$\Delta m^2 \approx 10^{-2}$–$10^{-3}$ 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 ($\bar{\nu}_e$) sources. Reactor experiments would probe the "disappearance" of the $\bar{\nu}_e$, 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.

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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

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

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

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.

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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.

References

1. Natl. Ignition Facility Conceptual Design Rep., NIF-LLNL-94-113, L-16973-1, Lawrence Livermore Natl. Lab., Livermore, Calif. May 1994.
2. Independent Cost Estimate—Natl. Ignition Facility, contract no. DE-AC01-94PR10016, Foster Wheeler USA Corp., Englewood, Colo., May 1994.

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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.

References

1. D. W. Pohl, W. Denk, M. Lanz, Appl.