Even such a simple concept as how Japan would be reimbursed for the money spent by foreign researchers had to be worked out, says Maki, who is a former KEK physicist. In the United States and Europe, he says, university teams working at a national laboratory typically set up an account to handle their local expenses, and the host lab collects money from the home institution. "But the Japanese government organization is not allowed to operate in this way," he says. "So we had to invent a tricky way to operate this kind of practice."

Now, foreign scientists are no longer an oddity at KEK. "Things have changed quite a bit," says Abe. "The procedure to get housing, for instance, is well defined, and we have a secretary who can teach them how to go to the bank and set up an account, or go shopping. Even the procedures for getting a visa are well defined."

Similar accommodations are being made in an effort to make Japan the world center of nuclear fusion research, a field in which Japan has a long history of international collaboration. In 1978, Japan sent a team of researchers, hardware, and $70 million to San Diego to participate in a joint magnetic fusion program involving a large DOE fusion facility run by General Atomics. "As a measure of its importance to them," says Roberts, "the Japanese turned off a domestic research facility and decided it was a better investment to put their money and people into the existing facility here."

That research work has steadily grown, and Japan is now one of four partners—with the United States, Russia, and Europe—in the ITER program, which is the first big-ticket scientific project in Japan that is international by definition. ITER has three co-centers, in San Diego, Munich, and Naka, the site of Japan's major fusion research center run by the Japan Atomic Energy Research Institute (JAERI). Each co-center is staffed by researchers from the four countries, who stay from 2 to 6 years. ITER's designated design period is scheduled to end in July 1998, and at that point, if the four partners decide to build a full-scale fusion machine, a site will be chosen. JAERI officials hope that Japan wins the prize.

With that in mind, Japan has built a Western-style office building in Naka. "That means one office per person, even though they clearly don't do that in their own buildings," says MIT's Bruce Montgomery, a prin-

PROFILE

A Sense of What to Look For

TSUKUBA—The discovery of carbon-60 molecules excited scientists around the world, but Sumio Iijima hesitated even to take a look at them. Studying the soccerball-shaped fullerene molecules "is not interesting for a microscopist," says the 55-year-old Iijima. But after a method of mass-producing C-60 had been developed, he had a hunch that electron microscopy might help elucidate how the molecules form. So in the summer of 1991, while most C-60 researchers were sifting through the sooty remains of the vaporized carbon rods, Iijima focused on the electrodes that vaporized them. And what he found—a form of fullerene called carbon nanotubes—may prove to be even more important than the C-60 molecules themselves.

CAROLINE PARSONS/SYGMA

Material pleasures. NEC's Sumio Iijima explores carbon nanotubes, which he discovered in 1991.

"I emphasize that it was serendipity," says Iijima. It's not false modesty: Although Iijima, a relaxed, affable man with a mop of salt-and-pepper hair, becomes bashful when describing his accomplishments, he's quite forthright about his gifts as a scientist. "I have the best technique in microscopy," he says flatly.

But there's more to Iijima than just technique. "He has a sense of what to look for, of what will give us the most interesting and most valuable information [about a material]," says Roy Lang, director of NEC's Fundamental Research Laboratories in Tsukuba, where Iijima is a research fellow.

Even before his discovery of carbon nanotubes propelled him to worldwide fame—and two of the 10 papers currently most cited in chemistry and physics—Iijima had attracted worldwide notice. After earning a doctorate in physics from Tohoku University and doing a stint there as a research associate, Iijima went to Arizona State University in 1970 to work under John Cowley. In addition to helping Cowley's group take electron microscopy to ever finer levels of resolution, Iijima became the first microscopist to image localized atomic defects in crystals.

Iijima returned to Japan in 1982 to join one of the first projects funded under the innovative Exploratory Research for Advanced Technology (ERATO) program started by the Science and Technology Agency. As part of the Hayashi Ultra-Fine Particle Project, Iijima worked with a specially designed electron microscope equipped with a fast videotape recording system to capture moving images on an atomic scale. Among other achievements, he showed that crystalline particles of gold spontaneously change shape and that the arrangement of the atoms within the particles also changes. "That type of work had never been done by any other group," he says. His peers agreed: In 1985 he received Japan's prestigious Nishina Memorial Award in physics.

When the ERATO project ended in 1987, Iijima declined offers from several universities and joined NEC, lured with promises of a $2-million, custom-built, ultrahigh-vacuum, high-resolution transmission electron microscope. Iijima has been applying electron microscopy to the study of new materials. Ironically, he was using a standard transmission electron microscope, not his prize tool, when he found the carbon nanotubes.

Being as much a materials scientist as a microscopist, Iijima has continued to explore nanotubes since his 1991 discovery. Despite having a tiny team—one colleague, an assistant, and the occasional postdoc—Iijima has succeeded in filling the tubes with liquid lead, describing how the tubes change diameter along their length, and finding single-shell tubes instead of the more common multiple concentric tubes. He's now trying to mass-produce single-shell tubes to confirm predicted electrical and mechanical properties and to demonstrate applications, including new composite fibers and the use of nanotubes as templates to form nanometer-scale wires. Although serendipity has played a role, his superb technique and sense of what to look for should keep Iijima at the focal point of his field.

–D.N.