl.				TD		Phase	
			Pen.	Par.	Total	Lat.	QSE Type	Gamma	Pen. Mag.	Um. Mag.
Num			---- Durations ----		in Zenith					
			ΔT							
			s	m	m	m				
09651	2001 Jan 09	20:21:40	64	12	134	T	p-	0.3720	2.1618	1.1889
		311.0	196.3	61.0	22N	57E				
09652	2001 Jul 05	14:56:23	64	18	139	P	t-	-0.7287	1.5475	0.4947
		325.1	159.3	-	23S	137E				
09653	2001 Dec 30	10:30:22	64	24	144	N	a-	1.0731	0.8933	-0.1155
		243.5	-	-	24N	157W				
09654	2002 May 26	12:04:26	64	29	111	N	-a	1.1758	0.6893	-0.2888
		216.6	-	-	20S	179E				
09655	2002 Jun 24	21:28:13	64	30	149	N	a-	-1.4439	0.2095	-0.7925
		129.1	-	-	25S	39E				

09656	2002	Nov	20	01:47:40	64	35	116	N	-t	-1.1126	0.8600	-0.2264
					264.3	-	-	19N	30W			
09657	2003	May	16	03:41:13	64	41	121	T	-a	0.4123	2.0747	1.1276
					306.5	193.9	51.4	19S	56W			
09658	2003	Nov	09	01:19:38	64	47	126	T	-t	-0.4319	2.1139	1.0178
					363.2	211.4	22.0	16N	24W			
09659	2004	May	04	20:31:17	65	53	131	T	p-	-0.3132	2.2627	1.3035
					315.7	203.2	75.5	17S	51E			
09660	2004	Oct	28	03:05:11	65	59	136	T	p-	0.2846	2.3637	1.3081
					353.8	218.7	80.5	13N	50W			
09661	2005	Apr	24	09:55:55	65	65	141	N	h-	-1.0885	0.8650	-0.1436
					245.6	-	-	14S	150W			
09662	2005	Oct	17	12:04:27	65	71	146	P	a-	0.9796	1.0585	0.0625
					259.8	56.0	-	10N	175E			
09663	2006	Mar	14	23:48:34	65	76	113	Nx	-t	1.0210	1.0300	-0.0604
					287.5	-	-	3N	6E			
09664	2006	Sep	07	18:52:25	65	82	118	P	-a	-0.9262	1.1329	0.1837
					254.4	91.1	-	7S	77E			
09665	2007	Mar	03	23:21:59	65	88	123	T	-p	0.3175	2.3188	1.2328
					365.4	221.1	73.4	7N	13E			
09666	2007	Aug	28	10:38:27	66	94	128	T-	-p	-0.2145	2.4526	1.4758
					327.3	212.2	90.0	10S	159W			
09667	2008	Feb	21	03:27:09	66	100	133	T	a-	-0.3992	2.1451	1.1062
					339.0	205.4	49.8	10N	48W			
09668	2008	Aug	16	21:11:12	66	106	138	P	t-	0.5646	1.8366	0.8076
					330.5	188.1	-	13S	43E			
09669	2009	Feb	09	14:39:22	66	112	143	N	a-	-1.0640	0.8994	-0.0882
					238.8	-	-	14N	144E			
09670	2009	Jul	07	09:39:43	66	117	110	N	-t	-1.4915	0.1562	-0.9133
					121.5	-	-	24S	143W			

09671	2009 Aug 06	00:40:18	66	118	148	N	t-	1.3572	0.4019	-0.6661
		189.8	-	-		16S	9W			
09672	2009 Dec 31	19:23:46	67	123	115	P	-a	0.9765	1.0556	0.0763
		251.1	60.0	-		24N	70E			
09673	2010 Jun 26	11:39:34	67	129	120	P	-t	-0.7091	1.5773	0.5368
		322.1	162.9	-		24S	174W			
09674	2010 Dec 21	08:18:04	67	135	125	T	-p	0.3214	2.2807	1.2561
		335.1	208.7	72.3		24N	125W			
09675	2011 Jun 15	20:13:43	67	141	130	T+	pp	0.0897	2.6868	1.6999
		336.1	219.3	100.2		23S	57E			
09676	2011 Dec 10	14:32:56	68	147	135	T	p-	-0.3882	2.1860	1.1061
		356.4	212.2	51.1		23N	140E			
09677	2012 Jun 04	11:04:20	68	153	140	P	a-	0.8247	1.3183	0.3704
		270.0	126.6	-		22S	166W			
09678	2012 Nov 28	14:34:07	68	159	145	N	t-	-1.0869	0.9155	-0.1873
		276.0	-	-		20N	139E			
09679	2013 Apr 25	20:08:38	68	164	112	P	-a	-1.0121	0.9866	0.0148
		247.7	27.0	-		14S	57E			
09680	2013 May 25	04:11:06	68	165	150	Nb	a-	1.5350	0.0157	-0.9335
		33.6	-	-		19S	63W			
09681	2013 Oct 18	23:51:25	68	170	117	N	-h	1.1508	0.7649	-0.2718
		239.1	-	-		11N	2W			
09682	2014 Apr 15	07:46:48	69	176	122	T	-a	-0.3017	2.3182	1.2907
		343.9	214.7	77.8		10S	116W			
09683	2014 Oct 08	10:55:44	69	182	127	T	-p	0.3826	2.1456	1.1659
		318.1	199.5	58.8		6N	167W			
09684	2015 Apr 04	12:01:24	69	188	132	T	t-	0.4460	2.0792	1.0008
		357.5	209.0	4.7		5S	179W			
09685	2015 Sep 28	02:48:17	69	194	137	T	p-	-0.3296	2.2296	1.2764

09686	2016 Mar 23	11:48:21	310.7 255.4	199.9 -	71.9 -	2N 0S	44W 175W	N a-	t-	1.1591	0.7747	-0.3118
09687	2016 Sep 16	18:55:27	239.3	-	-	3S	75E	N	a-	-1.0548	0.9080	-0.0635
09688	2017 Feb 11	00:45:03	259.2	-	-	13N	8W	N	-a	-1.0254	0.9884	-0.0354
09689	2017 Aug 07	18:21:38	300.9	115.2	-	15S	86E	P	-t	0.8668	1.2886	0.2464
09690	2018 Jan 31	13:31:00	317.2	202.7	76.1	17N	161E	T	-p	-0.3014	2.2941	1.3155
09691	2018 Jul 27	20:22:54	373.8	234.5	103.0	19S	56E	T+	pp	0.1168	2.6792	1.6087
09692	2019 Jan 21	05:13:27	311.5	196.8	62.0	20N	75W	T	p-	0.3684	2.1684	1.1953
09693	2019 Jul 16	21:31:55	333.7	177.9	-	22S	39E	P	t-	-0.6430	1.7037	0.6531
09694	2020 Jan 10	19:11:11	244.6	-	-	23N	74E	N	a-	1.0726	0.8956	-0.1160
09695	2020 Jun 05	19:26:14	198.2	-	-	21S	69E	N	-a	1.2406	0.5683	-0.4053
09696	2020 Jul 05	04:31:12	165.0	-	-	24S	66W	N	a-	-1.3638	0.3546	-0.6436
09697	2020 Nov 30	09:44:01	261.0	-	-	21N	148W	N	-t	-1.1309	0.8285	-0.2620
09698	2021 May 26	11:19:53	302.0	187.4	14.5	21S	170W	T	-a	0.4774	1.9540	1.0095
09699	2021 Nov 19	09:04:06	361.5	208.4	-	19N	139W	P	-t	-0.4552	2.0720	0.9742
09700	2022 May 16	04:12:42						T-	p-	-0.2532	2.3726	1.4137

318.7 207.2 84.9 19S 64W

Catalog of Lunar Eclipses: 2001 to 2100 (2001 CE to 2100 CE)

of	Cat	Calendar	Greatest	Greatest			Type	QSE	Gamma	Phase	
				Luna	Saros	Ecl.				Pen.	Um.
Num	Date	Eclipse	ΔT	Num	Num	Lat.	Lng.		Mag.	Mag.	
		Pen.	Par.	Total							
		s	m	m		m					
09701	2022 Nov 08	11:00:22	73	282	136	T+	p-	0.2570	2.4143	1.3589	
		353.9	219.8	85.0		17N	169W				
09702	2023 May 05	17:24:05	73	288	141	N	h-	-1.0349	0.9636	-0.0457	
		257.5	-	-		17S	98E				
09703	2023 Oct 28	20:15:18	74	294	146	P	a-	0.9471	1.1181	0.1220	
		264.6	77.4	-		14N	52E				
09704	2024 Mar 25	07:13:59	74	299	113	N	-t	1.0609	0.9557	-0.1325	
		279.1	-	-		1S	106W				
09705	2024 Sep 18	02:45:25	74	305	118	P	-a	-0.9792	1.0372	0.0848	
		246.3	62.8	-		3S	42W				
09706	2025 Mar 14	06:59:56	75	311	123	T	-p	0.3484	2.2595	1.1784	
		362.6	218.3	65.4		3N	102W				
09707	2025 Sep 07	18:12:58	75	317	128	T	-p	-0.2752	2.3440	1.3619	
		326.7	209.4	82.1		6S	87E				

09708	2026 Mar 03	11:34:52	75	323	133	T	a-	-0.3765	2.1838	1.1507
		338.6	207.2	58.3		6N	171W			
09709	2026 Aug 28	04:14:04	75	329	138	P	t-	0.4964	1.9645	0.9299
		337.8	198.1	-		9S	63W			
09710	2027 Feb 20	23:14:06	76	335	143	N	a-	-1.0480	0.9266	-0.0569
		241.0	-	-		10N	15E			
09711	2027 Jul 18	16:04:09	76	340	110	Ne	-t	-1.5758	0.0014	-1.0680
		11.8	-	-		22S	121E			
09712	2027 Aug 17	07:14:59	76	341	148	N	t-	1.2797	0.5456	-0.5254
		218.6	-	-		12S	108W			
09713	2028 Jan 12	04:14:13	76	346	115	P	-a	0.9817	1.0468	0.0662
		250.7	56.0	-		23N	61W			
09714	2028 Jul 06	18:20:57	77	352	120	P	-t	-0.7903	1.4266	0.3892
		310.6	141.5	-		23S	86E			
09715	2028 Dec 31	16:53:15	77	358	125	T	-p	0.3258	2.2742	1.2463
		336.2	208.8	71.3		23N	108E			
09716	2029 Jun 26	03:23:22	77	364	130	T+	pp	0.0124	2.8266	1.8436
		335.1	219.5	101.9		23S	50W			
09717	2029 Dec 20	22:43:12	78	370	135	T	p-	-0.3811	2.2008	1.1174
		358.0	213.3	53.7		23N	19E			
09718	2030 Jun 15	18:34:34	78	376	140	P	a-	0.7534	1.4480	0.5025
		278.2	144.4	-		23S	82E			
09719	2030 Dec 09	22:28:51	78	382	145	N	t-	-1.0731	0.9416	-0.1628
		279.2	-	-		22N	21E			
09720	2031 May 07	03:52:02	78	387	112	N	-a	-1.0694	0.8814	-0.0904
		237.3	-	-		18S	59W			
09721	2031 Jun 05	11:45:17	78	388	150	N	a-	1.4731	0.1292	-0.8199
		95.6	-	-		21S	176W			
09722	2031 Oct 30	07:46:45	79	393	117	N	-h	1.1773	0.7161	-0.3204

				231.8	-	-	15N	121W				
09723	2032	Apr	25	15:14:51	79	399	122	T	-a	-0.3558	2.2192	1.1913
				342.4	211.2	65.5	14S	131E				
09724	2032	Oct	18	19:03:40	79	405	127	T	-p	0.4169	2.0830	1.1028
				315.4	195.9	47.1	10N	71E				
09725	2033	Apr	14	19:13:51	80	411	132	T	t-	0.3954	2.1711	1.0944
				361.2	215.0	49.2	9S	72E				
09726	2033	Oct	08	10:56:23	80	417	137	T	p-	-0.2889	2.3057	1.3497
				312.6	202.4	78.8	6N	167W				
09727	2034	Apr	03	19:06:59	80	423	142	N	t-	1.1144	0.8545	-0.2274
				265.4	-	-	5S	75E				
09728	2034	Sep	28	02:47:37	81	429	147	P	a-	-1.0110	0.9911	0.0144
				248.7	26.7	-	1N	44W				
09729	2035	Feb	22	09:06:12	81	434	114	N	-a	-1.0367	0.9652	-0.0535
				255.7	-	-	9N	133W				
09730	2035	Aug	19	01:12:15	81	440	119	P	-t	0.9433	1.1507	0.1037
				289.8	76.5	-	12S	17W				
09731	2036	Feb	11	22:13:06	82	446	124	T	-p	-0.3110	2.2751	1.2995
				316.1	201.9	74.5	14N	31E				
09732	2036	Aug	07	02:52:32	82	452	129	T+	pp	0.2004	2.5266	1.4544
				372.1	231.3	95.3	16S	41W				
09733	2037	Jan	31	14:01:38	82	458	134	T	p-	0.3619	2.1803	1.2074
				312.1	197.5	63.7	18N	153E				
09734	2037	Jul	27	04:09:53	83	464	139	P	t-	-0.5582	1.8584	0.8095
				340.8	192.4	-	20S	60W				
09735	2038	Jan	21	03:49:52	83	470	144	N	a-	1.0710	0.8996	-0.1140
				245.8	-	-	21N	54W				
09736	2038	Jun	17	02:45:02	83	475	111	N	-a	1.3082	0.4422	-0.5275
				176.3	-	-	22S	41W				
09737	2038	Jul	16	11:35:56	84	476	149	N	a-	-1.2837	0.4999	-0.4952

				192.4	-	-	23S	172W				
09738	2038	Dec	11	17:45:00	84	481	116	N	-t	-1.1448	0.8046	-0.2892
				258.5	-	-	22N	93E				
09739	2039	Jun	06	18:54:25	84	487	121	P	-a	0.5460	1.8272	0.8846
				296.7	179.3	-	22S	77E				
09740	2039	Nov	30	16:56:28	85	493	126	P	-t	-0.4721	2.0418	0.9426
				360.1	206.0	-	21N	104E				
09741	2040	May	26	11:46:22	85	499	131	T-	p-	-0.1872	2.4938	1.5348
				321.4	210.7	92.2	21S	177W				
09742	2040	Nov	18	19:04:40	85	505	136	T+	p-	0.2361	2.4525	1.3974
				353.6	220.4	87.8	20N	70E				
09743	2041	May	16	00:43:03	86	511	141	P	t-	-0.9746	1.0747	0.0645
				269.7	58.5	-	20S	12W				
09744	2041	Nov	08	04:35:05	86	517	146	P	a-	0.9212	1.1656	0.1696
				268.0	90.3	-	18N	73W				
09745	2042	Apr	05	14:30:11	86	522	113	N	-t	1.1080	0.8680	-0.2176
				268.4	-	-	5S	144E				
09746	2042	Sep	29	10:45:47	87	528	118	N	-a	-1.0261	0.9528	-0.0031
				238.5	-	-	2N	163W				
09747	2043	Mar	25	14:32:04	87	534	123	T	-t	0.3849	2.1900	1.1142
				359.3	214.6	53.4	2S	144E				
09748	2043	Sep	19	01:51:50	88	540	128	T	-a	-0.3316	2.2433	1.2556
				325.8	206.0	71.7	2S	29W				
09749	2044	Mar	13	19:38:33	88	546	133	T	a-	-0.3496	2.2303	1.2031
				338.4	209.1	66.4	2N	68E				
09750	2044	Sep	07	11:20:44	88	552	138	T	t-	0.4318	2.0860	1.0456
				344.0	206.2	33.9	5S	171W				

Catalog of Lunar Eclipses: 2001 to 2100 (2001 CE to 2100 CE)

of	Cat	Calendar	Greatest	Greatest				Phase	Pen.	Um.
				Luna	Saros	Ecl.	TD			
Num	Date	Eclipse	ΔT	Num	Num	Type	QSE	Gamma	Mag.	Mag.
		Pen.	Par.	Total	Lat.	Lng.				
		s	m	m	m					
09751	2045 Mar 03	07:43:26	89	558	143	N	a-	-1.0274	0.9623	-0.0168
		243.9	-	-		6N	113W			
09752	2045 Aug 27	13:54:50	89	564	148	N	t-	1.2060	0.6825	-0.3919
		241.7	-	-		9S	152E			
09753	2046 Jan 22	13:02:37	90	569	115	P	-a	0.9885	1.0347	0.0532
		250.0	50.4	-		21N	168E			
09754	2046 Jul 18	01:06:05	90	575	120	P	-t	-0.8691	1.2807	0.2461
		298.1	114.6	-		22S	14W			
09755	2047 Jan 12	01:26:14	90	581	125	T	-p	0.3317	2.2649	1.2341
		337.2	208.9	70.0		22N	19W			
09756	2047 Jul 07	10:35:45	91	587	130	T-	pp	-0.0636	2.7310	1.7513
		333.4	218.5	100.8		23S	157W			
09757	2048 Jan 01	06:53:55	91	593	135	T	p-	-0.3745	2.2141	1.1280
		359.4	214.3	55.9		23N	102W			
09758	2048 Jun 26	02:02:28	92	599	140	P	a-	0.6796	1.5825	0.6388
		285.7	159.2	-		23S	30W			
09759	2048 Dec 20	06:27:48	92	605	145	N	t-	-1.0624	0.9617	-0.1436
		281.6	-	-		22N	97W			

09760	2049	May	17	11:26:39	92	610	112	N	-a	-1.1337	0.7638	-0.2085
				224.3	-	-		21S	172W			
09761	2049	Jun	15	19:14:12	92	611	150	N	a-	1.4068	0.2511	-0.6985
				132.0	-	-		22S	72E			
09762	2049	Nov	09	15:52:11	93	616	117	N	-h	1.1964	0.6808	-0.3553
				226.1	-	-		18N	118E			
09763	2050	May	06	22:32:02	94	622	122	T	-h	-0.4181	2.1052	1.0767
				340.0	206.0	43.2		17S	21E			
09764	2050	Oct	30	03:21:47	95	628	127	T	-p	0.4435	2.0345	1.0538
				313.1	192.9	34.5		14N	54W			
09765	2051	Apr	26	02:16:28	96	634	132	T	p-	0.3371	2.2773	1.2022
				364.8	220.8	69.6		13S	34W			
09766	2051	Oct	19	19:11:50	97	640	137	T-	p-	-0.2542	2.3708	1.4118
				314.2	204.3	83.6		10N	69E			
09767	2052	Apr	14	02:18:06	98	646	142	N	t-	1.0628	0.9466	-0.1305
				276.0	-	-		9S	34W			
09768	2052	Oct	08	10:45:58	99	652	147	P	a-	-0.9726	1.0642	0.0821
				256.6	63.3	-		5N	164W			
09769	2053	Mar	04	17:22:10	99	657	114	N	-a	-1.0530	0.9323	-0.0808
				251.1	-	-		5N	102E			
09770	2053	Aug	29	08:05:50	100	663	119	Nx	-t	1.0164	1.0191	-0.0330
				277.8	-	-		8S	121W			
09771	2054	Feb	22	06:51:27	101	669	124	T	-p	-0.3242	2.2491	1.2769
				314.7	200.9	72.1		10N	99W			
09772	2054	Aug	18	09:26:30	102	675	129	T	pp	0.2806	2.3805	1.3062
				369.5	226.5	82.9		13S	140W			
09773	2055	Feb	11	22:46:17	103	681	134	T	p-	0.3526	2.1970	1.2246
				312.9	198.4	66.0		14N	22E			
09774	2055	Aug	07	10:53:18	104	687	139	P	t-	-0.4769	2.0069	0.9594

				346.3	203.4	-	17S	161W				
09775	2056	Feb	01	12:26:06	105	693	144	N	a-	1.0682	0.9056	-0.1096
				247.2	-	-	18N	177E				
09776	2056	Jun	27	10:03:09	106	698	111	N	-a	1.3769	0.3143	-0.6519
				149.9	-	-	22S	149W				
09777	2056	Jul	26	18:43:24	106	699	149	N	a-	-1.2048	0.6435	-0.3489
				214.4	-	-	20S	81E				
09778	2056	Dec	22	01:48:56	107	704	116	N	-t	-1.1559	0.7857	-0.3109
				256.4	-	-	22N	27W				
09779	2057	Jun	17	02:26:20	108	710	121	P	-a	0.6167	1.6967	0.7555
				290.6	169.3	-	23S	36W				
09780	2057	Dec	11	00:53:38	109	716	126	P	-t	-0.4853	2.0178	0.9181
				358.8	204.0	-	23N	15W				
09781	2058	Jun	06	19:15:48	110	722	131	T-	pp	-0.1181	2.6210	1.6611
				323.6	213.4	97.3	23S	71E				
09782	2058	Nov	30	03:16:18	111	728	136	T+	p-	0.2208	2.4802	1.4260
				353.0	220.7	89.7	22N	52W				
09783	2059	May	27	07:55:35	112	734	141	P	t-	-0.9097	1.1946	0.1829
				281.7	97.2	-	22S	119W				
09784	2059	Nov	19	13:01:36	113	740	146	P	a-	0.9004	1.2037	0.2079
				270.5	99.2	-	20N	161E				
09785	2060	Apr	15	21:37:04	114	745	113	N	-t	1.1621	0.7674	-0.3156
				255.0	-	-	9S	37E				
09786	2060	Oct	09	18:53:32	115	751	118	N	-a	-1.0670	0.8796	-0.0799
				231.3	-	-	6N	74E				
09787	2060	Nov	08	04:04:15	115	752	156	N	a-	1.5332	0.0266	-0.9375
				43.6	-	-	18N	65W				
09788	2061	Apr	04	21:54:05	116	757	123	T	-t	0.4300	2.1044	1.0341
				355.0	209.6	29.9	6S	33E				
09789	2061	Sep	29	09:38:13	117	763	128	T	-a	-0.3810	2.1556	1.1621

					324.8	202.4	59.0	2N	146W			
09790	2062	Mar	25	03:33:50	118	769	133	T	p-	-0.3150	2.2905	1.2695
					338.3	211.3	74.7	2S	52W			
09791	2062	Sep	18	18:34:02	119	775	138	T	p-	0.3735	2.1959	1.1496
					349.3	212.4	59.5	1S	80E			
09792	2063	Mar	14	16:05:49	120	781	143	P	a-	-1.0007	1.0088	0.0342
					247.8	40.6	-	1N	121E			
09793	2063	Sep	07	20:41:12	121	787	148	N	t-	1.1374	0.8101	-0.2678
					260.4	-	-	5S	49E			
09794	2064	Feb	02	21:48:57	122	792	115	P	-a	0.9969	1.0197	0.0377
					249.0	42.5	-	18N	37E			
09795	2064	Jul	28	07:52:48	123	798	120	P	-t	-0.9473	1.1361	0.1038
					284.3	75.7	-	20S	116W			
09796	2065	Jan	22	09:58:58	124	804	125	T	-p	0.3371	2.2561	1.2231
					338.2	209.0	68.8	20N	146W			
09797	2065	Jul	17	17:48:40	125	810	130	T-	pp	-0.1402	2.5890	1.6121
					331.0	216.3	97.0	21S	95E			
09798	2066	Jan	11	15:04:47	126	816	135	T	p-	-0.3687	2.2259	1.1378
					360.7	215.2	57.9	21N	136E			
09799	2066	Jul	07	09:30:29	127	822	140	P	a-	0.6055	1.7179	0.7753
					292.3	171.3	-	22S	141W			
09800	2066	Dec	31	14:30:10	128	828	145	N	t-	-1.0539	0.9773	-0.1281
					283.3	-	-	22N	144E			

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TD

of		Greatest								Phase	
Cat	Calendar	Greatest		Luna Saros Ecl.				Pen.	Um.		
Num	Date	Eclipse	----- Durations -----		in Zenith			Gamma	Mag.	Mag.	
			Pen.	Par.	ΔT	Num	Num				Type
		s		m		m					
09801	2067 May 28	18:56:08	129	833	112	N	-a	-1.2012	0.6403	-0.3329	
		208.5	-	-	-	23S	76E				
09802	2067 Jun 27	02:41:06	129	834	150	N	a-	1.3394	0.3754	-0.5753	
		159.8	-	-	-	22S	39W				
09803	2067 Nov 21	00:04:42	130	839	117	N	-h	1.2106	0.6544	-0.3811	
		221.5	-	-	-	21N	4W				
09804	2068 May 17	05:42:17	131	845	122	P	-t	-0.4851	1.9826	0.9532	
		336.6	199.0	-	-	20S	86W				
09805	2068 Nov 09	11:47:00	132	851	127	T	-p	0.4645	1.9962	1.0149	
		311.2	190.2	18.4	18N	180E					
09806	2069 May 06	09:09:57	133	857	132	T+	pp	0.2717	2.3965	1.3229	
		368.1	226.2	84.3	17S	138W					
09807	2069 Oct 30	03:35:06	134	863	137	T-	p-	-0.2263	2.4235	1.4616	
		315.4	205.6	86.8	14N	57W					
09808	2070 Apr 25	09:21:24	135	869	142	Nx	t-	1.0044	1.0515	-0.0209	
		286.9	-	-	-	12S	140W				
09809	2070 Oct 19	18:51:12	137	875	147	P	a-	-0.9406	1.1258	0.1383	
		263.2	81.7	-	-	9N	74E				
09810	2071 Mar 16	01:31:09	137	880	114	N	-a	-1.0756	0.8879	-0.1194	
		245.1	-	-	-	1N	20W				
09811	2071 Sep 09	15:05:41	138	886	119	N	-t	1.0834	0.8989	-0.1586	

				265.2	-	-	4S	133E				
09812	2072	Mar	04	15:23:07	140	892	124	T	-p	-0.3430	2.2127	1.2441
				313.2	199.4	68.5	6N	133E				
09813	2072	Aug	28	16:05:42	141	898	129	T	-t	0.3563	2.2428	1.1662
				366.0	220.3	64.2	9S	119E				
09814	2073	Feb	22	07:24:53	142	904	134	T	p-	0.3388	2.2218	1.2503
				313.8	199.7	69.2	10N	107W				
09815	2073	Aug	17	17:42:41	143	910	139	T	t-	-0.3998	2.1479	1.1013
				350.5	211.6	50.1	13S	96E				
09816	2074	Feb	11	20:55:58	144	916	144	N	a-	1.0611	0.9191	-0.0972
				249.5	-	-	15N	50E				
09817	2074	Jul	08	17:21:38	145	921	111	N	-a	1.4456	0.1870	-0.7765
				116.6	-	-	21S	101E				
09818	2074	Aug	07	01:56:03	145	922	149	N	a-	-1.1291	0.7813	-0.2091
				232.2	-	-	17S	27W				
09819	2075	Jan	02	09:55:03	146	927	116	N	-t	-1.1642	0.7714	-0.3271
				254.9	-	-	22N	147W				
09820	2075	Jun	28	09:55:35	147	933	121	P	-a	0.6897	1.5624	0.6220
				283.4	157.0	-	23S	147W				
09821	2075	Dec	22	08:55:55	148	939	126	P	-t	-0.4945	2.0008	0.9013
				357.6	202.5	-	23N	134W				
09822	2076	Jun	17	02:39:47	149	945	131	T-	pp	-0.0452	2.7554	1.7943
				325.3	215.1	100.2	23S	39W				
09823	2076	Dec	10	11:34:51	150	951	136	T+	p-	0.2102	2.4990	1.4460
				352.2	220.6	90.8	23N	175W				
09824	2077	Jun	06	14:59:52	151	957	141	P	t-	-0.8387	1.3257	0.3123
				293.6	125.0	-	24S	135E				
09825	2077	Nov	29	21:35:53	152	963	146	P	a-	0.8854	1.2309	0.2356
				272.0	105.0	-	23N	34E				
09826	2078	Apr	27	04:35:44	153	968	113	N	-t	1.2222	0.6558	-0.4246

				238.2	-	-	13S	68W				
09827	2078	Oct	21	03:08:03	154	974	118	N	-a	-1.1021	0.8171	-0.1462
				224.8	-	-	10N	50W				
09828	2078	Nov	19	12:40:04	154	975	156	N	a-	1.5147	0.0615	-0.9047
				66.0	-	-	21N	166E				
09829	2079	Apr	16	05:10:45	155	980	123	P	-t	0.4799	2.0100	0.9451
				350.1	203.4	-	10S	77W				
09830	2079	Oct	10	17:30:30	156	986	128	T	-a	-0.4246	2.0786	1.0791
				323.8	198.7	42.4	7N	95E				
09831	2080	Apr	04	11:23:38	157	992	133	T	p-	-0.2751	2.3607	1.3460
				338.3	213.6	82.1	6S	170W				
09832	2080	Sep	29	01:52:42	158	998	138	T	p-	0.3203	2.2967	1.2443
				353.7	217.4	73.8	3N	30W				
09833	2081	Mar	25	00:22:01	159	1004	143	P	a-	-0.9687	1.0652	0.0953
				252.4	67.1	-	3S	4W				
09834	2081	Sep	18	03:35:26	161	1010	148	N	t-	1.0747	0.9270	-0.1545
				275.7	-	-	1S	55W				
09835	2082	Feb	13	06:29:19	161	1015	115	P	-a	1.0101	0.9955	0.0134
				247.2	25.5	-	14N	93W				
09836	2082	Aug	08	14:46:42	163	1021	120	Nx	-t	-1.0203	1.0011	-0.0294
				269.8	-	-	17S	141E				
09837	2083	Feb	02	18:26:46	164	1027	125	T	-p	0.3463	2.2400	1.2052
				338.9	208.8	66.5	17N	88E				
09838	2083	Jul	29	01:05:34	165	1033	130	T-	pp	-0.2143	2.4520	1.4773
				328.0	212.9	90.4	19S	14W				
09839	2084	Jan	22	23:13:00	166	1039	135	T	p-	-0.3610	2.2407	1.1513
				362.0	216.3	60.5	19N	15E				
09840	2084	Jul	17	16:58:51	167	1045	140	P	a-	0.5312	1.8540	0.9119
				298.1	181.4	-	20S	107E				

09841	2085	Jan 10	22:32:29	168	1051	145	N	t-	-1.0453	0.9927	-0.1119
			284.9	-	-		21N	24E			
09842	2085	Jun 08	02:17:36	169	1056	112	N	-a	-1.2745	0.5065	-0.4682
			188.5	-	-		24S	34W			
09843	2085	Jul 07	10:04:40	169	1057	150	N	a-	1.2694	0.5047	-0.4478
			183.5	-	-		21S	149W			
09844	2085	Dec 01	08:25:35	170	1062	117	N	-a	1.2189	0.6387	-0.3957
			218.5	-	-		23N	128W			
09845	2086	May 28	12:43:47	171	1068	122	P	-t	-0.5585	1.8486	0.8180
			332.0	189.4	-		22S	169E			
09846	2086	Nov 20	20:19:42	172	1074	127	P	-p	0.4799	1.9679	0.9865
			309.5	188.1	-		20N	52E			
09847	2087	May 17	15:55:20	173	1080	132	T+	pp	0.1999	2.5276	1.4554
			371.0	230.6	95.1		19S	121E			
09848	2087	Nov 10	12:05:33	174	1086	137	T-	p-	-0.2043	2.4654	1.5006
			316.4	206.6	88.9		17N	175E			
09849	2088	May 05	16:16:50	175	1092	142	P	t-	0.9387	1.1695	0.1019
			297.9	77.1	-		16S	116E			
09850	2088	Oct 30	03:03:20	177	1098	147	P	a-	-0.9147	1.1761	0.1831
			268.5	93.6	-		13N	49W			

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of					TD		Phase
Cat	Calendar	Greatest	Greatest	Luna Saros Ecl.		Pen.	Um.
			----- Durations -----		in Zenith		

Num	Date	Eclipse	ΔT		Num	Num	Type	QSE	Gamma	Mag.	Mag.
			Pen.	Par.							
			s	m	m	m					
09851	2089 Mar 26	09:34:14	178	1103	114	N	-a	-1.1038	0.8332	-0.1681	
		237.8	-	-		4S	142W				
09852	2089 Sep 19	22:11:17	179	1109	119	N	-t	1.1447	0.7893	-0.2737	
		252.2	-	-		0N	26E				
09853	2090 Mar 15	23:48:31	180	1115	124	T	-p	-0.3674	2.1659	1.2012	
		311.3	197.5	63.0		1N	6E				
09854	2090 Sep 08	22:52:29	181	1121	129	T	-t	0.4257	2.1167	1.0377	
		362.0	213.1	31.9		5S	17E				
09855	2091 Mar 05	15:58:22	182	1127	134	T	p-	0.3212	2.2537	1.2832	
		315.0	201.3	72.9		6N	124E				
09856	2091 Aug 29	00:38:25	183	1133	139	T	t-	-0.3270	2.2810	1.2351	
		353.4	217.5	72.9		10S	8W				
09857	2092 Feb 23	05:20:59	184	1139	144	N	a-	1.0509	0.9383	-0.0789	
		252.4	-	-		11N	76W				
09858	2092 Jul 19	00:41:58	185	1144	111	Ne	-a	1.5131	0.0620	-0.8992	
		67.7	-	-		19S	8W				
09859	2092 Aug 17	09:13:59	185	1145	149	N	a-	-1.0568	0.9131	-0.0757	
		246.7	-	-		14S	136W				
09860	2093 Jan 12	18:00:03	186	1150	116	N	-t	-1.1733	0.7553	-0.3444	
		253.1	-	-		20N	93E				
09861	2093 Jul 08	17:24:18	187	1156	121	P	-a	0.7632	1.4275	0.4872	
		275.3	141.9	-		22S	101E				
09862	2094 Jan 01	17:00:06	188	1162	126	P	-t	-0.5024	1.9858	0.8871	
		356.5	201.2	-		22N	107E				
09863	2094 Jun 28	10:01:57	190	1168	131	T+	pp	0.0288	2.7865	1.8234	

				326.5	215.7	100.6	23S	149W				
09864	2094	Dec	21	19:56:32	191	1174	136	T+	p-	0.2016	2.5138	1.4627
				351.2	220.5	91.6	24N	61E				
09865	2095	Jun	17	22:00:11	192	1180	141	P	t-	-0.7653	1.4617	0.4459
				304.7	146.9	-	24S	31E				
09866	2095	Dec	11	06:15:02	193	1186	146	P	a-	0.8742	1.2510	0.2565
				272.9	108.9	-	24N	95W				
09867	2096	May	07	11:24:42	194	1191	113	N	-t	1.2896	0.5309	-0.5469
				216.9	-	-	16S	171W				
09868	2096	Jun	06	02:43:41	194	1192	151	Nb	t-	-1.5723	0.0047	-1.0584
				21.2	-	-	24S	41W				
09869	2096	Oct	31	11:30:23	195	1197	118	N	-a	-1.1307	0.7666	-0.2006
				219.3	-	-	13N	175W				
09870	2096	Nov	29	21:22:22	195	1198	156	N	a-	1.5017	0.0862	-0.8816
				78.1	-	-	23N	37E				
09871	2097	Apr	26	12:18:17	196	1203	123	P	-t	0.5377	1.9013	0.8420
				344.0	195.2	-	13S	176E				
09872	2097	Oct	21	01:30:55	197	1209	128	T	-a	-0.4608	2.0152	1.0097
				323.1	195.2	15.2	11N	26W				
09873	2098	Apr	15	19:04:48	198	1215	133	T-	p-	-0.2272	2.4454	1.4369
				338.3	215.8	89.0	10S	74E				
09874	2098	Oct	10	09:19:58	200	1221	138	T	pp	0.2749	2.3831	1.3246
				357.4	221.0	82.7	7N	143W				
09875	2099	Apr	05	08:30:56	201	1227	143	P	a-	-0.9304	1.1333	0.1680
				257.7	88.1	-	7S	127W				
09876	2099	Sep	29	10:36:38	202	1233	148	Nx	t-	1.0174	1.0340	-0.0512
				288.3	-	-	3N	161W				
09877	2100	Feb	24	15:05:11	203	1238	115	N	-a	1.0267	0.9649	-0.0170
				244.6	-	-	10N	138E				
09878	2100	Aug	19	21:44:58	204	1244	120	N	-t	-1.0905	0.8716	-0.1575

Index to Five Millennium Catalog of Lunar Eclipses

Each link below displays a web page containing 100 years of lunar eclipses. The data for each eclipse includes the date and time of greatest eclipse, Saros series, eclipse type, quincena solar eclipse parameter, gamma, eclipse magnitudes, and eclipse phase durations. Every eclipse also has links to digrams of eclipse geometry and world visibility, and [Saros](#) series tables.

Five Millennium Catalog of Lunar Eclipses

	-1999 --	-1899 --	-1799 --	-1699 --	-1599 --
	1900	1800	1700	1600	1500
	-1499 --	-1399 --	-1299 --	-1199 --	-1099 --
	1400	1300	1200	1100	1000
	-0999 --	-0899 --	-0799 --	-0699 --	-0599 --
	0900	0800	0700	0600	0500
	-0499 --	-0399 --	-0299 --	-0199 --	-0099 --
Centuries	0400	0300	0200	0100	0000
	0001 - 0100	0101 - 0200	0201 - 0300	0301 - 0400	0401 - 0500
	0501 - 0600	0601 - 0700	0701 - 0800	0801 - 0900	0901 - 1000
	1001-1100	1101-1200	1201-1300	1301-1400	1401-1500
	1501-1600	1601-1700	1701-1800	1801-1900	1901-2000
	2001-2100	2101-2200	2201-2300	2301-2400	2401-2500
	2501-2600	2601-2700	2701-2800	2801-2900	2901-3000

These web pages are part of the [Five Millennium Catalog of Lunar Eclipses: -1999 to +3000](#)

Calendar

The Gregorian calendar is used for all dates from 1582 Oct 15 onwards. Before that date, the Julian calendar is used. For more information on this topic, see [Calendar Dates](#). The Julian calendar does not

include the year 0. Thus the year 1 BCE is followed by the year 1 CE (See: [BCE/CE Dating Conventions](#)). This is awkward for arithmetic calculations. Years in this catalog are numbered astronomically and include the year 0. Historians should note there is a difference of one year between astronomical dates and BCE dates. Thus, the astronomical year 0 corresponds to 1 BCE, and astronomical year -1 corresponds to 2 BCE, etc..

Predictions

Lunar eclipse predictions must take into account the [enlargement of Earth's shadows](#). In this *Catalog*, Earth's penumbral and umbral shadow sizes have been calculated using Danjon's enlargement method.

The coordinates of the Sun used in the predictions are based on the VSOP87 theory [Bretagnon and Francou, 1988]. The Moon's coordinates are based on the ELP-2000/82 theory [Chapront-Touze and Chapront, 1983]. For more information, see: [Solar and Lunar Ephemerides](#). The revised value used for the Moon's [secular acceleration](#) is $\dot{n} = -25.858 \text{ arc-sec/cy}^2$, as deduced from the Apollo lunar laser ranging experiment (Chapront, Chapront-Touze, and Francou, 2002).

The largest uncertainty in the eclipse predictions is caused by fluctuations in [Earth's rotation](#) due primarily to tidal friction of the Moon. The resultant drift in apparent clock time is expressed as ΔT and is determined as follows:

1. **pre-1950's:** ΔT calculated from empirical fits to historical records derived by Morrison and Stephenson (2004)
2. **1955-2006:** ΔT obtained from published observations
3. **Post-2006:** ΔT is extrapolated from current values weighted by the long term trend from tidal effects

A series of [polynomial expressions](#) have been derived to simplify the evaluation of ΔT for any time from -1999 to +3000. The [uncertainty in \$\Delta T\$](#) over this period can be estimated from scatter in the measurements.

Acknowledgments

The data presented here were previously published in:

[Five Millennium Canon of Lunar Eclipses: -1999 to +3000 \(NASA TP-2009-214172\)](#)

[Five Millennium Catalog of Lunar Eclipses: -1999 to +3000 \(NASA TP-2009-214173\)](#)

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