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Sir Arthur Eddington[1] developed the fundamental theory for the fine-structure constant $\alpha = e^2/\hbar c$. Basically the theory said that "double phase space" has $4^2(4^2+1)/2 = 136$ real dimensions; hence $\alpha_E = 1/136$. It was later modified to include "Bond's constant,"[1] $\beta = 137/136$, which gives a corrected value of $\alpha_{EB} = 1/136\,\beta = 1/137$. His theory has been variously applied[1,2,3] to predict with great success such things as the ratio of the proton mass to the electron mass, the gravitational constant G, the number of protons and electrons in the universe, and the temperature of absolute zero.

Recently a new mathematical theory for α has been advanced by Wyler,[4,5] which yields the closed-form expression $\alpha_W = (9/8\pi^4)(\pi^5/2^4 5!)^{1/4} = 1/137.036083$. This number is in amazingly good agreement with the current experimental value of $\alpha_{EXP} = 1/(137.03602 \pm 0.00021)$, which is based on a detailed analysis of the fundamental physical constants e, c, and h.[6] It is in even better agreement with the value $\alpha_{WQED} = 1/(137.03610 \pm 0.00022)$, which has been obtained from experiments without quantum electrodynamics.[7]

These results have led to much excitement about the possible validity of the above theories. It is the purpose of this letter to report on the "experimental" discovery, by the use of elementary

methods, of thirteen new closed-form expressions for α. These expressions, along with their numerical values, are presented in Table I. Also shown in Table I for comparison are the previously mentioned values of α. It should be noted that all thirteen new expressions for α have values which are within one-half standard deviation of the two experimental values. It is hoped that these new expressions will lead to the development of even better theories for the fine-structure constant.

References

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Table 1

$$\alpha_{EXP} = 1/(137.03602 \pm .00021)$$

$$\alpha_{WQED} = 1/(137.03610 \pm .00022)$$

α_E	$= 1/136$	
α_{EB}	$= 1/137$	
α_W	$= (9/8\pi^4)(\pi^5/2^4 5!)^{1/4}$	$= 1/137.036083$
α_1	$= (41/4 \cdot 5^5)(7^{1/2}/2^{1/4})$	$= 1/137.035988$
α_2	$= (10/17 \cdot 89) \cdot 2^{1/7}$	$= 1/137.035990$
α_3	$= (2 \cdot 5^2/3 \cdot 37)(\pi/15)^{11/3}$	$= 1/137.036014$
α_4	$= \frac{1}{2}(3/10)^3 (5^{1/4}/\pi^{8/9})$	$= 1/137.036018$
α_5	$= (5/3 \cdot 71)(\pi/8)^{5/4}$	$= 1/137.036021$
α_6	$= (139/10^4)(2^{1/4}/\pi^{5/7})$	$= 1/137.036025$
α_7	$= (10/7 \cdot 11 \cdot 29) \cdot 3^{4/9}$	$= 1/137.036050$
α_8	$= (3/10 \cdot 59)(\pi/2)^{4/5}$	$= 1/137.036057$
α_9	$= (2\pi/199)(1/3)^{4/3}$	$= 1/137.036065$
α_{10}	$= (5/4 \cdot 7 \cdot 41)(\pi/2)^{8/7}$	$= 1/137.036065$
α_{11}	$= 67/(16 \cdot \pi^{9/5} \cdot 5^{8/3}$	$= 1/137.036092$
α_{12}	$= (9/4^5)(3/16)^{1/9}$	$= 1/137.036129$
α_{13}	$= (9/2 \cdot 5^2 \cdot 23)(4/7)^{1/8}$	$= 1/137.036131$

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