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Physics with heavy ions at FCC-hh

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This presentation will review the projected accelerator performance and the physics opportunities for a heavy-ion programme at FCC-hh [1]. In addition, the status of the FCC-hh detector design studies will be discussed.

Operating FCC-hh with heavy-ion beams would provide Pb-Pb and p-Pb collisions at center of mass energy of 39 and 63 TeV per NN pair, respectively. Current estimates indicate that a luminosity of about 30/nb could be integrated during a one-month Pb-Pb run, that is more than one order of magnitude above the maximum projections for the LHC. The FCC-hh beams could also be used for fixed-target collisions, either with beam extraction or gaseous target.

The Quark-Gluon Plasma state produced in Pb-Pb collisions at 39 TeV is expected to have initial temperature and energy density substantially larger than at LHC energy, a stronger flow field and freeze-out volume twice as large. The larger temperature could entail novel features, like e.g. abundant in-medium production of charm quarks. The latter could determine an increase in the number of degrees of freedom of the QGP and provide a new tool to study its temperature evolution. New, rarer, hard probes would be available, like boosted top quarks, which could give access to the time-evolution of the medium opacity.

The physics of high gluon densities at small Bjorken-x and the onset of saturation can be studied using pA, AA, and gamma-A collisions. The FCC-hh will provide access to the region down to x<10−6 with perturbative probes like heavy quarks and quarkonia and to the region of high Q2 down to x~10−4 with W, Z and top. High-energy photon-photon interactions in ultraperipheral AA collisions will also enable the study of very rare processes such as light-by-light scattering and gamma-gamma to W+W−.

[1] A. Dainese et al., Heavy ions at the Future Circular Collider, arXiv:1605.01389

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