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Progress towards A Fixed-Target ExpeRiment at the LHC: AFTER@LHC

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The multi-TeV LHC beams offer the possibility to perform the most energetic fixed-target experiments ever, in order to study with high precision pp and pA collisions at $\sqrt{s_{NN}} \simeq 115$ GeV and Pbp and PbA collisions at $\sqrt{s_{NN}} \simeq 72$ GeV. AFTER@LHC – A Fixed-Target ExperRiment – can greatly complement collider experiments, in particular those of RHIC and EIC projects. We thus discuss the possibility of a multi-purpose fixed-target experiment using LHC beams extracted by a bent crystal or using an internal gas target inspired from the LHCb SMOG system. We have evaluated that the instantaneous luminosity achievable with AFTER would surpass that of RHIC by more than 3 orders of magnitude. This provides a quarkonium, prompt photon and heavy-flavour observatory 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. In addition, the fixed-target mode has the advantage to allow for spin measurements with polarized targets over the full backward rapidity domain. 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. We will show first results of the fast simulations based on a LHCb-like detector used in the fixed-target mode and discuss connections with data from LHCb SMOG, which can be seen as a low-density internal gas target.

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