Why Build the Spallation Neutron Source?

As the needs of our high-technology society have advanced, so have our demands for new materials that are stronger, lighter, and cheaper yet perform well under severe conditions. More than ever, major research facilities, such as x-ray and neutron sources, are used to understand and "engineer" materials at the atomic level. Such materials have greatly improved properties offering both better performance and new applications. For example:

- Our electronic devices require smaller and faster components.
- Commercial and military aircraft, as well as our space probes, need new, lighter alloys and stronger welds for increased speed using less fuel.
- Automobiles are using more high-temperature materials, lightweight alloys, and plastics to become more fuel efficient and less polluting.
- Computers require ever-increasing storage capacity using magnetic materials.
- New high-temperature superconducting materials promise more efficient motors and power transmission.
- Designer drugs and genetic engineering are revolutionizing medicine and health care.
- New fuel cells, conductors, and hydrogen-storage materials are crucial for the development of a hydrogen-based economy that will help clean our air and reduce greenhouse emissions.

Neutron-scattering research plays an important role in all these areas and more.

Although not obvious to most people, the fruits of neutron-scattering research also include improvements in the range and quality of products used in our everyday lives, such as

- jets;
- credit cards;
- therapeutic drugs;
- compact discs, computer disks, and magnetic recording tapes;
- shatter-proof windshields, adjustable seats, and automatic window openers in cars;
- geological maps of oil deposits;
- environmentally friendly dry cleaning;
- batteries and fuel cells; and
- cement.

Neutron scattering is used by a variety of scientific disciplines to study the arrangement, motion, and interaction of atoms in materials. It's important because it provides valuable information that often cannot be obtained using other techniques, such as optical spectroscopies, electron microscopy, and X-ray diffraction. Scientists need all these techniques to provide the maximum amount of information on materials.

Although the United States pioneered the development and use of early neutron sources, Europeans and the Japanese have capitalized on this early experience and developed newer sources that have been the best in the world for the past 15 to 20 years. Because the SNS will be the most advanced and powerful pulsed neutron source in the world, it will provide research opportunities unavailable elsewhere. Hence, this unique facility will attract scientists and researchers in a variety of disciplines from all over the country and around the world. Studies conducted at the SNS will be basic research and development that can lead to technological and industrial breakthroughs that could ultimately benefit scientific, business, and industrial communities around the world.

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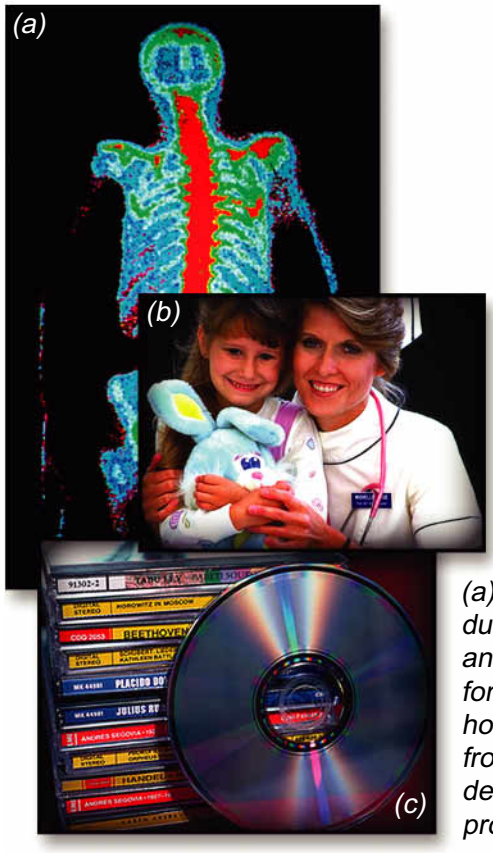
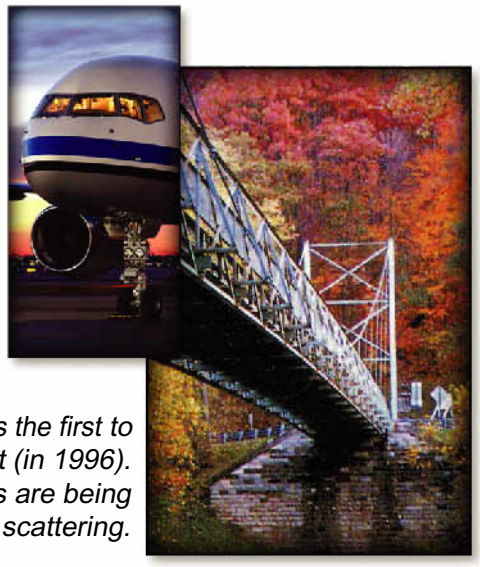
Powerful neutron beams will be produced in the SNS facility by bombarding a mercury target with energetic protons from a large accelerator complex. The protons will excite the mercury nuclei in a reaction process called spallation, releasing neutrons that are formed into beams and guided to neutron instruments. Using these sophisticated instruments, up to 24 of which will exist when the SNS is fully operational, scientists and engineers will explore the most subtle structural details of a vast array of novel materials.



(a) Neutrons have been used to learn how bones mineralize during development and how they decay during osteoporosis, and they make it possible for us to devise and to test remedies for demineralizing diseases. (b) Of the people who enter hospitals, one in three (or about 100 million each year) benefit from isotopes produced by neutrons. (c) Neutrons help us develop improved polymers for the plastics used in many products, such as compact discs.

Much of the Boeing 757 airplane is made of lightweight plastic. Neutron studies could lead to safer, faster, more energy-efficient aircraft.



Neutron scattering has been used to determine how to best manufacture and weld piping materials for use in oil pipelines to reduce residual stresses and prevent cracking and oil leaks.

The Corbin Bridge in Pennsylvania was the first to have an aluminum deck replacement (in 1996). Aluminum welds for such decks are being characterized by neutron scattering.