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Precision proton-proton and proton-nucleus collision studies at A Fixed-Target ExpeRiment at the LHC (AFTER@LHC)

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We discuss the physics opportunities [1] which are offered by a next generation and multi-purpose fixed-target experiment exploiting the LHC beams. The multi-TeV LHC proton beam grants the most energetic fixed-target experiment ever performed, to study pp, pd and pA collisions at sqrt(s_NN) ˜ 115 GeV. AFTER@LHC – for A Fixed-Target ExperRiment – gives access to new domains of particle and nuclear physics complementing that of collider experiments, in particular RHIC and the projects of electron-ion colliders.

With a beam extracted by a bent crystal, the typical instantaneous luminosity achievable with AFTER@LHC in pp and pA mode [1] surpasses that of RHIC by more than 3 orders of magnitude and is comparable to that of the LHC collider mode, without pile-up thanks to the slow extraction mode. Another possibility is offered by the LCHb SMOG system, with a priori a limited luminosity, though. This provides a quarkonium, prompt photon and heavy-flavour observatory [1,2] in pp and pA collisions where, by instrumenting the target-rapidity region, gluon and heavy-quark distributions of the proton, the neutron and the nuclei can be accessed at large x and even at x larger than unity in the nuclear case. The nuclear target-species versatility provides a unique opportunity to study the nuclear matter versus the hot and dense matter formed in heavy-ion collisions. Modern detection technology should allow for the study of quarkonium excited states, in particular the chi(c) and chi(b) resonances thanks to the boost of the fixed-target mode. This would allow one to study gluon TMDs as suggested for instance in [3]. The fixed-target mode also has the advantage to allow for spin measurements with polarized targets, for instance single-spin asymmetries for Drell-Yan pair production [4]. We will review all these aspects and show first simulation results.

References

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