

PHYSICS TODAY

2001

Articles

Motile Behavior of Bacteria

E. coli, a self-replicating object only a thousandth of a millimeter in size, can swim 35 diameters a second, taste simple chemicals in its environment, and decide whether life is getting better or worse
--Howard C. Berg

Retinal Imaging and Vision at the Frontiers of Adaptive Optics

By compensating for the minor, as well as the major, defects in the eye's optics, we can look through the lens to observe retinal features the size of single cells--Donald T. Miller

Physics and the Information Revolution

Quantum physics holds the key to the further advance of computing in the postsilicon era--Joel Birnbaum and R. Stanley Williams

Departments

Physics Update

From the Editor

Reference Frame

Mass without mass II: The medium is the mass-age --Frank Wilczek

Letters

Search and Discovery

[Mapping the interstellar cloud we live in](#)...The decreasing Arctic ice cover...What really gives a quantum computer its power?...Experts dismiss doomsday scenarios for RHIC

Washington Reports

[DOE shuts Brookhaven lab's HFBR in a triumph of politics over science](#)...Washington ins & outs: Wolf to leave as NOAO head, Oertel departs AURA...Washington briefings: One too many mishaps on voyages to Mars; NIF faulted for cost and schedule overruns; Disappointing report card on K-12 education

Physics Community

[Stakes rise in row over siting UK synchrotron light source, as fury persists over canceled French facility](#)...UMinn faculty teach each other science...Chiaverina and Hubisz join AAPT presidential line...Sartwell is AVS president-elect for 2000...In brief...

Web Watch

Books

Making Physics: A Biography of Brookhaven National Laboratory, 1946-1972, R. P. Crease (reviewed by R. W. Seidel)...*Active Galactic Nuclei: From the Central Black Hole to the Galactic Environment*, J. H. Krolik (reviewed by R. A. Daly)...*Properties of Materials*, M. A. White (reviewed by T. F. Rosenbaum)...*Accelerator Physics*, S. Y. Lee (reviewed by D. Hartill)...*X-Ray Scattering from Soft-Matter Thin Films: Materials Science and Basic Research*, M. Tolan (reviewed by M. D. Ward)

New Products

Focus on data acquisition

We Hear That

Obituaries

Edwin Thompson Jaynes...Gregory Eugene Stillman

Information Exchange

Articles

The Road to the Neutrino

It took experimenters three decades to convince themselves that the b-decay spectrum really is continuous. Then, to save conservation of energy, Pauli had to invent the neutrino. -- *Allan Franklin*

Negative Pressures and Cavitation in Liquid Helium

When subjected to intense sound waves, liquids can be stretched until they break and gas bubbles appear -- *Humphrey Maris and Sebastien Balibar*

Physicists Triumph at 'Guess My Number'

Quantum entanglement looks like telepathy when three physicists get together on a game show -- *Andrew M. Steane and Wim van Dam*

Departments

Physics Update

Reference Frame

Brainwashed by Feynman? -- *Philip W. Anderson*

Letters

Search and Discovery

[Creating and characterizing individual molecular bonds with a scanning tunneling microscope](#) . . .

Researchers perform quite a magic trick: making nickel-48 materialize . . . Galileo flyby discovers immense lava fountain on a Jovian moon

Minneapolis Will Host the APS March Meeting

Washington Reports

Richardson sends nuclear security agency plan to Congress, but dual roles provoke questions . . . [Los Alamos director talks about security problems, morale, and recruiting young scientists at lab](#) . . .

Washington briefings: US pays up UN arrears but leaves out UNESCO; Removing sanctions on India still perplexes Argonne

Physics Community

Trans-Alps neutrino beam gets CERN go-ahead . . . Korean neutrino observatory axed . . . Middle East synchrotron project moves ahead . . . In Brief

Web Watch

Books

Walther Nernst and the Transition to Modern Physical Science, D. K. Barkan (reviewed by H. Kragh) . . . *Greenhouse: The 200-Year Story of Global Warming*, G. E. Christianson (reviewed by M. Battle) . . . The American Astronomical Society's First Century, edited by D. H. DeVorkin (reviewed by M. S. Roberts) . . . *The Five Ages of the Universe: Inside the Physics of Eternity*, F. Adams and G. Laughlin (reviewed by J. I. Silk) . . . *The Touchstone of Life: Molecular Information, Cell Communication, and the Foundations of Life*, W. R. Loewenstein (reviewed by R. H. Austin)

New Products

Focus on magnetism

We Hear That

Obituaries

Henry Way Kendall . . . Stanley Geschwind

Information Exchange

Articles

Nonequilibrium Patterns in Granular Mixing and Segregation

Granular flows that mix different species exhibit a surprisingly diverse repertoire of striking and beautiful behaviors. Better understanding of the mixing process should help in predicting whether a given flow will mix—or segregate—its constituents.

— *Troy Shinbrot and Fernando J. Muzzio*

Atmospheric Infrasound

The search for ways to monitor compliance with the Comprehensive Test Ban Treaty has sparked renewed interest in sounds with frequencies too low for humans to hear — *Alfred J. Bedard Jr and Thomas M. Georges*

Liquid Crystals and Carbon Materials

The macroscopic properties of carbon materials are determined by their structure at the nanometer length scale, and there is great potential to tailor their structure during the liquid-crystal phase of the synthesizing process — *Robert H. Hurt and Zhong-Ying Chen*

Departments

Physics Update

Reference Frame

[What's wrong with this elegance?](#) — *N. David Mermin*

Letters

Search and Discovery

Learning about high- T_c superconductors from their imperfections . . . Experiments reveal how heat is mixed into cold dense water in the abyssal ocean . . . A photon-activated switch detects single far-infrared photons . . . Survey halves estimated population of big near-Earth asteroids

Washington Reports

Clinton celebrates an 'era of unparalleled promise' powered by technology and driven by science . . . Washington briefings: R&D tax credit extended five years; It's rescission time for federal agencies; US eases export controls on fastest computers; Tax break for the Spallation Neutron Source

Physics Community

[Remaining ITER partners settle on an outline design for a downsized fusion reactor](#) . . . Nick Hitchon is better known for being in the "Up" movies than for his physics . . . Recovery continues in physics job market . . . In Brief . . . Bachelor's degree production holds steady in physics

Web Watch

Opinion

Quantum theory needs no 'interpretation' — *Christopher A. Fuchs and Asher Peres*

Books

[The Principia: Mathematical Principles of Natural Philosophy, I. Newton, translated by I. B. Cohen, A. Whitman and J. Budenz \(reviewed by A. E. Shapiro\)](#) . . . *Cosmology and Particle Astrophysics*, L. Bergström and A. Goobar (reviewed by A. J. Albrecht) . . . *Howard Aiken: Portrait of a Computer Pioneer*, I. B. Cohen and *Makin' Numbers: Howard Aiken and the Computer*, edited by I. B. Cohen and G. W. Welch (reviewed by A. E. Brenner) . . . *Computational Physics*, J. M. Thijssen (reviewed by A. F. Wright) . . . *Statistical Methods in Quantum Optics 1: Master Equations and Fokker-Planck Equations*, H. J. Carmichael (reviewed by M. O. Scully)

New Products

Focus on test and measurement

We Hear That

Obituaries

John Wainwright Evans Jr . . . Kenneth Alan Johnson . . . Jose Roberto Manzano

Articles

Radionuclide Therapy

Physicists and physicians are working together to devise new methods for exploiting the power of ionizing radiation to treat cancer and coronary artery disease

— Bert M. Coursey and Ravinder Nath

A Fresh Look at Entropy and the Second Law of Thermodynamics

The existence of entropy, and its increase, can be understood without reference to either statistical mechanics or heat engines

— Elliott H. Lieb and Jakob Yngvason

The Composite Fermion: A Quantum Particle and Its Quantum Fluids

The fractional quantum-Hall effect and other exotic behaviors of electrons trapped in two dimensions can be understood in terms of composite particles—electrons sporting attached flux quanta

— Jainendra K. Jain

Departments

Physics Update

Reference Frame

Letters

Search and Discovery

Explorers focus more sharply on their prey: Weakly interacting dark matter . . . Ultracold neutrons are magnetically trapped at NIST . . . Magnetic semiconductors enable efficient electrical spin injection

Washington Reports

[Clinton's 'historic' R&D budget for fiscal 2001 puts Republican Congress in a quandary](#) . . . [APS and AAAS leaders protest 'inhumane treatment' of suspected Los Alamos spy in jail, awaiting trial](#)

Physics Community

Bell Labs wins long-running patent battle over high- T_c superconductor . . . UCSC to get grades . . . From quarks to squawks: Former physicist plays avant-garde sax . . . Ban on nuclear waste transport eased in Germany . . . Cosmology prize starts with a bang . . . Strasbourg interdisciplinary institute gets off the ground . . . Global seismic hazard map unveiled . . . In Brief . . . [Web Watch](#)

Books

Stepping Stones: The Making of Our Home World, S. A. Drury, *The Search for Life on Other Planets*, B. Jakosky, and *Planetary Dreams: The Quest to Discover Life beyond Earth*, R. Shapiro (reviewed by A. H. Knoll) . . . *Astronomy in Prehistoric Britain and Ireland*, C. Ruggles (reviewed by M. H. Shank) . . . *The Odd Quantum*, S. Treiman (reviewed by R. H. March) . . . *Reason Enough to Hope: America and the World of the Twenty-first Century*, P. Morrison and K. Tsipis (reviewed by W. Happer) . . . *Dorothy Hodgkin: A Life*, G. Ferry (reviewed by E. V. Mielczarek) . . . *Adaptive Optics for Astronomical Telescopes*, J. W. Hardy and *Adaptive Optics in Astronomy*, edited by F. Roddier (reviewed by L. Thompson)

New Products

Focus on microscopy

We Hear That

Obituaries

Robert Rathbun Wilson . . . Richard Latter . . . Barbara Hope Cooper . . . Charles Edward Swenberg . . . Jan van Paradijs . . . Klaus Kinder-Geiger . . . Dorothy N. Davis Locanthi

Information Exchange

Articles

Career Opportunities in Optics

Demand for ever faster data transmission is fueling rapid advances in fiber optic communications and a frenzied search for personnel trained in optics

— Anthony M. Johnson and C. Breck Hitz

Modern Classical Physics Through the Work of G. I. Taylor

One scientist's work provides material for an entire course, covering topics ranging from hydrodynamic stability and turbulence to electrohydrodynamics and the locomotion of small organisms

— Michael P. Brenner and Howard A. Stone

Andrei Sakharov and the Nuclear Danger

A decade after Sakharov's death, his guidance remains relevant to the nuclear perils we face in today's post-cold war world

— Sidney D. Drell

Departments

Physics Update

Letters

Search and Discovery

Novel composite medium exhibits reversed electromagnetic properties . . . Chandra probes deeper into the mystery of the x-ray background . . . Have heavy ion collisions at CERN reached the quark-gluon plasma? . . . The quantum Hall effect—in pentacene?

San Francisco is the Site of CLEO/QELS 2000

Washington Reports

Goldin's 'faster, cheaper, better' approach still valid after NASA's failures in Mars missions . . . [Clinton's one-day visit to India's Silicon Valley leads to science and technology collaborations](#) . . . Engineers proclaim top achievements of 20th century, but neglect attributing feats to roots in physics

Physics Community

Bohr-Heisenberg symposium marks Broadway opening of *Copenhagen* . . . UK ends site stalemate by sending synchrotron south . . . French science minister fired . . . Dyson gets religion prize . . . In Brief

Books

The Quantum Theory of Fields, Vol. 3: Supersymmetry, S. Weinberg (reviewed by F. Wilczek) . . . *Cosmological Physics*, J. A. Peacock (reviewed by L. M. Krauss) . . . *Quantum Generations: A History of Physics in the Twentieth Century*, H. Kragh (reviewed by L. M. Brown) . . . *Introduction to Superconducting Circuits*, A. M. Kadin (reviewed by H. Kroemer) . . . *Einstein's German World*, F. Stern (reviewed by H. Rechenberg) . . . *Quasars and Active Galactic Nuclei: An Introduction*, A. K. Kembhavi and J. V. Narlikar (reviewed by K. A. Weaver) . . . *Fiber Bragg Gratings: Fundamentals and Applications in Telecommunications and Sensing*, A. Othonos and K. Kalli (reviewed by G. E. Kohnke)

New Products

Focus on sensors

We Hear That

Obituaries

Louis Michel . . . Jan Peter van der Ziel

Information Exchange

Articles

The Physics of the Sun and the Gateway to the Stars

The Sun is stranger than you think, displaying mysterious manifestations of the familiar laws of physics and posing new problems with every major advance in exploratory measurement
— *Eugene N. Parker*

The Origins of Mathematical Physics: New Light on an Old Question

A recently resurfaced tenth-century manuscript, the Archimedes Palimpsest, includes the sole extant copy of Archimedes's treatise, the Method. As scholars begin study, new insights into Archimedes are emerging
— *Reviel Netz*

Spin and Isospin: Exotic Order in Quantum Hall Ferromagnets

Spin and a peculiar kind of isospin in two-dimensional electron gases can exhibit novel counterintuitive ordering phenomena
— *Steven M. Girvin*

Departments

Physics Update

Reference Frame

What is quantum theory? — *Frank Wilczek*

Letters

Search and Discovery

The heat flow through nanoscale wires faces a fundamental limit . . . Femtosecond comb technique vastly simplifies optical frequency measurements . . . Titanium carbide nanocrystals shed light on late phase of stellar lifestyle . . . Two satellites observe details of ocean-atmosphere coupling

Washington Reports

[US and Russia quarrel over an old issue: missile defense, now dubbed 'Star Wars Lite'](#) . . . As term nears end, Clinton names Dresselhaus to strengthen support for DOE science research . . . Clinton nominates General Gordon to lead new NNSA

Physics Community

[A new generation of gamma-ray telescopes prepares to plumb the nonthermal universe](#) . . . Jordan will likely host Middle East synchrotron light source . . . Physics enrollment leveling off, make-up changing . . . [Web Watch](#)

Opinion

[Teaching and propaganda](#) — *Mano Singham*

Books

The New World of Mr. Tompkins, G. Gamow and R. Stannard (reviewed by D. M. Greenberger) . . . *Little Book of Streamlines*, C. Pozrikidis (reviewed by S. A. Berger) . . . *The Unmaking of the Medieval Christian Cosmos, 1500–1760: From Solid Heavens to Boundless Aether*, W. G. L. Randles (reviewed by O. Gingerich) . . . *Classical Electrodynamics*, J. Schwinger, L. L. DeRaad Jr, K. A. Milton, and W. Tsai (reviewed by F. Rohrlich) . . . *General Relativity: A Geometric Approach*, M. Ludvigsen (reviewed by S. F. Shandarin)

New Products

Focus on photonics

We Hear That

Obituaries

Andrei Tsolakovitch Amatuni . . . Kurt J. Lesker Jr

Information Exchange

Articles

[Phase-Sensitive X-Ray Imaging](#)

New approaches that can detect x-ray phase shifts within soft tissues show promise for clinical and biological applications -- *Richard Fitzgerald*

Special Focus: Perspectives on Copenhagen

[A Historical Perspective on Copenhagen](#)

What was Werner Heisenberg trying to tell Niels Bohr during his visit to Copenhagen in 1941, and what did he want from Bohr? -- *David C. Cassidy*

[The German Uranium Project](#)

The Farm Hall tapes show that Werner Heisenberg did not know how to calculate the critical mass in 1945, indicating that he did not work on atomic bombs during the war -- *Hans A. Bethe*

[Werner Heisenberg and Albert Einstein](#)

Departments

[Physics Update](#)

Reference Frame

[The contemplation of quantum computation](#)
-- *N. David Mermin*

[Letters](#)

Search and Discovery

- [Balloon measurements of the cosmic microwave background strongly favor a flat cosmos](#)
- [An atom is trapped by the field of just one photon](#)
- [Our knowledge of G gets worse, then better](#)

[ACA Celebrates its 50th Anniversary this Month](#)

Washington Reports

- [Astronomers envision new observing instruments in next decade to focus on farthest reaches](#)
- [Washington ins & outs: Rosenfeld, Creedon, and Kelly advance](#)

Physics Community

- [Argo begins systematic global probing of the upper oceans](#)
- [An 'A' for UK physics](#)
- [String theorist wins premier book prize](#)
- [Physics lags in attracting women](#)
- [In Brief](#)
- [Web Watch](#)

Books

- [*In the Shadow of the Bomb Bethe, Oppenheimer, and the Moral Responsibility of the Scientist:*](#) , S. S. Schweber (reviewed by S. D. Drell)
- [*Physics with Tau Leptons*](#), A. Stahl (reviewed by M. L. Perl)
- [*Black Hole Physics: Basic Concepts and New Developments*](#), V. P. Frolov and I. D. Novikov (reviewed by J. A. Isenberg)
- [*ENIAC: The Triumphs and Tragedies of the World's First Computer*](#), S. McCartney (reviewed by J. R. Macdonald and H. G. Cragon)
- [*Polymers at Surfaces and Interfaces*](#), R. A. L. Jones and R. W. Richards (reviewed by M. Muthukumar)
- [*Their Day in the Sun: Women of the Manhattan Project*](#), R. H. Howes and C. L. Herzenberg (reviewed by B. C. Zulueta)
- [New books](#)

New Products

Focus on vacuum technology

We Hear That

Obituaries

- [Fredrik Zachariasen](#)

- [James Edward Zimmerman](#)
- [Thaddeus Francis Kycia](#)
- [Michael Danos](#)

Information Exchange

Articles

[QCD Made Simple](#)

Quantum chromodynamics is conceptually simple. Its realization in nature, however, is usually very complex. But not always -- *Frank Wilczek*

[Diffusion Waves and Their Uses](#)

Diffusion waves lack wavefronts, can't be beamed, and don't travel very far, yet they form the basis of several new and revolutionary measurement technologies
-- *Andreas Mandelis*

[Physicists in the New Era of Electronic Publishing](#)

New electronic opportunities for scientific communication, and changes in how scientists use journals, are prompting a complete reevaluation of the roles of scientific journals and of scholarly societies like the APS -- *James Langer*

Departments

[Physics Update](#)

Letters

[Create Life From Scratch? It's a Matter of Time](#)

[Feynman Brainwashed?](#)

[The Matter of WIMPs](#)

[The Universe in a Glass of Beer](#)

[Elegance: Keeping it Simple and Testable](#)

[Proper Credit Given for Early Cancer Work](#)

[The Neutrino Road Not Taken](#)

[Trouble for Quantized Hubble](#)

[Moon Yields Info on Near-Earth Asteroids](#)

[Archimedes Floats](#)

Search and Discovery

[Researchers can now vary the atomic interactions in a BoseEinstein condensate](#)

[An optical spoon stirs up vortices in a BoseEinstein condensate](#)

[Galaxy survey finds limit of cosmic structure size](#)

Physics Community

[Physics graduate programs train students for industrial careers](#)

[In Brief](#)

[Web Watch](#)

Books

[Strange Beauty: Murray Gell-Mann and the Revolution in Twentieth-Century Physics](#), G. Johnson (reviewed by S. S. Schweber)

[Thermal Physics](#), R. Baierlein and [An Introduction to Thermal Physics](#), D. V. Schroeder (reviewed by H. Gould)

[ITEP Lectures on Particle Physics and Field Theory, Vols. 1 and 2](#), M. A. Shifman (reviewed by F. Wilczek)[Introduction to Stellar Winds](#), H. J. G. L. M. Lamers and J. P. Cassinelli (reviewed by C. T. Bolton)

[Red Atom: Russia's Nuclear Power Program from Stalin to Today](#), P. R. Josephson (reviewed by R. W. Seidel)

[CP Violation](#), G. C. Branco, L. Lavoura, and J. P. Silva and [CP Violation](#), I. I. Bigi and A. I. Sanda (reviewed by A. Falk)

[New books](#)

New Products

[Focus on lasers](#)

We Hear That

[This Year's MacArthur Fellows Chosen](#)

[AAS Presents Awards in New York](#)

[In brief](#)

Obituaries

[Sam Bard Treiman](#)

[Ivan Kuscer](#)

[Donald Anderson Edwards](#)

[Richard Alexander Beth](#)

Job Opportunities

Articles

[Physics in the Whirlwind of Optical Communications](#)

Accelerating demands for high-speed communications are driving rapid innovations in lightwave communication, including versatile, high-bandwidth fibers, sources, amplifiers, and switches -- *Gordon A. Thomas, David A. Ackerman, Paul R. Prucnal, and S. Lance Cooper*

[DNA-Inspired Electrostatics](#)

Not just the repository of our genetic information, DNA is also a fascinating, shape-shifting molecule whose behavior in solution counters our intuition and challenges our physical understanding -- *William M. Gelbart, Robijn F. Bruinsma, Philip A. Pincus, and V. Adrian Parsegian*

[Hot Prospects for Ultracold Molecules](#)

Researchers have taken giant strides down several paths toward trapping molecules at submillikelvin temperatures. At the end of these paths lies the promise of more precise measurements and new phenomena -- *Barbara Goss Levi*

Departments

[Physics Update](#)

Letters

[Quantum Theory - Interpretation, Foramation, Inspiration](#)

[Fuchs and Peres reply:](#)

[Physics, Engineering Are Intimately Independent](#)

[Single Photon's Nondestruction Clarified](#)

[Low Dose Rates Need Consideration in LNT?](#)

[Corrections](#)

Search and Discovery

[Organic material debuts as both an injection laser and a superconductor](#)

[Solid-state NMR reveals key structural features of membrane transportation system](#)

[Theorists and experimenters seek to learn why gravity is so weak](#)

[Pulse shaping improves efficiency of soft x-ray harmonic generation](#)

[American Vacuum Society to Convene in Boston](#)

Physics Community

[UK astronomers face tough decisions on telescope closures](#)

[Fusion community cheers European bid for ITER](#)

[Journal cost studies again ruled fair](#)

[Slice of millimeter spectrum saved for science](#)

[Physics Olympiad 2000 held in UK](#)

[In Brief](#)

[Web Watch](#)

Books

[The Genius of Science: A Portrait Gallery](#), A. Pais (reviewed by S. S. Schweber)

[Rare Earth: Why Complex Life Is Uncommon in the Universe](#), P. D. Ward and D. Brownlee (reviewed by L. Krauss)

[Carl Sagan: A Life in the Cosmos](#), W. Poundstone, and [Carl Sagan: A Life](#), K. Davidson (reviewed by D. H. DeVorkin)
[Quintessence: The Mystery of Missing Mass in the Universe](#), L. Krauss (reviewed by M. S. Turner)
[Introduction to Semiconductor Physics](#), H. T. Grahn (reviewed by E. D. Jones)
[The Lyotropic State of Matter: Molecular Physics and Living Matter Physics](#), A. G. Petrov (reviewed by R. Podgornik)
[Biology in Physics: Is Life Matter?](#), K. Bogdanov (reviewed by H. C. Berg)
[New books](#)

New Products

[Focus on cryogenics](#)

We Hear That

[AGU Presents Awards and Medals in Washington](#)
[Astronomical Society of the Pacific Presents Awards](#)
[In brief](#)

Obituaries

[Hendrik Brugt Gerhard Casimir](#)
[David George Crighton](#)
[Michael Marinov](#)
[Kandarpa Narahari Rao](#)
[Douglas MacPherson Van Patter](#)
[Katherine Ella Mounce Weimer](#)

Job Opportunities