

Study of heavy-ion and proton interactions with nuclei on the LHC beams with fixed target

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Using the multi-TeV LHC proton and lead beams in a fixed target experiment (Project AFTER) has an advantage for investigation of rare processes of particle production and polarization phenomena. Within the framework of the project it is planned to determine the parameters necessary for the analysis of cosmic rays and neutrino astrophysics, a detailed study of processes of quarkonia production, the investigation of the quark and gluon structure of hadrons and the search for new physics in the phase transition of nuclear matter to quark-gluon plasma. The halo of the high intensity beams of protons and lead ions accumulated in the LHC collider could be used by placing into it a solid or gaseous fixed target or a bent crystal for beam extraction. A polarized target could be installed in the extracted beam. The particle energy reaches values only half as much as at the RHIC collider, but the luminosity exceeds the luminosity of the collider. For a proton beam with an energy of 7 TeV $\sqrt{s_{NN}} = 114.6$ GeV, and for lead ions with an energy of 2.76 TeV per nucleon $\sqrt{s_{NN}} = 71.8$ GeV. Since only the halo of the beam is used, the functioning of the main LHC installations is not violated. By using LHC beams with reduced energy on a fixed target, the data will be obtained in the energy range 30-100 GeV, which could be more promising than at ultrahigh energies for the search of the phase transition effects and the determination of the critical point.

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