

Multichannel Analyzer

World's Smallest

'Pocket MCA'

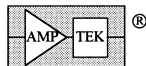


Size: 6.5" x 2.8" x 0.8"
(165mm x 71mm x 20mm)
Weight: <300 grams (including batteries)

The **MCA8000A** is a full featured, low power Multichannel Analyzer intended to be used with a wide variety of detector systems.

- 16k data channels
- Stores up to 128 spectra
- 24 hours of continuous data acquisition from two 1.5V AA batteries
- Conversion time $\leq 5 \mu\text{s}$ ($\geq 200,000$ cps)
- Two stage input analog pipeline
- Differential nonlinearity $< \pm 0.6\%$
Integral nonlinearity $< \pm 0.02\%$
Sliding-scale linearization
- Two peak detection modes:
First peak after threshold (nuclear spectroscopy)
Absolute peak after the threshold (aerosol particle detection)
- Two TTL compatible gates for coincidence & anticoincidence
- Stand-alone data acquisition
- Date-time stamp - Y2K Compliant
- Stored spectra protection via software security & serial ID number
- 115.2 kbps serial interface

Free Windows & DOS software



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figure 2 as it appears today in the museum, no evidence of the explosion exists. The museum is open to the public. See <http://www.haigerloch.de/keller/EKELLER.htm>.

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Born Coined the Term

In the article by Gerald Holton (PHYSICS TODAY, July 2000), the photograph caption on page 39, stating that Werner Heisenberg named the new physics "quantum mechanics," is misleading.

The expression "quantum mechanics" was first used in the scientific literature by Max Born in a 1924 article in which he discussed "the formal passage from classical mechanics to a quantum mechanics."¹

When Heisenberg wrote his famous paper² that laid the foundations of the new theory, he used Born's expression; the term was common in articles by Born, Pascual Jordan, Heisenberg, Wolfgang Pauli, and Paul Dirac that appeared immediately afterward. In particular, Born and Jordan's paper that introduces the subject of matrix mechanics bears the title "On Quantum Mechanics."³

These statements are based on Bartel Leendert van der Waerden's well-known book on the history of quantum mechanics,⁴ which includes English translation of the principal works.

References

1. M. Born, *Zeitschrift für Phys.* **26**, 379 (1924).
2. W. Heisenberg, *Zeitschrift für Phys.* **33**, 879 (1925).
3. M. Born, P. Jordan, *Zeitschrift für Phys.* **34**, 858 (1925).
4. B. L. van der Waerden, *Sources of Quantum Mechanics*, Dover Publications, New York (1967).

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Education Must Capture Student Enthusiasm

The success of the play *Copenhagen* demonstrates once again the public's potential enthusiasm for physics and related societal topics.

Now cut to physics education, where introductory courses dwell on

classical mechanics and electromagnetism with at most a superficial introduction to special relativity and "old" (pre-1925) quantum physics. We seldom hint that Newton's laws are only low-energy approximations to the quantum-relativistic principles that seem to describe the universe, that Newtonian mechanics is not valid for most phenomena, and that an enormous conceptual gulf exists between a Newtonian clockwork mechanism and contemporary physics.

Do physics students experience the depth and excitement elicited by *Copenhagen*? I think not. Do they sense the wonder of the uncertainty principle, or do they, at best, merely run through yet another formulaic calculation involving symbols called delta-x and delta-p? Do they ever hear anything about, say, quantum entanglement, a phenomenon that has perplexed physicists since the 1930s, that is comparable in significance to quantum uncertainty, and about which significant new results have appeared regularly since the 1960s? Even in courses for nonscientists, in which there is no constraint to cover the encyclopedic minutia of Newtonian mechanics, we fill our students' brains with watered-down versions of the "real" physics courses that are based on the manipulation of classical formulas.

We are living in what should be the golden age of physics education. Physics has never been so exciting. We've been given the Big Bang, dark matter, quantum entanglement, and much more. A smash Broadway hit is even based on the subtleties of physics, and of its social implications. We are not required to throw this excitement away when we enter the classroom. Small enrollments, student antipathy to anything titled "physics," and lukewarm public support need not be our fate. By replacing formulaic manipulation with conceptual understanding, and above all by focusing on modern concepts and societal connections, teachers can capture the latent enthusiasm for ideas that is so evident in the success of *Copenhagen*.

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Pantazis Mouroulis (PHYSICS TODAY, November 2000, page 78) writes that teaching "the Big Bang to college sophomores is a bad idea." He goes on to say "Real science courses should be taught only when students have the background to appreciate

and understand the material." To be realistic, however, one first-year or sophomore astronomy course is often the only time we physical scientists get a crack at a student. We have to make the most of that opportunity by describing the most exciting aspects of our fields. Of course, we should be as clear as possible and link the discussion to a wider context and to scientific ways of thought, but if we wait until we "reinstate rigor in science instruction," we will miss the overwhelming majority of students.

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Low-Dose Radiation No Risk to Air Crews

Having read the letters in the April 2000 issue of *PHYSICS TODAY* (page 11) in response to Zbigniew Jaworowski's article "Radiation Risk and Ethics" in the September 1999 issue (page 24), I'd like to add to the discussion. Jet airliner crews receive larger daily ionizing radiation doses from cosmic rays than almost any sector of the US population. This exposure has involved a large number of people over some 40 years.

At 10 000 meters altitude, the cosmic ray intensity is about 2 rem/year. Cockpit crews, those that actually operate the aircraft, are limited by labor rules to about 1000 duty hours per year, which is about 0.12 year. Cabin crews are not so limited; therefore, we assume that they work the usual 40-hour week, or 0.24 year. Jet air crews get at least 0.25 to 0.5 rem/y dose of cosmic radiation in addition to their typical dose of about 0.3 rem/y.¹ They receive elevated ionizing radiation doses greater than 0.5 rem/y.

The rem is the product of the quality factor (QF) times the rads, the energy deposited in tissue. Rads can be measured with a dosimeter; however, the QF is a matter for interpretation. For electromagnetic radiation—x rays, for example—the QF is taken to be 1. The QF for neutrons is open to some dispute, but is often taken to be 10, the argument being that neutrons can induce nuclear reactions that cause additional tissue damage. Cosmic rays are predominantly very energetic protons, which cause spallation reactions in tissue and produce neutrons. The cosmic-ray QF should exceed 1 for the same reasons as it does for

neutrons, yet the author of ref. 1 uses 1 for the cosmic-ray QF.

The era of jet travel was inaugurated with the Boeing 707 in 1958; some jet airliner crew members have retired after 40 years. Many crew members have been women of child-bearing age; they have not produced an excess of children with birth defects. That the insurance industry has not singled out jet airliner crews for increased premiums for life or health coverage suggests that the excess radiation exposure has not posed a health threat. Perhaps it is time to reconsider the effects of low-level radiation exposures.

Reference

1. R. C. Weast, ed., *CRC Handbook of Chemistry and Physics*, vol. 69, CRC Press, Boca Raton (1988), p. F163.

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Math Encoding Gets Extra Credit

In the December 2000 issue of *PHYSICS TODAY* (page 76) you reported that Design Science had acquired WebEQ, a suite of software tools for building dynamic math Web pages based on MathML (Mathematical Markup Language). Unfortunately, your article describes MathML as a "program produced by Wolfram Research," which is incorrect.

MathML is an XML encoding for mathematical expressions standardized through the World Wide Web Consortium (W3C),¹ and was developed by the W3C Math Working Group. While Wolfram Research was represented on the working group, so were many other organizations, including Design Science, Waterloo Maple, IBM, and the American Mathematical Society. Complete working group membership information is available at ref. 2.

References

1. <http://www.w3.org/TR/MathML2>.
2. <http://www.w3.org/TR/MathML2/appendixi.html>.

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Correction

February 2001, page 74—In performing the work that earned her one of the three 2000 Leo Apker Awards, Heather J. Lynch completed her thesis under the supervision of Lydia L. Sohn at Princeton University. ■

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