The Columbus Dispatch

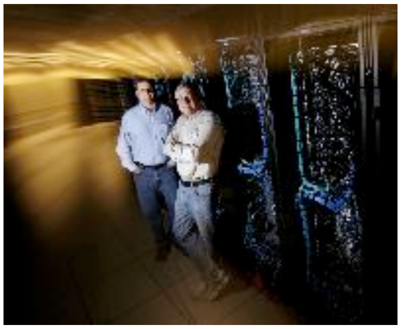
A universe of data

Supercomputers around the world enlisted to help manage Large Hadron Collider information

Sunday, June 6, 2010 02:59 AM

BY SPENCER HUNT

THE COLUMBUS DISPATCH



ERIC ALBRECHTDISPATCH

Douglas Johnson, left, with the Ohio Supercomputer Center, and Thomas Humanic, an Ohio State physicist, are awaiting collider data.

Workers constructed the ALICE chamber inside the Large Hadron Collider.

Having trouble understanding the sub-atomic experimental physics at work at the Large Hadron Collider in Switzerland? • Thinking of it in terms of a recipe might help. • 1. Take two lead atoms and strip them of their orbiting electrons. • 2. Mix them in a 17-mile-long bowl until they collide at a velocity that approaches the speed of light. • 3. Bake them in the resulting atomic fireball and feast on the data from the eruption of hundreds of particles that made up the atoms' neutrons and protons.

That last step is a tough order. The data is mountainous and more than 1,000 physicists are sitting at the table, forks in hand, waiting for morsels that could help unravel secrets of the universe.

Help is on the way — 95 supercomputer centers around the world, including one in Columbus, are ready to crunch the data.

"It's very exciting, fun to be right on the edge of something," said Ohio State University physicist Thomas Humanic. "We are in unknown territory. No one has ever been there before."

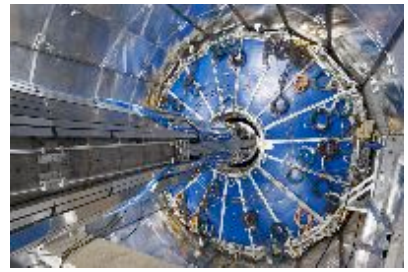
Unfamiliar with the collider? The $8 billion project has a "simple" task: To blast down to the most fundamental forms of matter and find the set of rules that everything in the universe — down to subatomic particles — lives by.

Humanic and OSU colleague Michael Lisa hope data from the forthcoming lead atom collisions will shed new light on the structure of mass, the "quark-gluon plasma," which physicists theorize existed only briefly in the hot, dense environment created mere microseconds after the Big Bang.

The universe at that moment was a soup of sub-atomic particles including quarks and gluons that bonded to form atoms.

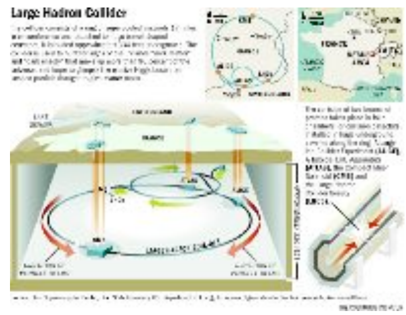
The Hadron collider, the largest machine ever built, offers a chance to examine these particles in collisions three times more powerful than those produced by smaller atomic colliders.

While the collider is colossal, so is the data. That's where the network of computers comes in to play.



PHOTOS COURTESY OF CERN

The silicon pixel detector in the ALICE chamber will help detect and track the subatomic particles.



Doug Johnson, senior systems developer at the Ohio Supercomputer Center, said he began working with Humanic and others on something called A Large Ion Collision Experiment, or ALICE, in 2000.

Johnson spent years helping to work on AliEn, a program that distributes data worldwide and helps researchers sort through it to get what they need. It's a tremendous computing challenge.

Data from the Hadron Collider flows at 1.25 gigabytes — two CD-ROMs worth of data — every second. AliEn distributes that data among the computing centers for storage and then retrieves portions of it for physicists at 105 universities, labs and research institutes in 30 countries.

The Ohio Supercomputer Center has allotted 30 terabytes of storage space for ALICE data. That's enough memory to store all the text contained in the Library of Congress, three times over.

The computers there can perform as many as 75 trillion computations every second.

"When you consider the complexity of all of the computing centers and all the networks that have to be in place, (ALICE) is just amazing," Johnson said.

The first batches of data, collected from the collisions of protons on protons, began flowing into Ohio in early May.

Humanic and other researchers involved with ALICE are largely waiting until the collider starts smashing lead atoms later this year.

Humanic and other researches involved with ALICE want to study heavy atom explosions because they produce more subatomic particles than the proton collisions. They believe the dense cloud of particles created would more closely represent the quark-gluon plasma.

Lisa said he's looking for a more fundamental understanding of the "strong force" that binds quarks and gluons. Such an understanding could lead to a more complete picture of how matter organized itself at the smallest, most elemental level.

The more collision data the computers crunch, the more specialized researchers can be.

For example, Peter Jacobs, a physicist at the Lawrence-Berkeley National Laboratory, said he wants to look for rare head-on collisions between lead atoms, which create quarks that jet through the fireball at right angles.

An analysis of the wake the jets leave behind could reveal more about the structure of quark-gluon plasma. The problem is, most of the lead atoms will shatter from glancing blows that don't produce these jets.

"I'll be throwing away about 99 percent of the data," Jacobs said.

Humanic and his OSU colleagues joined the ALICE experiment in 1997.

"We definitely have been chomping at the bit," Humanic said.

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