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Thermal dilepton polarization and microscopic dynamics in the QCD plasma

The virtual photons emitted during the early stages of relativistic heavy-ion collisions can escape the strongly interacting matter and be measured. This study shows that their polarization can reveal much about the nature of their production mechanism. We present the results of a comprehensive investigation of dilepton polarization generated by a quark-gluon plasma produced in Pb+Pb collisions at the LHC. We compare the polarization results predicted by leading-order (LO) and next-to-leading order (NLO) dilepton emission rate calculated with thermal field theory [1] and highlight the differences. The rates are integrated using a state-of- the-art multi-stage framework which includes IP-Glasma+KøMPøST+MUSIC+URQMD [2], and this end-to-end realistic dynamical approach is used to compute the polarization coefficients, like λ_θ, that can be compared to experimental measurements. We observe sizeable differences between LO and NLO results: both in overall sign and in magnitude. On non-perturbative grounds, the NLO results can be confirmed by a new correlator recently studied on the lattice [3]. Furthermore, the behaviour of λ_θ in the limit of small invariant masses indicates that the inclusion of the NLO corrections is mandatory to recover the correct transverse polarization. Our study confirms the important role played by dileptons as probes of early time dynamics.

[1] Jessica Churchill, Lipei Du, Charles Gale, Greg Jackson, and Sangyong Jeon, Phys. Rev. Lett. 132 (2024) 17, 172301; Phys. Rev. C 109, 044915 (2024)
[2] Charles Gale, Jean-François Paquet Björn Schenke and Chun Shen, Phys.Rev.C 105, 014909 (2022)
[3] HotQCD Collaboration, Phys. Rev. D 110, 054518 (2024)

Category

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Authors: Ms FOSTER, Bailey (McGill University); GALE, Charles; JACKSON, Greg (SUBATECH (CNRS/IN2P3)); GAO, Han; JEON, Sangyong; WU, Xiang-Yu (McGill University)

Presenters: GAO, Han; WU, Xiang-Yu (McGill University)

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