

A Review of Speed of Light Measurements Since 1676

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ABSTRACT

Published measurements of the speed of light in vacuo, and associated measurements of this speed, show no trend of a progressive decrease or increase of this speed.

Measurements of the speed of light settled down to its present accepted value of 299,792 kilometres per second around about 1955. Before then, errors in the estimation of this value, and the use of less sensitive instruments than we have now, resulted in discrepancies in this estimate with values equally above and below the average value obtained until then — this average value being remarkably close to the present verified and re-verified accepted value.

The story is comprehensively presented in a number of publications,^{1,2,3} which also identify the various reasons for the significant discrepancies in the measurements up to 1955.

Froome and Essen⁴ present the information in a number of tables which may be combined to give the information shown in Tables 1 and 2.

It is seen even without any sophisticated statistical analysis, that the data shows no upward or downward trend in the measurements of the speed of light since 1676, noting of course that Roemer's estimation was virtually a seminal, qualitative demonstration that light had a finite speed with respect to a space-interval in the solar system.

It is seen, from the data in Table 1, that 17 measurements are above the currently-accepted measurement of 299,792 kilometres per second, and 19 (including Roemer's) below it, with four measurements equal to it. The situation since 1954 shows only small variations (again without a trend) in the seventh significant figure of the estimations.

If we further consider Table 2 which presents an indirect set of measurements of c_0 , we find that eight of these are greater than 299,792 (km/sec) and nine below it, with

Date	Author	Method	Result (km/sec)	Limits of error
1676	Roemer	Jupiter's satellites	214,000	NA
1726	Bradley	Aberration of stars	301,000	NA
1849	Fizeau	Toothed wheel	315,000	NA
1862	Foucault	Deflection of light by rotating mirror	298,000	±500
1872	Cornu	Toothed wheel	298,500	±900
1874	Cornu	Deflection of light	300,400	±800
1878	Michelson	Deflection of light	300,140	±700
1879	Michelson	Deflection of light	299,910	± 50
1882	Newcomb	Deflection of light	299,810	± 30
1882	Michelson	Deflection of light	299,853	± 60
1891	Blondlot	Lecher wires	297,600	NA
1895	Trowbridge and Duane	Lecher wires	300,300	NA

1897	Saunders	Lecher wires	299,700	NA
1899	Maclean	Free space	299,100	NA
1908	Rose and Dorsey	Toothed wheel	299,901	± 84
1923	Mercier	Lecher wires	299,795	± 30
1924	Michelson	Rotating mirror	299,802	± 30
1926	Michelson	Rotating mirror	299,796	± 4
1928	Karolus and Mittelstaedt	Kerr Cell	299,778	± 20
1935	Michelson, Pease and Pearson	Rotating mirror	299,774	± 11
1937	Anderson	Kerr Cell	299,771	± 12
1940	Hüttel	Kerr Cell	299,768	± 10
1941	Anderson	Kerr Cell	299,776	± 14
1947	Essen and Gordon-Smith	Cavity resonator	299,792	± 3
1947	Smith, Franklin and Whiting	Radar	299,695	± 50
1947	Jones	Radar	299,687*	± 25
1949	Aslakson	Radar	299,792.4	± 2.4
1949	Bergstrand	Geodimeter	299,796	± 2
1949	Jones and Cornford	Radar	299,701*	± 25
1950	Essen	Cavity resonator	299,792.5	± 1
1950	Bergstrand	Geodimeter	299,793.1	± 0.26
1950	McKinley	Quartz modulator	299,780	± 70
1950	Houstoun	Quartz modulator	299,775	± 9
1950	Hansen and Bol	Cavity resonator	299,789.3	± 0.8
1951	Bergstrand	Geodimeter	299,793.1	± 0.4
1951	Aslakson	Radar	299,794.2	± 1.4
1951	Froome	Radio interferometer	299,792.6	± 0.7
1952	Rank, Ruth and Vanden Sluis	Spectral lines	299,776	± 6
1954	Froome	Radio interferometer	299,793.0	± 0.3
		Corrected 1958	299,792.75	± 0.3
1954	Rank, Shearer and Wiggins	Spectral lines	299,789.8	± 3
1954	Florman	Radio interferometer	299,795.1	± 3.1
1955	Schöldström	Geodimeter	299,792.4	± 0.4
1955	Plyler, Blaine and Cannon	Spectral lines	299,792	± 6
1956	Wadley	Tellurometer	299,792.9	± 2.0
			299,792.7	± 2.0
1956	Rank, Bennett and Bennett	Spectral lines	299,791.9	± 2
1956	Edge	Geodimeter	299,792.4	± 0.11
			299,792.2	± 0.13
1957	Wadley	Tellurometer	299,792.6	± 1.2
1958	Froome	Radio interferometer	299,792.5	± 0.1
1966	Karolus	Modulated light beam	299,792.1	± 0.2
		Corrected 1967	299,792.44	± 0.2
1967	Simkin, Lukin, Sikora and Strelenskii		299,792.56	± 0.11

* value in air

Table 1. Speed of light and of electromagnetic radiation in vacuo, from measurements tabulated by Froome and Essen.

no trend at all evident.

In all, this objective data gives absolutely no support to Norman and Setterfield's claim⁵ that the speed of light has been observably decreasing over the last 300 years.

REFERENCES

1. Froome, K. D. and Essen, L., 1969. The Velocity of Light and Radio Waves, Academic Press.

Date	Author	Value (km/sec) <i>in vacuo</i>
1857	Weber and Kohlrausch	310,800
1868	Maxwell	284,300
1869	Thomson and King	280,900
1874	McKichan	289,700
1879	Ayrton and Perry	296,100
1880	Shida	295,600
1883	Thomson, J. J.	296,400
1884	Klemencic	302,000
1888	Himstedt	301,000
1889	Thomson, W.	300,500
1889	Rosa	300,090
1890	Thomson, J. J. and Searle	299,690
1891	Pellat	301,010
1892	Abraham	299,220
1897	Hurmuzescu	300,190
1898	Perot and Fabry	299,870
1899	Lodge and Glazebrook	301,000
1907	Rosa and Dorsey	299,788

Table 2. Estimation of c_0 via the ratio of electromagnetic to electrostatic units.

2. Sanders, J. H., 1965. The Velocity of Light, Pergamon Press.
3. Beardon, J. A. and Thomson, J. S., 1959. American Journal of Physics, 27:569.
4. Froome and Essen, Ref. 1.
5. Norman, T. and Setterfield, B., 1987. The Atomic Constants, Light and Time, Stanford Research Institute International.

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