

More on gravity waves

R. L. Garwin, and J. Weber

Citation: [Physics Today](#) **28**, 11, 13 (1975); doi: 10.1063/1.2998965

View online: <https://doi.org/10.1063/1.2998965>

View Table of Contents: <https://physicstoday.scitation.org/toc/pto/28/11>

Published by the [American Institute of Physics](#)

ARTICLES YOU MAY BE INTERESTED IN

[Detection of gravity waves challenged](#)

[Physics Today](#) **27**, 9 (1974); <https://doi.org/10.1063/1.3129024>

[Joseph Weber](#)

[Physics Today](#) **54**, 74 (2001); <https://doi.org/10.1063/1.1397401>

[Gravitational waves](#)

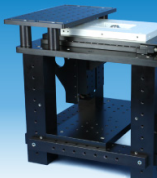
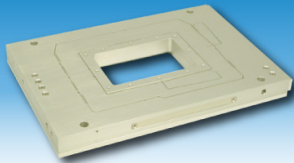

[Physics Today](#) **21**, 34 (1968); <https://doi.org/10.1063/1.3034919>

[Gravitational waves—a progress report](#)

[Physics Today](#) **26**, 44 (1973); <https://doi.org/10.1063/1.3127984>

[Detecting gravity waves](#)

[Physics Today](#) **26**, 9 (1973); <https://doi.org/10.1063/1.3128008>



Nanopositioning Systems Micropositioning AFM & SPM Single molecule

letters

- 2. I. K. MacKenzie, G. F. O. Langstroth, B. T. A. McKee, C. G. White, Can. J. Phys. 42, 1837 (1964).
- 3. I. K. MacKenzie, T. L. Khoo, A. B. MacDonald, B. T. A. McKee, Phys. Rev. Lett. 19, 946 (1967).
- 4. S. Berko, J. C. Erskine, Phys. Rev. Lett. 19, 307 (1967).
- 5. W. Brandt; see, for example, his discussion in *Proceedings of the International Conference on Positron Annihilation* (A. T. Stewart, L. O. Roellig, eds.), Academic, New York (1967) page 180.
- 6. B. Bergersen, M. J. Stott, Sol. State Comm. 7, 1203 (1969).
- 7. D. C. Connors, R. N. West, Phys. Lett. 30A, 24 (1969).
- 8. A. Seeger, J. Phys. F 3, 248 (1973).

A. N. GOLAND

Brookhaven National Laboratory
Upton, New York

The error attributed to Amaldi was introduced by our staff in the process of editing the original tape-recorded interview and not caught in proof.

EDITOR

More on gravity waves

Joseph Weber's reply to my letter in December 1974 (pages 9, 11) in no way addresses my claim "that the Maryland group has published no credible evidence at all for their claim of detection of gravitational radiation." He states "My first-hand knowledge is based entirely on other data including real-time counting and pen-and-ink records," but this evidence has not been published. Q.E.D.

Weber brings my own experiments into discussion,^{1,2,3} but these have nothing at all to do with the point of my letter. Indeed, the reader may judge the correctness of our conclusions shown graphically in figure 3 of reference 3,—that one month of data for our 480-kg bar show conclusively the absence of pulses intense enough to have been detected with good efficiency by Weber,⁴ assuming that his published events were indeed gravitational waves.

I shall not reply to Weber's innuendo, but I must respond to two criticisms he makes of our experiments:

1) That our equation 2 (reference 2) cannot be correct "because the detector relaxation time is not contained in it,"⁴ and

2) that "Garwin apparently overlooked the great importance of temperature control or automatic tracking of his cylinder with a reference oscillator."

Briefly, Weber seems to have misread our papers:

1) Equation 2 calculated P_{fa} , the "probability of false alarm"² (in one antenna). The rate of false alarms was

calculated in the next paragraph² as

$$r_d = (P_{fa})^2 / \tau_E$$

where τ_E is precisely the detector (energy) relaxation time.

2) In fact, our published results are insensitive to frequency offset of the reference oscillator or to temperature drift of the bar because for each data block (3 min¹ or 455 sec³) "Each data block is then processed by a computer which first computes the autocorrelation function and from it the decrement δ of the bar ($\delta = \pi \tau f_0 / Q$) and its offset ($f_0 - f_B$). These data are then used to predict from each pair of amplitudes [a vector $\mathbf{v}(t_n)$ in the phase plane] the amplitudes of the next point τ seconds later,

$$\mathbf{v}^*(t_n + \tau) \equiv \mathbf{v}(t_n) \exp(-\delta)$$

after obvious corrections for frequency offset."¹

Indeed, the effect of any imperfection of compensation is included in the measured system noise temperature T_e of 29.2 K¹ or 18.5 K.³ James L. Levine has reviewed the computation for a typical 4-hr stretch of the data³ and finds that the contribution to T_e from this source was 4×10^{-2} K. The details are available to anyone writing the author.

References

- 1. J. L. Levine, R. L. Garwin, Phys. Rev. Lett. 31, 173 (1973).
- 2. R. L. Garwin, J. L. Levine, Phys. Rev. Lett. 31, 176 (1973).
- 3. J. L. Levine, R. L. Garwin, Phys. Rev. Lett. 33, 794 (1974).
- 4. J. Weber *et al*, Phys. Rev. Lett. 31, 799 (1973).

R. L. GARWIN

Thomas J. Watson Research Center
Yorktown Heights, New York

WEBER RESPONDS: Real-time counting data were sent to Richard Garwin in a letter dated 8 February 1974.

It is regrettable that Garwin continued to publish incorrect information about Maryland experiments after submission of his earlier letter in PHYSICS TODAY.

In the 23 September 1974 *Physical Review Letters* (page 797), Garwin states that a Maryland computing error "was shown to account for essentially all of the zero delay excess events on a four day tape..." Figure 1 is a histogram for this four-day tape. The computing was checked by three independent scientists. The zero-delay excess is 5.7 standard deviations.

It is also regrettable that Garwin's clever instrumentation gives poor sensitivity. The experiments search for excitation of the normal mode of an elastic solid, by gravitational waves. Two

If you want
to hurt
the 240L RF
Power Amplifier



...you've got to do more
than short circuit its output.

As a matter of fact, this *brand new* instrument will deliver more than 40 watts of Class A linear power and up to 150 watts of CW and pulse power to any load impedance (from an open to a short circuit). Immune to load damage and unconditionally stable the 240L covers the frequency range of 20 KHz to 10 MHz with a flat 50 db gain. Completely *solid state* the 240L will faithfully reproduce input waveforms from any signal or function generator in its range.

If you need a transducer drive source for ultrasonics, RFI/EMI, biological research, electro or acousto optics the 240L was designed for you.

Solid state reliability is here at \$1595.00.

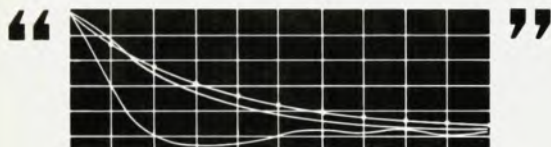
For further information or a demonstration contact ENI, 3000 Winton Road South, Rochester, New York 14623 (716) 473-6900 or TELEX 97-8283

ENI

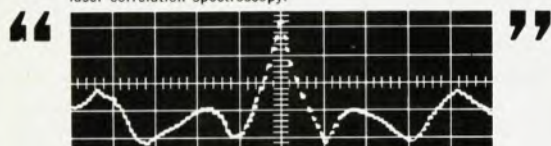
The world's leader
in solid-state power amplifiers.

Circle No. 13 on Reader Service Card

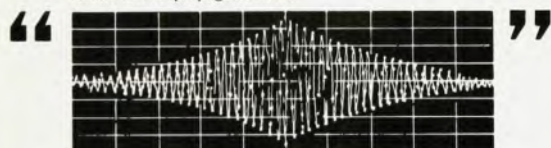
If SAICOR'S correlator could talk it would say...



Decay rate reveals molecular properties of materials using laser correlation spectroscopy.



Location of peak allows measurement and control of flow velocities and propagation time



Chamber pressure characteristics point up jet engine combustion problems

These quotations, and many more, are delivered by this unique all digital, high speed processing instrument. It performs auto and cross correlation, signal averaging, and probability, density and distribution analysis in real time.

The 400 point SAI-43A has a minimum Δt of 0.2 μ sec (5MHz sampling rate) and 800 precom-



putation delay points, linear and exponential averaging, digital bin markers and readout. Full digital input circuitry for photon counting applications is available. For those applications requiring only 100 point analysis, the new improved SAI-42A is available.

Let the SAICOR Correlators tell their own story. Call (516) 234-5700 for a demonstration or detailed technical data.

Do you really need that elaborate, complex, expensive, FFT system? now!!!

Total Digital Signal
Processing Capability with the NEW
Fourier Transform Analyzer (FTA)



Frequency Range: DC – 2.5 MHz (with SAI-43A)
DC – 1 MHz (with SAI-42A)
Resolution: 1000 Point Interpolated Display

The all-digital SAI-470 FTA used with either of our field-proven digital Correlation & Probability Analyzers provides these single and dual channel signal processing capabilities –

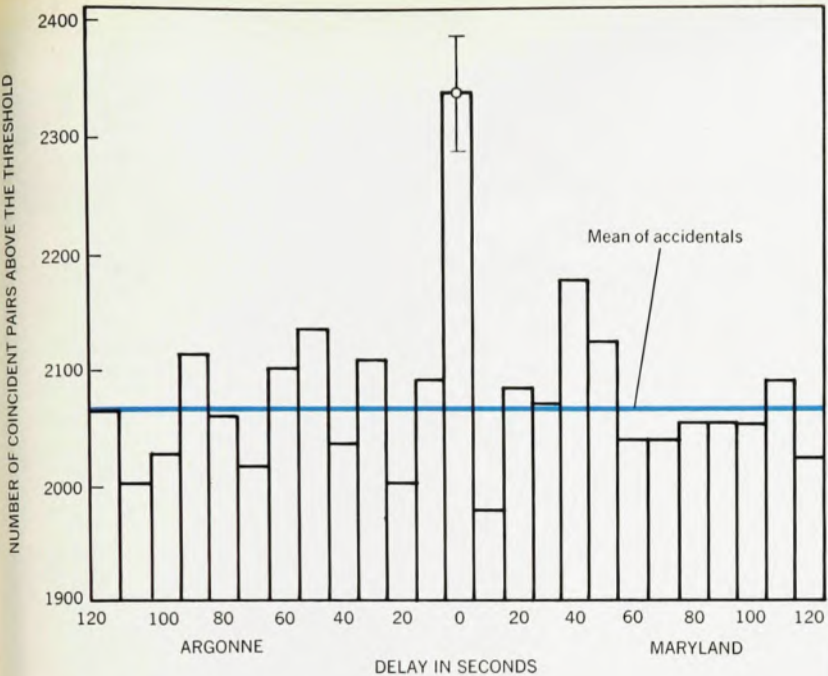
■ Auto Correlation ■ Power Spectral Density (Magnitude) ■ Cross Correlation ■ Cross Power Spectral Density ■ Co Spectra (Real) ■ Quad Spectra (Imag) ■ Phase Spectra ■ Signal Averaging ■ Probability Density ■ Probability Distribution ■ Nyquist, Bode, Nichols Plots

Call (516) 234-5700 for a demonstration or write for Technical Bulletin S-470

Honeywell

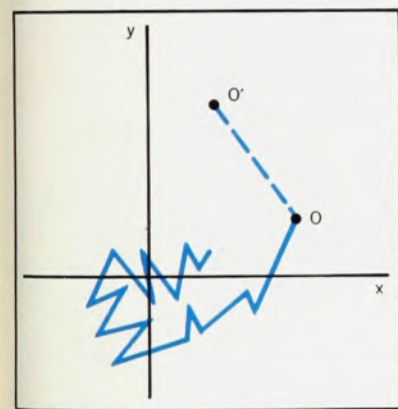
SIGNAL ANALYSIS OPERATION • TEST INSTRUMENTS DIVISION
595 Old Willets Path, Hauppauge, New York 11787 • 516/234-5700

SAICOR



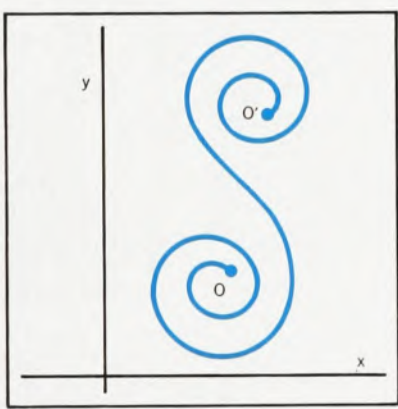
Histogram for Maryland-Argonne 4-day tape 217.

Figure 1



Brownian motion of antenna.

Figure 2



Response for swept frequency.

Figure 3

variables of the normal mode are its amplitude ρ and its phase ϕ . The electronics output consists of variables x and y related to ρ and ϕ by

$$x = \rho \cos \phi; y = \rho \sin \phi$$

Maryland experiments made use of an energy algorithm based on changes of $x^2 + y^2$, that is $\Delta(x^2 + y^2)$. Consider figure 2. The antenna mode undergoes Brownian motion, which corresponds to a random walk of the point x, y . This energy algorithm gives no response unless change $00'$ is primarily in the radial direction. Garwin assumed therefore that he would obtain greater sensitivity if he employed an amplitude algorithm based on the expression

$$(\Delta x)^2 + (\Delta y)^2$$

responsive to $00'$ in any direction. Ex-

pected increased sensitivity of his amplitude algorithm led Garwin to use a much smaller mass than that used at Maryland. Furthermore he abandoned the well established technique of a two-detector coincidence experiment.

Garwin's results were negative. Maryland experiments using the larger mass and both algorithms simultaneously show, for a recent 2½ month period, a larger event rate for the energy algorithm. An explanation suggested by our brilliant student Gustave Rydbeck is that the pulses are longer than Garwin thought, and they frequency sweep through the detector bandwidth, giving the spirals shown in figure 3. The result is to give some radial displacement for most signals, and a higher detection efficiency in comparison with similar displacements associated with heat-bath excitation.

continued on page 99

Radioactive Sources

ALPHA SOURCES

Am^{241}
 Po^{210} Cm^{244}
 Th^{228}
 for

SPECTROSCOPY

RUTHERFORD
SCATTERING

CALIBRATION

IONIZATION

Write for comprehensive
catalog or call collect at:
(213) 843-7000



ISOTOPE PRODUCTS LABORATORIES

404 S. Lake St., Burbank, Calif. 91502
Circle No. 15 on Reader Service Card
PHYSICS TODAY / NOVEMBER 1975

ACS Short Courses

American Chemical Society

DIGITAL ELECTRONICS FOR AUTOMATION AND INSTRUMENTATION

Dec. 7-12, 1975

Blacksburg, Va.

David G. Larsen, Dr. Peter R.
Rony, and Dr. Frank A. Settle Jr.

Fee: ACS members, \$325;
nonmembers, \$360

This in-depth laboratory/lecture course provides hands-on experience with the wiring of digital circuits of modest complexity involving the popular and inexpensive TTL integrated circuit chips. Several lectures are included that explore current trends in digital electronics, such as digital telecommunications. These lectures point the way to fruitful avenues for continued study in digital electronics. Upon completion of the course, the typical participant will be able to understand the jargon of digital electronics; wire a wide variety of digital circuits; read pin configurations from manufacturer's specifications; purchase state-of-the-art integrated circuit chips, hybrid modules, and digital instruments with reasonable confidence; appreciate future trends in digital electronics; and discuss projects with electronics design and instrumentation engineers. No prior knowledge of digital or analog electronics is required. Enrollment will be limited to 24.

To register or obtain complete information on the courses, student discounts, and free enrollment for unemployed ACS members, write or call the Education Department, ACS, 1155—16th St., N.W., Washington, D.C. 20036. During the two-week period prior to a course, registrations should be made by telephone: (202)872-4508.

letters

continued from page 15

Garwin's use of too small a mass, together with an algorithm tailored to signals having different spectral character than most of the ones we observe, account for his negative results. Garwin did overlook the importance of temperature control. Two effects are involved. Failure to control temperature produces excess noise because the cylinder is not in equilibrium, and this excess noise cannot be removed by Garwin's computer program. A second effect is that the cylinder drift relative to a reference oscillator produces a large phase-modulation background, and this can be removed, by computer-program corrections discussed by Garwin.

J. WEBER

University of Maryland
College Park, Maryland

Nuclear club

Your recent article "Nuclear Proliferation—30 Years after Hiroshima" (July, page 23) had some very interesting visual depictions of the growth of "The Nuclear Club." Unfortunately, they all indicate the Mideast as being non-nuclear now and in the immediate future. In fact, Israel has had nuclear reactors for some years and Egypt is in the process of getting one, while Iran, Saudi Arabia and others of the oil-rich Arabic States are standing in line to purchase reactor technology.

Since the Mideast is also a politically unstable area, which conceivably could be a tinderbox for a holocaust, ignoring this area in the visual presentations appears to be misleading.

ELLIOT WHEELER

South Houston, Texas

THE AUTHOR COMMENTS: In my view, you are quite correct in your criticism of the visual depictions of the "nuclear club" illustrating my article in July. My own listing of the nuclear club would include Israel today, and certainly Iran, Egypt and possibly Saudi Arabia in 1980.

BERNARD T. FELD

American Academy of Arts and Sciences
Boston, Massachusetts

Correction

June, page 88—The Committee on Science Education for the General Public should have been identified as a joint committee of both the American Association of Physics Teachers and The American Physical Society and not solely a committee of the APS. □

PREAMP- AMP- DISC



Model 509
\$265.00



- Charge Gain - 12 Volts per Picocoulomb
- Integral Linearity -0.1% to +10 Volts
- Variable Discriminator Threshold - - 100 Millivolts to 10 Volts

Mech-Tronics

NUCLEAR

430A Kay Ave., Addison, IL 60101

For more information
WRITE OR CALL COLLECT
(312) 543-9304

Circle No. 81 on Reader Service Card