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From strangeness to charm and beauty with Inner Tracking System of ALICE at LHC

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From strangeness to charm and beauty with Inner Tracking System of ALICE at LHC

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In the first part of this talk, we present the major motivations for the current new ALICE physics programme of measurements of low-momentum charm and beauty hadrons and low-mass dielectrons in heavy-ion collisions at the LHC. These studies of rare processes will bring unique information on the properties of the quark-gluon plasma (QGP) and, in particular, on the process of QGP thermalization and its quantitative characterisation, including the heavy-flavour transport coefficients and space–time evolution of the QGP.

We will show also some several recent experimental observations by the ALICE collaboration in studies of medium induced effects on strange and charm particles yields, shape of jets, and of residual strong interaction between strange, charm and light hadrons. With these interesting results, new long-term physics ambitious goals appeared. To reach them, it was required to solve the most challenging task of improving the ALICE performance for heavy-flavour detection. It was at the core of the ALICE upgrade programme in the last decade. The following goals had to be met: (i) coverage in transverse momentum to be as complete as possible, in particular, down to very low momenta, (ii) very accurate identification of secondary vertices from decaying charm or beauty (D, J/ψ, Λc, Λb). The ALICE Collaboration designed the entirely new Inner Tracking System (ITS2) with the increased capabilities in readout speed, impact parameter resolution and the reduced material budget. The ITS2 was installed in spring 2021, commissioned with proton beams in October 2021 and June 2022 and successfully operating in LHC Run 3 at high collision rates since July 2022.

Today, the high granularity ITS2 (12,5 Gpixels) is the largest pixel detector ever built. It has 10 m2 of thin of 50 and 100 um thick ALPIDE chips— silicon monolithic active pixel sensors (MAPS) based on CMOS technology. We will present the status of ALICE ITS2 in Run 3. We will also discuss briefly the future prospects for development of the next generation of vertex trackers — the ITS3. The most central three cylindrical layers of silicon-only sensors with a further significant reduction in the material budget (0.3 ⟶ 0.05% X0/layer), are supposed to be installed during the Long Shutdown 3 (in 2026-2028).

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