$\Delta m^2 \approx 10^{-2}$–$10^{-3}$ eV^2.

It is useful to recall that low-energy neutrinos from nuclear reactors may compete with high-energy neutrinos from accelerators as sensitive and cost-effective probes for oscillations in this parameter range. Inasmuch as reactor neutrinos have energies of only about 5 MeV, about 1000 times smaller than those at Fermilab or CERN, the base line required to achieve comparable sensitivity is only about 1 km, about 1000 times smaller than for high-energy experiments. Accordingly, detector size and price tag for a reactor experiment are much more modest. So is the lead time for an experiment.

Reactors are pure electron-antineutrino ($\overline{\nu}_e$) sources. Reactor experiments would probe the "disappearance" of the $\overline{\nu}_e$, thus shedding light on the oscillations $\nu_e \longleftrightarrow \nu_\mu$, one of two possible modes that might explain the atmospheric puzzle.

There are two such experiments in preparation, each using a detector of about 10 tons. One is near the San Onofre nuclear power station in California, and the other is near a station at Chooz in France. These experiments will be capable of deciding conclusively whether there are $\nu_e \longleftrightarrow \nu_\mu$ oscillations. A positive result would explain the atmospheric puzzle and, more generally, establish that neutrinos have mass.

Felix Boehm
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Sound Reasoning on Materials and Moduli

The following statement in Ray Ladbury's news story (October, page 17) on the 9 June Bolivian earthquake is incorrect: "Because olivine is less dense than spinel of a similar temperature, the speed of sound would drop as it passed through olivine." The speed of sound in olivine is lower than in spinel, but not because olivine is less dense. The relevant relationships are

$$V_p = \{(K + \tfrac{4}{3}\mu)/\rho\}^{1/2}$$

$$V_s = (\mu/\rho)^{1/2}$$

where V_p and V_s are compressional and shear wave velocities, respectively, K is bulk modulus, μ is shear modulus, and ρ is density.

Note that ρ is in the denominator, so a decrease in ρ alone would increase velocity. I recognize that this is counterintuitive. Reconciliation with intuition follows from the fact that in most situations where we compare the velocities of sound in materials, the difference in the moduli is even greater than the difference in density. Materials of greater density usually have much greater moduli. I emphasize this point to my students and feel it worth emphasizing here.

Gary L. Kinsland
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National Ignition Facility Funding Foul-up, Fixed

In the recent summary of the 1995 Congressional R&D budget actions (October, page 59) Irwin Goodwin mistakenly refers to the proposed National Ignition Facility as "a massive $10 billion" project. In fact, the correct total project cost estimate for the NIF is $1.1 billion in as-spent dollars, including contingency. That figure is based on a detailed conceptual design study[1] submitted to the Department of Energy by a multilaboratory team consisting of scientific and engineering staff from the inertial confinement fusion programs at Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Sandia National Laboratory—Albuquerque and the University of Rochester. The project cost has been validated by independent cost estimators commissioned by the DOE.[2] Indeed, if funded by Congress, this seven-year project (FY 1996–2002) would be a significant investment by the US in inertial fusion energy technology and high-density physics.

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(The writer is project manager of the National Ignition Facility.)

Resolving Near-Field Microscopy History

The news story "Near-Field Optical Microscopes Take a Close Look at Individual Molecules," by Graham P. Collins (May 1994, page 17), was of particular relevance to us, since our group at the IBM Zurich Research Laboratory was the first to build an NFO microscope. We feel that the report presents an incomplete and in some aspects erroneous view of the development of NFO microscopy. Our claim is based on published literature from an entire decade (the 1980s) that was not cited in Collins's report.

In particular:

▷ With the NFO microscope that we (in particular Dieter W. Pohl, W. Denk and Urs Dürig) built in 1983 and operated from then on, we obtained and published images showing details 20 nm in size,[1,2] somewhat better (and earlier) than the "unprecedented optical resolutions" of 50 nm cited by Collins. The Cornell group reported a resolution of the same order a few years later using a similar setup.[3]

The instrument that we developed at that time already possessed all the essential features found in present NFO microscopes. (Compare figure 1b of reference 1 with figure 1b of reference 4.)

▷ The "first scanners of this type" were etched quartz crystals whose facets formed highly pointed tips. They had an optimal angle of apex (close to 45°), were aluminum coated and could be prepared to form an extremely small aperture at the very apex. They were used as optical probes in our NFO microscope.[1,2] The micropipette technique, which Collins also describes as being used in the "first scanners," was introduced in 1986 by the Cornell group.[3]

▷ We are not aware of any comparison between our quartz probes and the optical fiber probe cited in Collins's report. The claim to have found an implementation with throughput "four orders of magnitude greater than those in previous designs" hence awaits to be substantiated.

▷ "Apertureless NFO microscopy" also was already conceived and demonstrated at our laboratory back in the 1980s, with U. C. Fischer as the main investigator.[5]

A fair and complete historical perspective on NFO microscopy should certainly include the 1928 proposal of E. H. Synge[6] and the 1972 microwave work of Eric A. Ash and coworkers,[7] as Collins's report appropriately did. It nevertheless remains the case that the way to present-day NFO microscopy was paved by the experimental work of the 1980s, in particular by our conception and successful demonstration of a complete NFO microscope.

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COLLINS REPLIES: I apologize for having underplayed the pioneering role of Dieter Pohl and his coworkers at IBM Zurich in the development of near-field scanning optical microscopy in my news story on single-molecule imaging using that technique. The published sentence about "unprecedented optical resolutions" was an unfortunate revision of a clearer earlier draft that referred to "the unprecedented sensitivity and optical resolution necessary for single-molecule detection." In describing "the first scanners of this type" as using glass pipettes or quartz rods and having been constructed by "various groups," my intent was to avoid entering into a detailed comparison of the contributions of various researchers in the field in the early-to-mid-1980s, there being insufficient space in a Search and Discovery item on recent research to do justice to this contentious topic. However, I erred in not naming those researchers, who include Pohl and his coworkers at IBM, and also Aaron Lewis, Michael Isaacson, Alec Harootunian, Eric Betzig and coworkers, all then at Cornell. Reference 8 of my story was to a 1992 review article[1] that has an extensive set of references to original research papers and earlier review articles, including a review by Pohl.[2]

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Fargo Firing: A Final Fact

My colleagues on the North Dakota State University physics faculty omit from their letter (December, page 13) the fact that in August a three-faculty-member university senate appeals committee (which included the prestigious former four-term mayor of Fargo) ruled my firing "unwarranted" as it lacks "specific allegations" of "inadequate teaching, research, or service."

I would invite my colleagues who signed the letter to recognize that a university must be an environment where more than one point of view is allowed to flourish. They should not confuse everyday disagreements with "lack of collegiality" or "disruptive conduct." A professor should not be fired for simply disagreeing about academic issues or about departmental policies and practices he believes thwart the university mission.

MANUEL DE LLANO
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Brit Booze Bags Higgs Wits; US Dough's No Go

In the February 1994 issue of PHYSICS TODAY (page 95) I read that William Waldegrave, "Britain's close equivalent to a science minister," got five understandable explanations of the Higgs particle in response to his offer of a bottle of champagne. The American Association of Physics Teachers, through its Harry Epstein Prize contest, created in memory of my father, has been offering $500 for such an explanation for two years, without an answer. Do the physics teachers need wider publicity or a switch from money to wine?

LEWIS EPSTEIN
San Francisco, California

Atom–Plane Exp't Lived Up to Its (r^{-3}) Potential

Barbara Goss Levi (April 1993, page 18) described the pleasing and beautiful results of a group at Yale validating the r^{-4} variation of the relativistic Casimir–Polder energy of interaction between an atom and a planar substrate.[1] Levi's piece also went on to say that our 1975 work[2] at the then-National Bureau of Standards "did not have sufficient precision to distinguish clearly between a retarded and an ordinary [r^{-3}] van der Waals potential."

Actually it's a lot happier than that. The 1975 results were not error limited as stated. Rather, it was cleanly evident from the deflection of an atomic beam that at short distances the "nonretarded" interaction between a K, Rb or Cs atom and a gold substrate goes as an inverse-cube law. This r^{-3} energy is quite distinct from the "retarded" inverse-fourth interaction delineated by the Yale group, who were observing at long distances.

What is so beautiful is that now, finally, we have a pretty good idea about *both* limiting laws. What's still puzzling is the 40% discrepancy between the coefficient we measured for the r^{-3} interaction and the best no-fudge-factor result calculated by feeding the full spectral response of atomic K and solid Au into Evgenii M. Lifshitz's generalized formulation of the Casimir–Polder result. Suggestions of a surface roughness correction[3] still need to be examined.

It is indeed satisfying that new work is being done on these basic and instructive questions.

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