and extremely complicated philosophical debate over the reality of the duality and the observer's influence on the outcome of experiments in quantum mechanics, the domain of atoms and smaller things: How much does what the observer sees depend on what he or she sets up to see?

Of particular experimental interest has been the attempt to drive the paradox to its most elemental manifestation: whether single particles exhibit wavelike behavior. (Where astronomically large numbers of particles are in play, it is easy to invent statistical reasons why wavelike behavior could show up.) Experiments have repeatedly shown that no matter how faint the light, it exhibits wavelike behavior. Some experiments have also claimed to be observing single photons. Aspect criticizes these because they used calculated probabilities to determine whether they were dealing with single photons and recorded data with the photoelectric effect. The photoelectric effect has a well-known quantal or particlelike quality, but, Aspect says, the light that triggers it need not be particulate or quantal. The appearance of the quantal photoelectric effect in itself "tells nothing about one or two photons."

Aspect's experiment proposed to show particlelike behavior of light directly by modern quantum optical means that do not require the intermediation of the photoelectric effect. A beam of light is split by a halfsilvered mirror: The two halves of the beam go off at 90° angles to each other. Detectors are put at the ends of equal paths in those directions.

If light is a wave, the wave will split into two. The two halves will take equal time to reach the detectors, and the recordings of the detectors will show a certain coincidence. If light is a stream of particles, says Aspect, one photon should go one way from the halfsilvered mirror, the next perhaps the other way, and so on. Over time the detectors' records should show much less than the coincidence proper to waves.

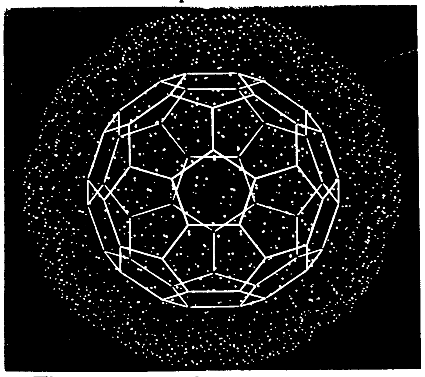
The experimenters tried various fine and delicate sources of light and could get no results better than the edge between the two. Then they turned to what Aspect calls "our secret source." This is cadmium energetically excited in such a way that it gives up its energy by emitting two photons in rapid succession, what atomic physicists call a cascade process. Each of the two photons has its own characteristic wavelength. The first photon of the cascade is used as a trigger. Equipment detecting its wavelength opens an optical gate long enough to admit the second, immediately following, photon. With this arrangement the experimenters got a particlelike coincidence reading. "We have proved that light behaves like a single photon," Aspect says.

Next they looked for wavelike behavior of the single photons. If what the half-silvered mirror splits is a wave, and the two half waves are recombined after they have gone over *unequal* distances, they will be out of phase with each other. As a result, when added together, they will reinforce each other in some places and cancel each other in other places. This produces a pattern of bright and dark "fringes" known as an interference pattern, and it is the standard test for wave behavior in everything from water in ponds to ionized hydrogen in the magnetosphere. To look for single-photon interferences, the experimenters inserted into the experiment an arrangement of transparent crystals that makes the experiment into what is called a Mach-Zehnder interferometer. When they did this, interference effects appeared. They appeared in just the way that physicists would expect in a case like this: At first the data are a random mush; gradually, as the seconds of observation pass, a distinct interference pattern builds up.

"I suspect," says Aspect, "that we have shown wave-particle duality, wavelike behavior, particlelike behavior. Here, you can think of the photon going one way or the other; here, you can think of the photon split into two. Sometimes it gives me a headache." *—D. E. Thomsen*

Molecular carbon: Playing 'buckyball'

Sports fans may recognize the proposed structure for a newly discovered 60-atom carbon molecule as the geometric pattern on a soccer ball. But images of R. Buckminster Fuller's geodesic domes inspired its name: buckminsterfullerene. Formed in the laboratory by the violent, laser-driven vaporization of graphite, such highly symmetric, stable carbon clusters may pervade the universe, especially around carbon-rich stars and within interstellar dust. These molecular "buckyballs" may also sit at the core of soot particles.



Nature/Kroto et al.

The molecule, C_{60}, as reported in the Nov. 14 NATURE, was discovered at Rice University in Houston during experiments aimed at studying how lengthy carbon chains are formed in interstellar space. To their surprise, the researchers found that under certain conditions 60-atom clusters show up in mass spectra much more often than do fragments of other sizes. "We figured there was something very magic about 60," says chemist Richard E. Smalley. "Why would 60, but not 58 or 62, be so stable?"

Normally, carbon atoms sit at the corners of tetrahedra in a diamond lattice or at the vertices of hexagons in chicken-wire sheets of graphite. Yet no graphite or diamond structures account for the remarkable stability of C_{60} in particular and clearly exclude the other possibilities, says Smalley. The structure that seems to fit best is a truncated icosahedron, made up of 12 pentagons and 20 hexagons and showing 60 vertices.

"It's not any old answer," says Smalley. "It's the largest number of objects that you can arrange on the surface of a sphere such that each one is identical." Each carbon atom has one double bond and two single bonds linking it with three other carbon atoms.

"The big mystery is how the system can rearrange itself like this," says Robert F. Curl, a member of the Rice team. "We're not really quite clear about what's happening in the vaporization process. Even if it comes off in graphite sheets, it somehow has to pull in a five-member ring in order to start curving around." *—I. Peterson*

AIDS virus: Infection up?

More than 2 million people in the United States have been infected by the AIDS virus, according to estimates from the New York Medical College in Valhalla that appear in the Nov. 21 NEW ENGLAND JOURNAL OF MEDICINE. Steven L. Sivak and Gary P. Wormser looked at reported antibody-positivity rates and AIDS incidence in hemophiliacs and intravenous drug users, and calculated that for every living adult with AIDS (7,152 as of Nov. 18), there are 300 infected individuals.

This is considerably higher than estimates by the Centers for Disease Control (CDC) in Atlanta. Based on the antibody-positive/AIDS-incidence ratio in a cohort of San Francisco male homosexuals, the CDC estimates that for each of the 14,653 cases—living or dead—of adult AIDS that have been diagnosed in the United States, there are 50 to 100 antibody-positive individuals.

In the Nov. 15 MORBIDITY AND MORTALITY WEEKLY REPORT, the CDC published guidelines stating that except under specific conditions involving direct contact with blood or body fluids, antibody-positive persons pose no hazard in the work place. □