FACTS

a passion for discovery

BROOKHAVEN NATIONAL LABORATORY

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The Relativistic Heavy Ion Collider (RHIC)

A Premier Facility for Nuclear Physics Research

Purpose:
To study the fundamental properties of matter from elementary atomic particles to the evolution of the universe

Sponsor:
U.S. Department of Energy's Nuclear Physics Division

Total Project Cost:
$600 million

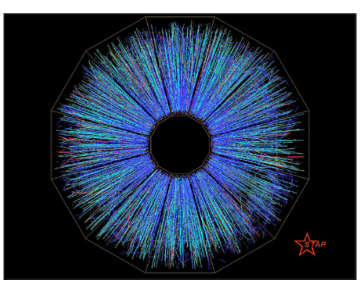
Operating Costs:
$130 million per year

Features:
- Two crisscrossing rings in a tunnel 2.4 miles in circumference
- 1,740 superconducting magnets
- Four experiments: BRAHMS, PHENIX, PHOBOS and STAR

Users:
1,000 per year from national and international laboratories, universities, and other research institutions.
- BRAHMS: 51 collaborators from 14 institutions and 8 countries
- PHENIX: 450 collaborators from 45 institutions and 10 countries
- PHOBOS: 70 collaborators from 12 institutions and 3 countries
- STAR: 400 collaborators from 33 institutions and 7 countries

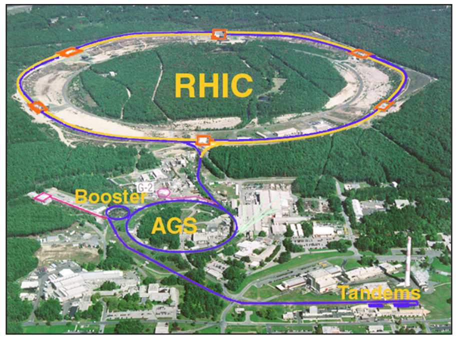
Competing Facilities:
None until 2007 when the Large Hadron Collider (LHC) is scheduled for operation at the CERN laboratory in Switzerland

www.bnl.gov/rhic



Particle tracks from one of RHIC's first collisions.

The Relativistic Heavy Ion Collider (RHIC) is the world's newest facility for basic research in frontier nuclear physics. It is designed to study matter as it existed fractions of a second after the birth of the universe — probably as a plasma of quarks and gluons, the fundamental components of all matter.



RHIC's chain of accelerators.

The key to new discoveries in this field is to accelerate heavy ions (atoms of heavy elements stripped of their electrons) and collide them at high energies to mimic the hot, dense conditions of the early universe.

The Machine

RHIC is really two accelerators in one — made of crisscrossing rings of superconducting magnets, enclosed in a tunnel 2.4 miles in circumference. In the two rings, beams of heavy ions are accelerated to nearly the speed of light in opposite directions, held in their orbits by the powerful magnetic fields.

The particles collide at six points around the circles where RHIC's two rings intersect. Thousands of collisions take place every second, each producing a spray of thousands of subatomic particles.

Complementary detectors known as BRAHMS, PHENIX, PHOBOS, and STAR are situated at four of the six intersection points. These detectors collect and analyze the collision products, providing physicists worldwide with data to help them investigate the inner workings of matter and the birth of the universe.

Accelerator Chain

RHIC draws upon a "chain" of accelerators at Brookhaven Lab. Heavy ions begin their travels in the Tandem Van de Graaff accelerator. The ions then travel through a transfer line to the small, circular Booster where, with each pass, they are accelerated to higher energy. From the Booster, ions travel to the Alternating Gradient Synchrotron (AGS), which then injects the beams into the two rings of RHIC.

In RHIC, the beams get a final accelerator "kick up" in energy from powerful, highly-focused radio waves. Once accelerated, the ions can zip around the rings for many hours.

RHIC can also conduct colliding-beam experiments with polarized protons using Brookhaven's chain of accelerators.

The Detectors

All four detectors are engaged in the search for the postulated quark-gluon plasma.

- BRAHMS measures a small number of particles emerging from a specific set of angles, and precisely measures characteristics such as momentum and energy.
- PHENIX detects collision products that can reveal information about the initial collision temperature, as well as the time evolution during its later stages.
- PHOBOS examines a very large number of collisions to detect rare and unusual collision events.
- STAR obtains fundamental data about the microscopic structure of the ion interactions, tracking thousands of particles emerging from the collisions.

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