letters

A new pastime—calculating alpha to one part in a million

[In August (page 18) we reported on a theoretical calculation by Armand Wyler that yields a value for the fine structure constant agreeing with the best experimental measurement to one half part per million (one third the standard deviation). The report stated that the probability is very small to get such good agreement if one were just to play with numbers. Here are some readers who can successfully dispute this claim.]

Experimental value[1]

$$\alpha^{-1} = 137.03611 \pm 0.00021$$

Wyler's value[2]

$137.036082 = 2^{19/4}3^{-7/4}5^{1/4}\pi^{11/4}$

My values

$137.035938 = 2^{-19/4}3^{10/3}5^{17/4}\pi^{-2}$

$137.036163 = 2^{-13/4}3^{17/4}5^{2/3}\pi^{5/4}$

$137.036120 = 2^{2/3}3^{7/3}5^{11/3}\pi^{-7/2}$

$137.036007 = 2^{5/3}3^{-8/3}5^{5/2}\pi^{7/3}$

$137.036289 = 2^{8/3}3^{3/4}5^{-1/2}\pi^{8/3}$

References

1. T. F. Finnegan, A. Denenstein, D. N. Langenberg, Phys. Rev., in press.
2. A. Wyler, Acad. Sci. Paris, Comptes Rendus *269A*, 743 (1969).

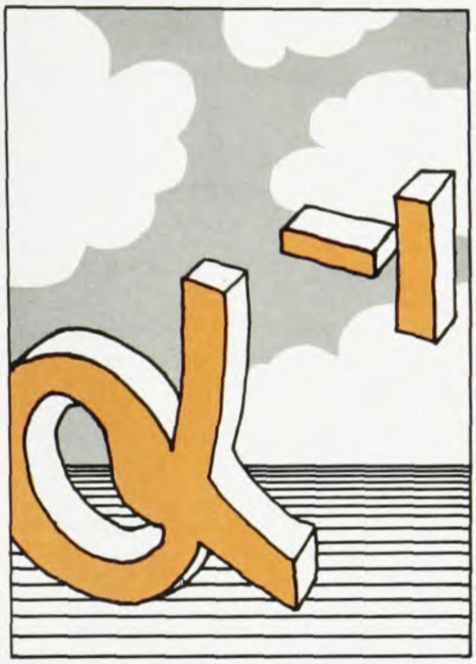
Ralph Roskies
Yale University and Stanford Linear Accelerator Center Stanford, Calif.

The editor comments: Roskies explained to us that he programmed a 360-91 computer to search through all combinations of powers of 2, 3, 5 and π with exponentials between -5 and $+5$ and having a dominator of 1, 2, 3 or 4. The program was to find those combinations that fall within one standard deviation of the experimental value of α. The program ran in less than 30 seconds and found that besides Wyler's there were five other polynomials that performed equally as well.

Another reader, Ivar Giaever (General Electric Research and Development Center, Schenectady) points out to us that

$$(5/2)^{1/2}(2)^{2/3}e^4 = 137.03597 \text{ (within a standard deviation)}$$

and E. D. Reilly, Jr calls attention to a paper he presented at the January APS meeting this year where he showed that



$$4\pi^3 + \pi^2 + \pi = 137.03630 \text{ (also within a standard deviation).}$$

And finally there is the following analysis of the situation:

The report in "Search and Discovery" stated that Wyler's theory might well be correct, because if you just play with numbers such as

$$(2^{19}3^{-7}5\pi^{11})^{1/4} = 137.03608$$

the probability is very small indeed for obtaining the fine structure constant

$$\alpha^{-1} = 137.03602\ (\pm 1.5\ \text{ppm})$$

Surprisingly, *it is not:* The question simply is how closely we can approximate α^{-4} by playing with integral powers of 2, 3, 5 and π. In other words, we have to find integers x, y, z and t such that

$$(1-\delta)\alpha^{-1} < (2^x3^y5^z\pi^t)^{1/4} < (1+\delta)\alpha^{-1}$$

where $\delta = 1.5 \times 10^{-6}$. This can be written as

$$-4(\log\alpha + \delta) < x\log 2 + y\log 3 + z\log 5 + t\log\pi < -4(\log\alpha - \delta)$$

This formula has a very simple geometrical significance: The integers x, y, z, t, form a unit lattice in a four-dimensional space. The expression $x \log 2 + y \log 3 + z \log 5 + t \log \pi$ represents a three-dimensional surface in that space, and the distance between the two limiting surfaces is

$$8\delta[(\log 2)^2 + (\log 3)^2 + (\log 3)^2 + (\log \pi)^2]^{-1/2} = 5.4 \times 10^{-6}$$

by elementary geometry. Therefore, we expect to find, on the average, one lattice point inside the slab, within any three-dimensional area of size 185 000. This is the volume of a sphere of radius 35.

It follows that one could be surprised if he finds a solution for $xyzt$ whose distance from the origin (or from any given point) is *much smaller* than 35. In Wyler's formula however, the distance is

$$(19^2 + 7^2 + 1^2 + 11^2)^{1/2} = 23$$

a number quite comparable to the radius of the sphere expected to contain one lattice point. Thus, we cannot discard the possibility that Wyler's result is a mere numerical coincidence, of the same kind as

$$\pi = 31^{1/3}\ (+67\ \text{ppm}).$$

Asher Peres
Israel Institute of Technology Haifa

The editor comments: Some theorists have told us they feel the above findings weaken the interest in Wyler's calculations. Wyler himself feels that the difference is that his formula is derived from a theoretical formalism which is related to the physical world—the conformal group 0(4,2) which is the natural invariance group of Maxwell equations.

No teaching jobs?

I would like to bring to the attention of those physicists who are considering careers in secondary education (Robert Clark, May, page 9) the possibility that programs like those at The University of Texas at Austin and The University at Wyoming will take them from the frying pan into the fire.

Sections of The University of Wyoming's brochure describing their "Insti-