Contribution ID: **263** Type: **Poster**

Investigating virtual photon polarization via $\gamma^* \to \mu\mu$ in Pb-Pb at $\sqrt{s_{NN}} = 2.76$ TeV by numerical calculation

Tuesday 24 September 2024 18:10 (20 minutes)

The virtual prompt photons are produced at the initial stage of heavy-ion collisions and are sensitive to the extremely strong magnetic field produced in non-central heavy-ion collisions. At LHC energies, this magnetic field can reach intensities of 10^{15} - 10^{16} T. In the presence of this magnetic field, the dilepton decayed from a virtual photon can be polarized in response to the direction of the magnetic field because the vacuum fermion fluctuation links photons to the magnetic field [1]. We define this phenomenon as the virtual photon polarization and propose the virtual photon polarization as a probe of the magnetic field.

We will present the first numerical calculation results on the intensity of virtual photon polarization in Pb-Pb at $\sqrt{s_{NN}} = 2.76$ TeV, specifically for the decay channel $\gamma^* \to \mu\mu$. These calculations are crucial for evaluating the feasibility of observing this effect with the ALICE experiment. The magnetic field intensity is calculated using magnetohydrodynamics [2], and we have determined the polarization intensity at each time step. This allows us to estimate the inclusive polarization in Pb-Pb collisions.

[1] Ken-Ichi Ishikawa, Daiji Kimura, Kenta Shigaki, Asako Tsuji, Int.J.Mod.Phys.A 28 (2013) 1350100
[2] Nakamura, Miyoshi, Nonaka, and Takahashi, Phys.Rev.C 107, 034912 (2023)

Category

Theory

Collaboration

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Session Classification: Poster Session

Track Classification: 4. Electromagnetic and electroweak probes