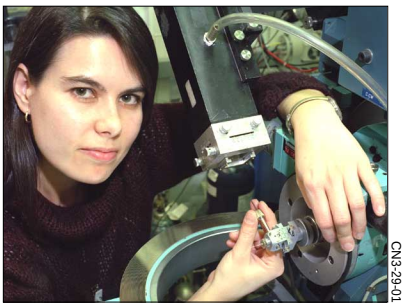
Of Matter and Materials

Brookhaven's research in the physical sciences ranges from probing the subatomic structure of matter to developing improved industrial materials.

First RHIC Results

Scientists representing the four experiments at Brookhaven's Relativistic Heavy Ion Collider (RHIC) have presented results from this new collider's first experimental run. More than 1,000 scientists are collaborating on these experiments, which aim to detect and study a new form of matter, the quark-gluon plasma. Scientists think this hot "soup" of free quarks and gluons last existed millionths of a second after the universe first formed.



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Physicist Beatriz Noheda studies piezoelectric transducers.

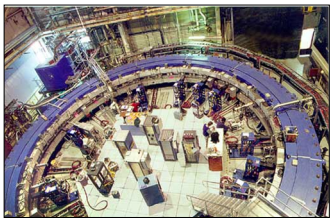
Early results from the RHIC experiments show that these high-energy collisions of gold ions produce the greatest concentration of energy per unit volume ever achieved under laboratory conditions. Scientists are now studying for the first time the properties of elementary particles produced in vast numbers under these extraordinary circumstances.

Exciting new results, and a greater understanding of how free quarks and gluons evolved into ordinary matter, will emerge as RHIC experiments continue.

Possible Violation of Standard Model

In February 2001, Brookhaven scientists, in collaboration with researchers from 11 other institutions in the U.S., Russia, Japan, and Germany, announced an experimental result that confronts the so-called Standard Model of particle physics. The work could open up a whole new world of exploration for physicists interested in new theories — such as super-symmetry — that extend the Standard Model.

The Standard Model is an overall theory of particle physics that has withstood rigorous experimental challenge for 30 years. The Brookhaven finding — the latest precision measurement of the anomalous magnetic moment of the muon, a type of subatomic particle — deviates significantly from the value predicted by the Standard Model. This indicates that other physical theories that go beyond the assumptions of the Standard Model may now be open to experimental exploration.



The world's largest superconducting magnet, where muon measurements were made.

High-Performance Transducers

Brookhaven physicists have made advances in the study of piezoelectric materials — materials that can be deformed by the application of an electric field, or that produce an electric current when physically deformed. They are commonly used in telephones, sonar devices, and ultrasound machines. Using Brookhaven's National Synchrotron Light Source, the scientists have discovered a previously unknown phase, or crystalline shape, for certain compositions of the most effective piezoelectric material. This knowledge could lead to the development of much more sensitive solid-state transducers.

New Way to Make Metal Oxides

Brookhaven scientists have devised a novel way of making metal oxides. This class of compounds, which includes magnesium oxide (a key ingredient of Milk of Magnesia) and zinc oxide (famous for its place on lifeguards' noses), is commonly used in catalysts and cosmetics, and is important to the growing field of nanotechnology. The new method allows greater control of the particle size and chemical composition of the product, and avoids the dangers and difficulties of working with molten liquid metal. Instead, the Brookhaven scientists combine the metal with graphite and heat it to form an intermediate compound, a metal carbide. Then the scientists apply more heat to decompose the metal carbide. The metal gets released as a vapor, which can be oxidized to form pure metal oxide powder.

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