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Séminaire

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Observing the structure of atomic nuclei at high-energy colliders

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Bât. 100, A015 and zoom:
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Over the past two decades, a program of high-energy heavy-ion collisions has been conducted in the world's largest accelerator facilities, the BNL Relativistic Heavy-Ion Collider (RHIC) and the CERN Large Hadron Collider (LHC), to create and study in the laboratory the hot and dense phase of strong-interaction matter, the quark-gluon plasma (QGP). The QGP was discovered nearly 20 years ago in ^{197}Au+^{197}Au collisions at RHIC. About ten years later, production of QGP droplets by means of ^{208}Pb+^{208}Pb collisions also started at the LHC.

With the advent of experimental data from additional collision systems, namely, ^{238}U+^{238}U collisions at RHIC, and ^{129}Xe+^{129}Xe collisions at LHC, it has been recently realized that many observables used in the analysis of heavy-ion collisions are strongly impacted by the collective structure (deformations and radial profiles) of the colliding ions. Nuclear structure manifests, in particular, in the azimuthal anisotropy of the emission of particles, which directly reflects the anisotropy of the geometric shape of the QGP formed in the region where the two interacting nuclei overlap. The simplest example is that of the nucleus ^{238}U. Experimentally, azimuthal anisotropy in ^{238}U+^{238}U collisions is strongly enhanced compared to ^{197}Au+^{197}Au collisions. This is immediately explained by an effect induced by the strongly-prolate shape of ^{238}U.

In this seminar, I review the basics of high-energy nuclear phenomenology, and I discuss recent activity in the field that has established high-energy nuclear experiments as a new probe of nuclear structure. High-energy observables have been found to carry, in particular, quantitative information about quadrupole, octupole, and triaxial deformations of the colliding ions, as well as about their neutron skin. They provide, thus, a new tool to obtain an information about the structure of nuclei that is fully complementary to that obtained in traditional nuclear experiments at lower energy.

References:

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