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Physics of heavy flavors and strangeness with a time-of-flight PID upgrade at CMS in the high-luminosity LHC era

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The intriguing phenomena emerging in the high-density quantum chromodynamics (QCD) matter are being widely studied in the heavy ion program at the LHC and will be understood more deeply during the high-luminosity LHC (HL-LHC) era. The CMS experiment is under the Phase 2 upgrade towards the HL-LHC era. Among others, a new timing detector is proposed with its timing resolution for minimum ionization particles (MIP) to be 30 ps. The MIP timing detector (MTD) will also provide the particle identification (PID) ability with a large pseudorapidity acceptance covering up to $|\eta| < 3$ through time-of-flight (TOF). Combining MTD with the other new subdetectors, i.e., a tracker with acceptance $|\eta| < 4$ and high-granularity calorimeters with acceptance $|\eta| < 5$, will enable deeper studies of high-density QCD matters in ultrarelativistic heavy ion collisions. In this presentation, the performances of a broad range of measurements in the future CMS heavy ion programs will be discussed using TOF-PID. Particular emphasis will be given to the future heavy flavor and strangeness program, including the (3+1)-dimensional evolution of heavy flavor quarks, fluctuations and transport of initially conserved quantum charges, and light nuclei physics.

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