Despite the relative scarcity of these numbers, Friedlander and Iwaniec not only proved that this particular sparse subset includes an infinite number of primes but also accurately determined the frequency of primes in the sequence—that is, the likely number of primes within a given range.

"Everybody expected that result," Sarnak says. "The surprise was that they could prove it. Even for experts, it seemed way out of reach."

The techniques developed by Friedlander and Iwaniec may turn out to be useful for tackling several other key questions in number theory. No one has yet proved that there is an infinite number of primes among numbers of the form $a^2 + 1$, which would be a subset of the subset studied by Friedlander and Iwaniec.

Mathematicians would also like to prove that the number of twin primes—pairs of primes, such as 17 and 19, that differ by 2—is infinite. "That's a major unsolved problem," Sarnak comments. "It's considered to be very, very difficult."

"The question is whether the work of Friedlander and Iwaniec represents a special case or is going to open the door to lots of other things," Granville says. "It's possible it could go a long way, but it's hard to tell what's coming."

Friedlander and Iwaniec are interested in extending their approach to primes of the type $a^2 + b^6$, which would have intriguing links to mathematical equations called elliptic curves. Such curves played an important role in the recent proof of Fermat's last theorem (SN: 11/15/97, p. 310). —*I. Peterson*

Xenon injects images with brightness

Breathed as an anesthetic, the inert gas xenon gives patients a light-headed feeling similar to that of laughing gas. Since the 1980s, researchers have been exploring another use for inhaled xenon—enhancing the capacity of magnetic resonance imaging (MRI) to obtain detailed pictures of the lungs and the brain.

Conventional MRI creates anatomical pictures by detecting protons, which reside mainly in a tissue's water molecules. Xenon also generates a distinct MRI signal, but as it travels through the bloodstream, it becomes too diffuse to yield useful images.

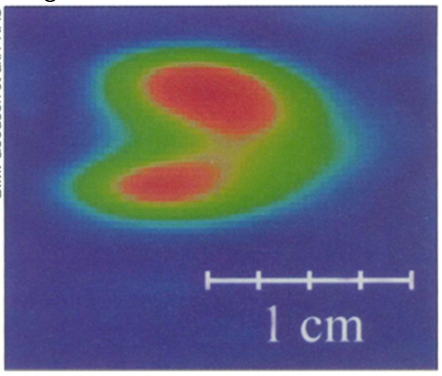
Now, scientists report that an injection of xenon can deliver high concentrations of the gas to parts of the body far from the lungs. An injection localizes the gas in a particular organ, which can then be scanned using MRI, says Alexander Pines of the Lawrence Berkeley (Calif.) National Laboratory and the University of California, Berkeley.

Pines, Thomas F. Budinger of the University of California, San Francisco, Gil Navon of Tel Aviv University in Israel, and their colleagues report the findings in the Dec. 23, 1997 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

"It's a very nice study," says Scott D. Swanson of the University of Michigan in Ann Arbor, who is developing brain imaging techniques using inhaled xenon. Physicians may someday choose inhalation or injection, depending on which organs they want to see, he says.

Using a technique called optical pumping (SN: 7/30/94, p. 70), Pines and his colleagues hyperpolarized the xenon nuclei, aligning their spins and thereby enhancing their MRI signal. The scientists then dissolved the treated xenon in a solvent compatible with the tissues to be imaged. Once dissolved, the xenon spins begin to fall out of alignment. In their experiment, the researchers had less than a minute to inject the solution into the hind legs of rats and detect the circulating xenon.

Pines and his team are also delving into whether the treated xenon can transfer its polarization to other molecules in the body (SN: 5/4/96, p. 282). If it can, hyperpolarized xenon could enhance a variety of conventional MRI images. —*C. Wu*



B.M. Goodson et al./PNAS

A magnetic resonance image of the upper hind leg of a rat 8 seconds after injection with laser-polarized xenon.

New foam tames an asbestos

Ever since the carcinogenicity of asbestos came to light, regulators have been pushing building owners to rid their structures of the mineral or to seal it in place so that it cannot escape. Yet removing or treating asbestos, a material widely used from at least the 1940s through the 1960s for fireproofing and thermal insulation, can release mineral fibers into the air, creating a carcinogenic dust.

Now, chemists from W.R. Grace & Co. of Boca Raton, Fla., and the Energy Department's Brookhaven National Laboratory (BNL) in Upton, N.Y., have developed a chemical foam that lets building owners treat asbestos-containing fireproofing material without removing it. As the foam seeps into the fireproofing, it initiates chemical reactions that "digest" any asbestos, say Grace and BNL scientists. Within 24 hours, more than 99 percent of the fibers present undergo a transformation that makes them less toxic by altering their chemistry and their shape, notes BNL chemist Leon Petrakis.

Almost all of the asbestos used for fireproofing is chrysotile. Its fibers have a hollow, "jelly-roll structure" of chemically bound sheets of magnesium oxide and silicon oxide, explains foam project manager David F. Myers, a chemical engineer in Grace's Cambridge, Mass., office.

"Because of the differences in the atomic radii of silicon and magnesium, when the sheets fall one atop the other they grow into a hollow tube," Petrakis says.

The foam contains both an acid, which attacks the magnesium oxide, and a tiny amount of fluoride ions. Together, they "synergistically unbind the sheets and selectively remove some [positively charged materials]," Petrakis explains. "What remains is a hard material—globs of minerals bound together."

In animal tests, the treated material proved nontoxic. In fire tests, it retained its ability to protect metal structures used in buildings.

Seven patents on the foam are pending, and Grace hopes to begin marketing it in the next few months. Meanwhile, Petrakis' team continues to work on adapting the technology for other types of asbestos and applications, such as thermal insulation. —*J. Raloff*

W.R. Grace/Insets: BNL

Asbestos treated with foam still protects building materials. With treatment, formerly carcinogenic fibers (left inset) become blobs of nontoxic minerals (right inset).