

electrostatic energy analysis

PRICE BREAK
\$9250



The Comstock System III Electrostatic Energy Analysis System includes Double Focusing Electrostatic Energy Analyzer, Dual Channelplate Detector, Einzel Lens, Analyzer Power Supply and Electrostatic and Magnetic Shield and Mounting Boxes. **All the major components you need for a state-of-the-art Electrostatic Energy Analysis System. Total system price is \$9250. F.O.B. Oak Ridge, TN.**

comstock

P.O. BOX 199 OAK RIDGE, TENNESSEE 37831 (615)483-7690

Circle number 67 on Reader Service Card

HELIUM LEAK DETECTION

Easy to operate, easy to maintain and easy on your budget. These are just some of the reasons that our MD-180 Leak Test Station is the ideal instrument for laboratory, industrial and process applications. This fast, accurate and fail-safe system

incorporates features that make it the most advanced and reliable on the market today.

- The spectrometer tube is tuned automatically—no more fiddling with different controls.
- All valves are operated and interlocked automatically to provide fail-safe operation.
- Instant sensitivity checks can be made without removal of the test piece.
- Modular construction and straightforward design make it easy to maintain.

...The Easy Way



WE INVITE YOU TO
COMPARE THE
MD-180 WITH THE
LEAK DETECTORS
OF OTHER
MANUFACTURERS.
CONTACT US FOR
DETAILS!

VACUUM INSTRUMENT CORPORATION
2099 Ninth Avenue, Ronkonkoma, NY 11779
Tel. 516-737-0900 / Telex 968909

Circle number 68 on Reader Service Card

letters

and UF_6 spectroscopy, involving as it did heavy spherical tops, was the first to reveal the clustering phenomenon fully, but this does not constitute discovery of the effect. Clustering was, in fact, of peripheral concern to our interest in identifying the SF_6 transitions that couple with CO_2 laser radiation, and it was not used in our analysis.

This is no way diminishes Dorney and Watson's discovery and explanation of the effect, nor Harter and Patterson's elegant further development of the theory. Their work has provided a useful semiclassical explanation for why the energy levels of spherical tops behave as they do, and it is currently finding application to the hyperfine structures of high- J rotational states that are now being observed as resolving power increases still further.

References

1. J. Moret-Bailly, *Cah. Phys.* **15**, 237 (1961); *J. Mol. Spectrosc.* **15**, 344, 355 (1965).
2. C. D. Cantrell, H. W. Galbraith, *J. Mol. Spectrosc.* **58**, 158 (1975). H. W. Galbraith, *J. Chem. Phys.* **68**, 1677 (1978).
3. J. P. Aldridge, H. Filip, H. Flicker, R. F. Holland, R. S. McDowell, N. G. Nereson, K. Fox, *J. Mol. Spectrosc.* **58**, 165 (1975).
4. I. Godnev, *Acta Physicochim. URSS* **20**, 189 (1945).
5. B. J. Krohn, Los Alamos Report LA-6554-MS, Los Alamos National Laboratory (1976); *J. Mol. Spectrosc.* **68**, 497 (1977).
6. R. S. McDowell, H. W. Galbraith, B. J. Krohn, C. D. Cantrell, E. D. Hinkley, *Opt. Commun.* **17**, 178 (1976). R. S. McDowell, H. W. Galbraith, C. D. Cantrell, N. G. Nereson, E. D. Hinkley, *J. Mol. Spectrosc.* **68**, 288 (1977).
7. A. J. Dorney, J. K. G. Watson, *J. Mol. Spectrosc.* **42**, 135 (1972).
8. K. Fox, H. W. Galbraith, B. J. Krohn, J. D. Louck, *Phys. Rev. A* **15**, 1363 (1977).

ROBIN S. McDOWELL

10/86 Los Alamos National Laboratory

Quantum Hall neglect

Five years have elapsed since Klaus von Klitzing's discovery of the quantized Hall effect (see *PHYSICS TODAY*, June 1981, page 17; July 1983, page 19; December 1985, page 17), yet little progress has been reported about its theoretical understanding. With all the experts who have had a go at it, one may now well assume that a theory of the effect cannot be a simple reduction to standard quantum methods. While this magazine is not the place to argue the pros and cons of alternatives, it does seem appropriate to call attention to a slight omission in your reporting.

Your reports of June 1981 and July

SHOCK PHYSICS and EXPLOSIVE TECHNOLOGY**SHOCK WAVES IN SOLIDS**

August 24 - 28, 1987
Santa Fe, New Mexico

This course covers essentials of applied continuum dynamics and shock waves in solids. Methods for solving problems in compressible fluid dynamics will be described using analytical and numerical methods. Major topics covered are:

- Shock Matching
- Governing Equations for Continuous Flow
- Theory of Characteristics
- Properties of Shock Waves
- Shock Waves in Elasto-Plastic Solids
- Supersonic Flow
- Regular & Mach Reflections of Shock Waves
- Numerical Methods
- Impact Phenomena

Lecturers: **Dr. J. M. Walsh**
Los Alamos National Laboratory
Dr. Charles L. Mader
Mader Consulting Co.

DETONATION PHYSICS

October 12 - 16, 1987
Makaha, Hawaii

This course is intended for professionals interested in the theoretical, experimental and computational aspects of detonation physics. The essentials of explosive technology, detonation theory, explosive initiation, experimental methods and numerical modeling of detonation are described. Major topics covered are:

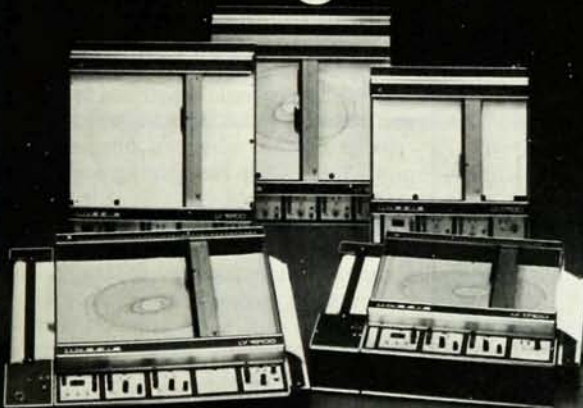
- Explosive Technology
- Detonation Theory
- Shock Physics
- Experimental Methods
- Numerical Modeling
- Reactive Flow, Reaction Zones
- Steady-State Solutions
- Detonation Analogs

Lecturers: **Dr. Charles L. Mader**
Mader Consulting Co.
Dr. Wildon Fickett
Los Alamos National Laboratory
Dr. William C. Davis
Los Alamos National Laboratory

For course brochures and registration information contact:

COMPUTATIONAL MECHANICS ASSOCIATES
SUITE 614, OXFORD BLDG., 8600 LaSALLE ROAD, BALTIMORE, MARYLAND 21239 (301) 821-6189

Looking for HP equivalent
in analog XY's?



The Answer: **LINSEIS**

Toll Free 1-(800)
RECORDER

LINSEIS
THE RECORDER COMPANY

East:
LINSEIS INC., P.O. Box 666,
Princeton, N.J. 08550
Phone: (609) 799-6282
Telex: 843 360

West:
LINSEIS CORP., P.O. Box 10991,
Marina Del Rey, CA 90295
Phone: (213) 306-3112

PICOSECOND—NANOSECOND PULSE GENERATORS



Our free 70 page catalog handbook describes over 100 models of pulse generators, pulse amplifiers, impulse generators, sample and hold amplifiers, delay generators, transformers, power splitters, bias tees and scope probes with specifications covering the following ranges:

- RISE & FALL TIMES TO 60 PSEC
- PW FROM 130 PSEC TO 100 USEC
- PRF FROM 0 TO 300 MHZ
- VOLTAGES FROM 5 TO 350 VOLTS
- PEAK CURRENTS TO 100 AMPS
- DELAYS FROM 10 NSEC TO 100 USEC

AVTECH
ELECTROSYSTEMS
LIMITED

P.O. Box 265 Ogdensburg
New York 13659
(315) 472-5270

P.O. Box 5120 Stn "F"
Ottawa, Canada K2C 3M4
(613) 226-5772
Telex: 053-4591

Germany: MICROSCAN GmbH Hamburg 040/ 63 2003-0
UK: LYONS INSTRUMENTS Huddersfield (0992) 467161
France: EQUIPEMENTS SCIENTIFIQUES Sa Garches 741 90 90
Japan: MEISHO ELECTRONICS Tokyo (03) 816 6581 2

Circle number 69 on Reader Service Card

Circle number 70 on Reader Service Card

letters

1983 mention a major theoretical hurdle that presented itself with the subsequent discovery of fractional quantization at Bell Labs in 1982. Permit me therefore to confront your readers with a published description¹ that quite naturally accommodates the original as well as the fractionally quantized Hall effect.

In my treatment, Hall impedance is expressed as the ratio of the two period

integrals of flux and charge. They are straightforward space-time extensions of the time-honored Aharonov-Bohm² and Gauss-Ampère³ integral laws. A rational fraction is now implied, because the first integral counts the flux units involved, and the second integral counts the electrons involved in this cooperative state of velocity order.

Neither in personal discussions with theorists here nor in their writings have I found any indication that they will even consider the just-cited inte-

gral laws as a replacement for standard quantum procedures. One may presume that Copenhagen convictions stand in the way of their acceptance. However, this would not be the first time in recent years that macroscopic quantum effects have favored an Aharonov-Bohm type description.

Yet more important than the merits or demerits of the cited description is the frightening closed-shop attitude of American physics. I gladly accept the good faith of your reporter; I am not too sure, though, about his sources. The need for proprietary claims and continued funding, so prevalent in American physics, may someday deceive the pursuit of truth.

References

1. E. J. Post, Phys. Lett. A **94**, 343 (1983).
2. E. J. Post, Phys. Lett. A **92**, 224 (1982).
3. E. J. Post, J. Math. Phys. **19**, 374 (1978).

E. J. POST

1/86

Playa Del Rey, California

Two stabilized lasers for the price of one.

It's quite a bargain.

You get a versatile 1 mW HeNe laser with frequency stability.

Or simply turn a key and get a 1 mW HeNe laser with amplitude stability.

All in a single package.

The 117A from Spectra-Physics is a model of simplicity. Stability is attained minutes after turn-on. The laser requires practically no maintenance.


It operates near ambient temperature. And it has a proven hard seal with a typical lifetime of 20,000 hours.

If you're involved in metrology, interferometry, optical testing, holography or related technologies, you'll find the Model 117A a real workhorse.

And, of course, you can't beat the new low price.

For further information contact your local Spectra-Physics sales engineer. Or write for our detailed brochure, Spectra-Physics Laser Products Division, 1250 Middlefield Road, Mountain View, CA 94039-7013. Phone (800) 227-8054.



 **Spectra-Physics**

I recently read Francisco Izaguirre's letter (October, page 15) with regard to the quantized Hall effect, as well as your related story (December 1985, page 17) and Bertrand I. Halperin's article on the topic in *Scientific American* (April 1986, page 52). I was surprised to find no mention of E. J. Post's work, which is based on topological arguments.¹

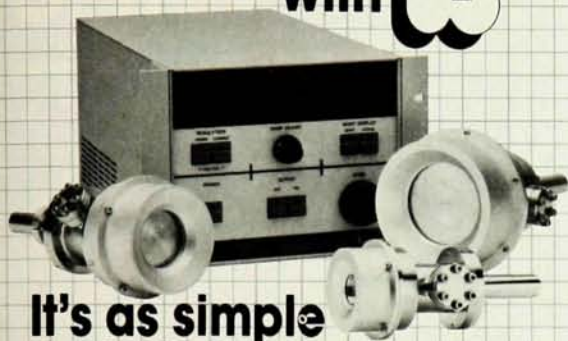
As Halperin and Izaguirre point out, the fractional Hall effect is surprising to many because it does not appear to be sensitive to size, shape or material. There exist a number of such physical properties, and the list is growing as physicists become sensitized to the idea that topology as well as geometry has an important place in physics. Independence from size, shape and sample means that a phenomenon is topological deformation invariant. The most obvious other example of such a topological phenomenon is the Planck blackbody radiation spectrum. A bit of reflection will show that other deformation-invariant laws of nature include Gauss's law, Ampère's law, the Bohr-Sommerfeld quantization condition, the Aharonov-Bohm effect and the transition probability.

I have a private letter from Post dated 15 September 1981, expressing his rational-fraction result for the Hall impedance and saying to watch for the pending publication. For some reason known only to referees and reviewers, his article was not published until March of 1983. Moreover, the work seems to be unknown to or ignored by the physical community active in work on the fractional Hall effect, and

Circle number 71 on Reader Service Card

Solve your thin film deposition problems

with **US** INC.



**It's as simple
as 1. 2. 3.**

The US' Guns™ have been designed for easy installation and target change in a R&D or production environment. US' Guns can be operated in DC or RF power modes and are available in either 1, 2, or 3 inch target models. For further information, please call.



the pruneyard • tower one, suite 725 • campbell, ca 95008
(408) 371-6900

Circle number 72 on Reader Service Card

Review of Scientific Instruments

Contains articles and notes concerning new and improved scientific instruments and apparatus for physics, chemistry and the life sciences, and new methods for using them. Includes state of the art reviews, book reviews and brief descriptions of new items of interest that are commercially available.

Monthly • Approx. 2700 pages annually •

\$345 U.S. & Possessions

\$365 Foreign

\$375 Optional Airfreight Europe

\$385 Optional Airfreight Asia

\$345 Microfiche First Class or Airmail

**Reduced rates are available for individuals.*

For details, please call (212) 661-9404, ext. 536.

Please address orders and inquiries to Marketing Services

American Institute of Physics

335 East 45 Street, New York, NY 10017 1/87



Oceanography Workshop

If You Teach College Science or Engineering, You Should Know What's Happening in Oceanography

You Can Find Out an All-Expenses Paid Workshop June 21-26 in Woods Hole, Massachusetts or Seattle, Washington

Sponsored By:

- Woods Hole Oceanographic Institution
- Massachusetts Institute of Technology
- University of Washington

WE INVITE YOU TO APPLY IF YOU TEACH UNDERGRADUATE COLLEGE MATH, PHYSICS, ENGINEERING, CHEMISTRY, GEOLOGY OR BIOLOGY

**Bring an open mind.
We're going to pack it full.**

For an application, call
(617) 548-1400, ext. 2200
or (206) 543-5039

letters

answers the question posed by Izaguirre.

The undergraduate and graduate training of most scientists is extraordinarily lacking in the topological perspective. This is a problem that the academic and scientific community must face and rectify. Scientists must be trained to separate geometrical (constitutive and local) features from topological (global or deformation-invariant) features of physical systems.

Reference

1. E. J. Post, *Phys. Lett. A* **94**, 343 (1983).
R. M. KIEHN
11/86 University of Houston

Industrial astronomers

In his editorial (February 1986, page 128) urging that astronomy departments offer graduate training in "applied astronomy," James Wertz points out that "most astronomy faculty members have never held a job outside of academic astronomy." I strongly suggest that any applied astronomy program must include several faculty members with at least ten years' experience in industry or nonacademic research, in order that the applied astronomy taught be based on experience. We don't expect training in spectroscopy, for example, to be given by professors who have never done spectroscopy. If faculty with industrial experience are not present, the departments will be effectively telling the students that astronomers who work outside academia do not rate as "real" astronomers.

I do question Wertz's assertion that "the astronomer has a good conceptual understanding of orbits, attitude and celestial geometry." Twenty years ago, when I was a graduate student interested in satellite dynamics, most of the astronomy graduate students I knew were not particularly interested in orbits, and attitude dynamics was not considered in our celestial mechanics courses. Has the orbital mechanics content of astronomy education changed since then?

VICTOR J. SLABINSKI
INTELSAT
3/86 Washington, DC

Heisenberg and isotopic spin

In connection with Arthur I. Miller's discussion (November 1985, page 60) of Werner Heisenberg's contribution to nuclear and particle physics (they were

indistinguishable in the 1930s) I would like to point out especially the idea of isotopic spin.

The symmetry between proton and neutron as well as between pairs of mirror nuclei ($\text{He}^3\text{-T}$, $\text{C}^{14}\text{-O}^{14}$ and so on) was rather obvious after the discovery of the neutron as a real particle. But there was a temptation to treat this as a discrete mirror symmetry. It needed the talent and deep thinking of Heisenberg to introduce the idea of isotopic spin, that is, of a continuous rotation in abstract space gradually changing protons into neutrons and vice versa—the SU(2) group.

This idea led immediately to the prediction of the neutral pion as a necessary member of the representation comprising experimentally known charged pions. Later, with the discovery of strange particles, it led to the SU(3) group. So was laid the way to quarks.

Isotopic spin turned out to be an approximate symmetry, but it was the beginning of the long road leading to the idea of exact color symmetry and all of quantum chromodynamics.

Do not forget ancestors!

YA. B. ZEL'DOVICH
Institute for Physical Problems
Academy of Sciences of the USSR
8/86 Moscow, USSR

Mathisson identified

The "unidentified conferee" in the photo also showing Wolfgang Pauli and Gerhard Dieke (PHYSICS TODAY, December 1985, page 40) is Myron Mathisson, a Polish mathematical physicist. Contrary to what is stated in the caption, the photo must have been taken in 1937 and not in 1934 because the 1937 conference at the Bohr Institute was the first and only one that Mathisson ever attended. Bohr invited Mathisson to that conference at H. A. Kramers's request.

Mathisson's knowledge of mathematics, and especially of the mathematics of general relativity, was probably not inferior to Pauli's—nor was his dislike of sloppy thinking weaker. In 1935 I heard Jacques Hadamard highly praise Mathisson for his work on the Cauchy problem, on the occasion of Mathisson's seminar lecture at the Collège de France. However, Mathisson was also a dreamer of the kind Pauli could hardly stand (in particular, Mathisson believed that there was evidence for some yet undiscovered links between general relativity and quantum mechanics). This explains Pauli's stronger interest in the sandwich he was eating (see the photo) than in Mathisson's ideas. Mathisson had better luck

with Paul A. M. Dirac: When Mathisson died in 1940 at the age of 43, Dirac wrote his obituary and published it in *Nature* (9 November 1940).

W. OPECHOWSKI
University of British Columbia
Vancouver, British Columbia
Canada

3/86

Oscillation omission

The October 1985 news story (page 17) on the exciting discovery of quasiperiodic x-ray oscillations in low-mass x-ray binaries, in which we were involved, mentions a dozen scientists, but not the one person who most deserves credit: Michiel van der Klis of the European Space Research and Technology Centre.

Van der Klis was one of the coinvestigators on the EXOSAT proposal that led to the discovery of quasiperiodic oscillations in GX5-1. He analyzed the data (together with graduate student Fred Jansen of Leiden) and was the first to recognize the oscillations, and he demonstrated their unique relation to the source intensity. This was a remarkable accomplishment, and consequently he became the first author on our discovery paper.

WALTER H. G. LEWIN
Massachusetts Institute of Technology
Cambridge, Massachusetts
JAN VAN PARADIJS
E. P. J. VAN DEN HEUVEL
University of Amsterdam
Amsterdam, The Netherlands
J. TRÜMPER
M. SZTAJNO
Max Planck Institute
for Extraterrestrial Physics
8/86 Garching, FRG

Pseudopotential pseudocredit

In John C. Bean's article "The growth of novel silicon materials" (October, page 36), he mentions on page 39 "pseudopotential calculations (performed by Richard Wright and Chris Van de Walle at the Xerox Palo Alto Research Center)." The reference should be to Richard Martin, not Richard Wright. This work is described in C. G. Van de Walle, R. M. Martin, *Phys. Rev.* **34**, 5621 (1986).

CHRIS G. VAN DE WALLE
IBM Thomas J. Watson Research Center
12/86 Yorktown Heights, New York

Correction

March, page 88—In the obituary for Henry Levinstein, Nathan Ginsburg's name was misspelled. □