New Best Values of the Fundamental Constants

Quantity	*1969 value*	*1969 error (ppm)*	*Change from 1963 (ppm)*	*1963 error (ppm)*
$1/\alpha$	137.03602	1.5	−20	4.4
e	$1.6021917 \times 10^{-19}$ coulomb	4.4	+57	12
h	6.26196×10^{-34} joule-second	7.6	+91	24
m	9.109558×10^{-31} kilogram	6.0	+52	14
N	6.022169×10^{26} per kilomole	6.6	−58	15

ference between them.[3] It permits determination without using quantum electrodynamics of the fine-structure constant $\alpha = 2\pi e^2/hc$, electron charge e, electron mass m, Planck's constant h and Avogadro's number N (see table). Then a comparison with values from QED offers a clue to inconsistency of theory or inaccuracy of measurement.

Taylor, Parker and Langenberg begin their paper with a discussion of the constants, the choices one must make in determining them and the accuracy of various experiments they take into account in their evaluation. Then they search for discrepancies and with least-squares adjustments determine a non-QED value of α. With this value they calculate Lamb shifts, fine and hyperfine splittings and magnetic-moment anomalies. A comparison of these values with experiment gives them a test of QED.

With further least-squares adjustments they obtain a final recommended set of constants, and then they conclude their paper with suggestions of further work that might produce more accurate future values. For the next improvement in the fundamental constants, they say, look with particular attention at macroscopic quantum phase-coherence effects in superfluids.

References

1. B. N. Taylor, W. H. Parker, D. N. Langenberg, Rev. Mod. Phys. **41**, 375 (1969); to be published also by Academic Press as a monograph.
2. E. R. Cohen, J. W. M. DuMond, Rev. Mod. Phys. **37**, 537 (1965); J. W. M. DuMond, PHYSICS TODAY **18**, no. 10, 26 (1965).
3. PHYSICS TODAY **20**, no. 4, 66 (1967).

Hermes II Produces 150 000 Amperes of 13-MeV Electrons

Sandia Laboratories is operating a high-intensity electron accelerator, Hermes II, that produces a 150 000-ampere beam of 13 MeV in 100 nanosec. The device has a maximal 1-megajoule energy store and has produced 6000 rad at 1 meter.

The bremsstrahlung output of the device is used to simulate the gamma flash (initial gamma-ray output) from nuclear weapons, and one can simulate the weapons effect on electronic components, according to Thomas H. Martin, who heads electron-beam physics research at Sandia.

Like other recently developed high-intensity electron accelerators (PHYSICS TODAY, June, page 59), Hermes II consists of a Marx generator (that has 186 1.0-microfarad, 100-kV capacitors) and a Blumlein transmission line. The electron beam strikes a tantalum target to produce x rays. The device cost about $900 000.

IN BRIEF

A sector-focused isochronous cyclotron, which produces high-intensity beams of 10–140-MeV protons, was recently dedicated at the University of Maryland.

CW lasers have been pushed further into the ultraviolet. W. T. Silfvast (Bell Labs) built a cadmium laser that operates at 325 nanometers. It can be built and operated with relatively simple techniques, similar to those used in helium–neon lasers, according to Silfvast.

University of Chicago and Illinois Institute of Technology have started a Laboratory of Atmospheric Probing. It will study phenomena ranging from dynamics of severe storms to mechanisms of clear-air turbulence.

A research institute for engineering sciences has been established at Wayne State University in Detroit. The multidisciplinary facility will concentrate on molecular engineering, statistical mechanics and wave propagation. □