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Probing collective behaviour of Heavy Quarks through p_T–differential radial flow $v_0(p_T)$

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We present, for the first time, the charmed hadron p_T–differential radial flow $v_0(p_T)$, within a Langevin transport framework that incorporates event-by-event fluctuations. We propose $v_0(p_T)$ of heavy quarks as a novel and sensitive observable for probing the properties of the Quark–Gluon Plasma (QGP). This observable exhibits a pronounced sensitivity to the interaction strength between heavy quarks and the medium. When evaluated across three transport scenarios, ranging from weak to strong coupling, $v_0(p_T)$ increases by nearly a factor of five at intermediate p_T, offering a powerful tool to constrain the heavy-quark transport coefficients, a long-standing objective in heavy-ion physics. At low p_T, $v_0(p_T)$ is also highly sensitive to the hadronization mechanism: coalescence plus fragmentation leads to a larger $v_0(p_T)$ for Λ_c baryons compared to D mesons, while pure fragmentation yields similar values. Our results indicate that heavy quarks participate in the collective expansion of the QGP, with a radial flow magnitude comparable to that observed for light hadrons in recent ALICE and ATLAS measurements. These features make $v_0(p_T)$ a powerful tool to investigate both transport and hadronization dynamics and open new directions for future studies in small systems such as p+A and O+O collisions, relevant to the HI-LHC program.

[1] M. L. Sambataro, S. Plumari, S. K. Das and V. Greco, e-print: 2510.19448 (submitted to PRL).
[2] S. Plumari et al., PLB 805 (2020) 135460.

Authors: Prof. PLUMARI, Salvatore (University of Catania, LNS-INFN); SAMBATARO, Maria Lucia (Università di Catania - LNS (INFN)); DAS, Santosh K. (School of Physical Sciences, Indian Institute of Technology Goa); GRECO, Vincenzo (University of Catania, LNS-INFN)

Presenter: Prof. PLUMARI, Salvatore (University of Catania, LNS-INFN)

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