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Physics performance studies for the NA60+ experiment at the CERN SPS

The region of the QCD phase diagram at high μ_B can be accessed by fixed-target experiments working at future or existing facilities providing nuclear beams in the multi-GeV energy range. In particular, the CERN SPS is able to provide high-intensity beams over a wide energy interval ($\sqrt{s_{NN}} = 5-17$ GeV) that are ideal for the study of rare signals. Recently, an expression of interest has been presented for a new experiment at the CERN SPS, NA60+, aimed at measuring hard and electromagnetic probes in nuclear collisions with unprecedented precision with an energy scan. The physics goals of such an experiment are very broad and ambitious. On one hand, NA60+ proposes the investigation of the order of the phase transition to the QGP in the region $\mu_B \sim 200-400$ MeV with the first measurement of a caloric curve, and the first direct measurement of $\rho - a_1$ chiral mixing by a precision measurement of the dimuon yield in the a_1 mass region.

These physics topics can be addressed via the study of the dimuon continuum from threshold up to 3 GeV. On the other hand, the study of the transport properties of the QGP close to the threshold energy for the occurrence of deconfinement can be accessed for the first time by a simultaneous precision study of hidden and open charm. The measurements of charmonium and open charm states are performed through dimuon and hadronic decays, respectively. In this talk, the physics case of the experiment will be reviewed with a detailed discussion of the results of the physics performance studies. The talk will stress the competitiveness and complementarity of the NA60+ program in the landscape of the proposals foreseen at other facilities in the next decade.

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