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CHECKING AN EMPIRICAL FORMULA FOR THE FINE STRUCTURE CONSTANT

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In [1, 2] we suggested an empirical formula for the fine structure constant α^{-1}. The results of calculations by this formula were compared with the available experimental data. A comparison of calculated values with recent experimental data on the fundamental physical constants [3] is presented below.

The formula for the fine structure constant has the form

$$\alpha^{-1} = \frac{\pi\left[\left(\frac{M}{m}\right)^{1/2} + 1 - \frac{1}{\pi\sqrt{2}}\right]}{1 + \frac{m}{\pi\sqrt{2}M}}, \tag{1}$$

where M and m are the proton and electron masses, respectively.

The value α^{-1} calculated from Eq. (1) well coincided with the experimental value reported in [3] from which we borrowed the recent data on the fundamental physical constants.

We note that, as can be seen from formula (1), only the value of the ratio M/m is required for calculations.

The values of α^{-1} calculated from formula (1) and the experimental values $\alpha^{-1}_{\exp}$ are presented in Table 1 together with the ratio M/m used in calculations and the calculation error (given in parentheses). In addition to the data of 2003 [3], Table 1 also presents the data recommended by the international community in 1986 [4] and 1973 [5], that is, more than 30 years ago.

From Table 1 it follows that according to [3], the fine structure constant calculated from Eq. (1) is $\alpha^{-1} = 137.03603882$. This value differs from the experimental value $\alpha^{-1}_{\exp} = 137.03599976$ by $\Delta\alpha^{-1} = 3.9057 \cdot 10^{-5}$; therefore, $\Delta\alpha^{-1}/\alpha^{-1}_{\exp} = 2.8501551 \cdot 10^{-7}$.

We note that Feynman [6] rather skeptically considered empirical dependences. He believed that these formulas could be fast derived using a computer. In our opinion, he was wrong. The main term in the denominator of formula (1) is unity, and the correction is $\frac{m}{\pi\sqrt{2}M} = 1.225 \cdot 10^{-4}$ or approximately $1.2 \cdot 10^{-2}$ %. The correction to unity in the numerator of Eq. (1) is approximately 0.68%. Thus, even the least terms compared to unity included in Eq. (1) exceed by more than 3 orders of magnitude the difference between the experimental and calculated data and hence cannot be adjustable parameters.

The results of calculations of α^{-1} by formula (1) with the experimental data borrowed from [4, 5] are also presented in Table 1 for a comparison. From the data in the table it follows that the ratio $\Delta\alpha^{-1}/\alpha^{-1}_{\exp}$ decreased compared to the preceding value.

Despite the fairly good coincidence of the results obtained from the empirical formula and the experimental values of α^{-1}, it is not obvious now whether the coincidence with the experiment is improved with increasing accuracy of measurements. Cardinal checking of our formulas calls for a precise independent experimental data on the fundamental

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TABLE 1

Year	α^{-1}	$\alpha_{\exp}^{-1}$	M/m
2003	137.03603882	137.03599976(50)	1836.1526675(39)
1986	137.03603604	137.0359895(61)	1836.152701(37)
1973	137.03599675	137.03604(11)	1836.15152(70)

constants α^{-1} and M/m. Whether the coincidence between the calculated and measured values of α^{-1} is better, will become clear only after refinement of the procedure for measuring these constants.

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