Experiments may reveal new state of matter for the 'glue particles', the gluons

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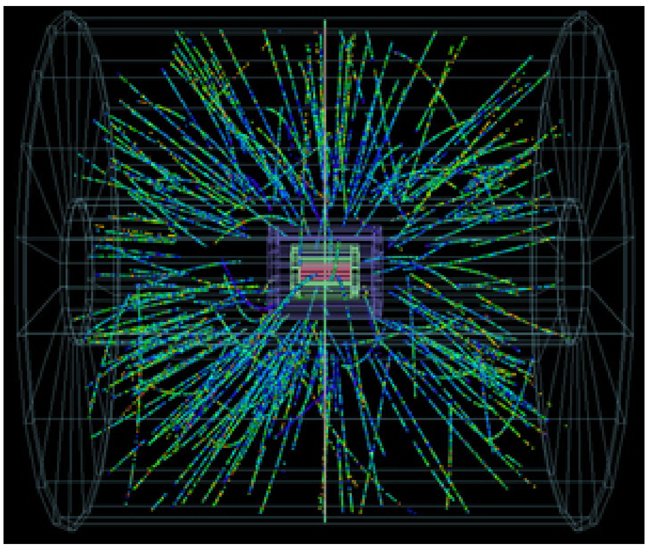

Collisions between protons and lead nuclei were established for the first time in the ALICE detector. Such collisions will enable scientists to investigate new aspects of the structure of nuclear particles.

(Phys.org)—At the LHC accelerator at CERN, collisions between protons and lead nuclei were established last week, for the first time in the ALICE detector.

"These first tests exceeded all expectations. The performance of the LHC and the ALICE detector is remarkable. Collisions were established in record time and we collected the first collision data during the night, says Professor Jens Jørgen Gaardhøje, at the Niels Bohr Institute, University of Copenhagen and adds that the data now will be analyzed at full speed.

Collisions between protons and lead nuclei will enable scientists to investigate new aspects of the structure of nuclear particles. "It is of very significant interest to study asymmetric collisions between large nuclei and the much smaller protons", says Jens Jørgen Gaardhøje and explains, that when the protons hit a lead nucleus it 'drills' a hole through the lead nucleus and leaves it relatively unscathed. As the proton cuts through the lead nuclei, the gluons inside the proton and the lead nucleus will collide and produce particles that can be measured in the Alice detector. In this way one can investigate the properties of nuclear matter, without heating it too much, as is done in lead-lead collisions.

It is the gluons, which are the bearers of the strong nuclear force, that the researchers are interested in studying. Gluons have the special property that they can interact with each other. This means that gluons may split into several gluons of lesser energy. If this splitting were to continue indefinitely, the nuclear particles would be filled with an infinite number of gluons of infinitely low energy and momentum, Jens Jørgen Gaardhøje explains and says that this is untenable. Fortunately, through the same mechanism gluons may also recombine and fuse together. It is therefore reasonable to assume that a status quo is established, resulting in a universal saturation density of gluons. The resulting state of matter has been dubbed the Color Glass Condensate (CGC).

The existence of CGC has not so far been unambiguously demonstrated, but the research group, HEHI at Niels Bohr Institute measured already in 2005 indications that the CGC might be realized. If the CGC exists, it may be an entirely new manifestation of Bose-Einstein Condensates (a situation in which the particles collect in the lowest energy states), in this case governed by the strong interaction.

"This nights successful test run at CERN with the ALICE detector is a preparation for the full experimental program scheduled to take place in January-February of 2013. This initial run was so successful, however, that it may already be able to give indications on whether the CGC exists in nature. This state will be very interesting to study and give us new opportunities to understand the properties of saturated gluon matter ", says Jens Jørgen Gaardhøje.

The research group, HEHI group atthe Niels Bohr Institute has built a special detector, the Forward Multiplicity Detector (FMD), covering a large kinematical range, that will prove crucial for the investigation of the Color Glass Condensate.

Provided by University of Copenhagen

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