The 22nd International Conference on
Strangeness in Quark Matter
22-27 March, 2026, Los Angeles, CA

Contribution ID: **20** Type: **Poster Presentation**

Charm-baryon measurements via strangeness tracking with ALICE at the LHC

Tuesday, 24 March 2026 18:36 (1 minute)

Heavy quarks, i.e., charm and beauty, in proton-proton collisions at the LHC are mainly produced in hard-parton scatterings at the early stages of the collisions. Owing to the large masses of the charm and beauty quarks compared to the QCD scale parameter ($\Lambda_{\rm QCD}$ $\sim$ 200 MeV), their production can be described using perturbative quantum chromodynamics (pQCD) calculations. During LHC Run 2, observations by ALICE have revealed a significant enhancement in charm-baryon production in hadronic collisions compared to electron–positron and electron–proton collisions. This challenges the conventional assumption of fragmentation universality. LHC Run 3 now offers the opportunity to extend these studies with improved detector performance, higher precision, and larger statistics.

A new method for detection of charmed baryons via their decays into strange baryons, called 'strangeness tracking', is adopted. Exploiting the upgraded silicon Inner Tracking System in ALICE during LHC Run 3, this method enables the novel possibility of tracking strange hadrons (Ξ, Ω) directly before they decay, leading to a significant improvement in secondary-vertex resolution. This enhanced precision not only allows more precise studies of charm-baryon decay modes, but also offers advantages for measurements of $\Omega_{\rm c}^{0}$ lifetimes, which are important for understanding their internal structure and decay dynamics.

This poster presents the $\Xi_{\rm c}^{0}$- and
$Omgea_{\rm c}^{0}$-baryon production measurements via the decay channels $\Omega_{\rm c}^{0} \rightarrow \ ^{-}\pi^{+}$, and the rare modes $\Omega_{\rm c}^{0} \rightarrow \ ^{-}\pi^{+}$ and $\Xi_{\rm c}^{0} \rightarrow \ ^{-}{\rm K}^{+}$ in pp collisions at $\sqrt{s}$ = 13.6 TeV in Run 3. It also discusses the prospects for a precise measurement of the $\Omega_{\rm c}^{0}$ lifetime. These results demonstrate the enhanced capability of strangeness tracking for reconstructing charm–strange baryons and will provide important constraints for hadronization models and theoretical descriptions of charm-baryon production.

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Session Classification: Poster Session