# Exploring Polarised Dilepton Production Rate as a QGP Signature

**Moulindu Kundu**, Aritra Bandyopadhyay, Victor E Ambruș, Maxim N Chernodub

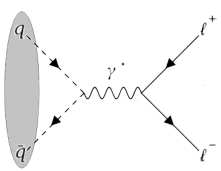
West University of Timișoara, Romania

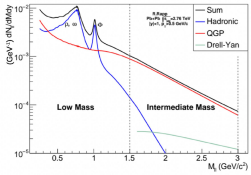
4 December 2025

# Exploring Polarised Dilepton Production Rate as a QGP Signature

Dilepton Production Rate (DPR) is given by,

$$\frac{dN}{d^4Q\,d^4X} = \frac{\alpha_{em}}{8\pi^4} e^{-\beta Q_0} \rho^{\mu\nu}(Q) I_{\mu\nu}(Q)$$




$\rho^{\mu\nu}(q)$ is the Photonic Factor (also the photonic spectral function), which can be written in terms of imaginary part of current-current correlator $C^{\mu\nu}$ as follows:

$$\rho^{\mu\nu}(q) = -\frac{1}{\pi} \frac{e^{\beta q^0}}{e^{\beta q^0} - 1} \frac{e_e^2}{q^4} \mathrm{Im}\left[C^{\mu\nu}(q)\right]$$

and the Leptonic Factor $I_{\mu\nu}(Q)$ is given by,

$$I_{\mu\nu} = \int \frac{d^3p_1}{E_1} \frac{d^3p_2}{E_2} \delta^4(P_1 + P_2 - Q) L_{\mu\nu},$$

$$L_{\mu\nu} = \frac{1}{4} \sum_{s_1, s_2} \mathrm{Tr}\left[u^{s_2}(P_2) \bar{u}^{s_2}(P_2) \gamma_\mu v^{s_1}(P_1) \bar{v}^{s_1}(P_1) \gamma_\nu\right]$$

# Exploring Polarised Dilepton Production Rate as a QGP Signature

## Unpolarised Leptonic Factor

The spin-sum formula:

$$\sum_{s_1} v^{s_1}(P_1)\bar{v}^{s_1}(P_1) = \not{P}_1 - m_l,$$
$$\sum_{s_2} u^{s_2}(P_2)\bar{u}^{s_2}(P_2) = \not{P}_2 + m_l$$

We get,

$$I_{\mu\nu}(Q) = \frac{2\pi}{3} B_l \left(Q_\mu Q_\nu - Q^2 g_{\mu\nu}\right)$$

where,

$$B_l = \left(1 + \frac{2m_l^2}{Q^2}\right)\left(1 - \frac{4m_l^2}{Q^2}\right)^{\frac{1}{2}}$$

## Polarised Leptonic Factor

Instead of the spin-sum, we take arbitrary spins $\vec{s_1}$ and $\vec{s_2}$ (unit 3-vectors) for lepton and antilepton respectively. We thus have,

$$v(P_1, S_1)\bar{v}(P_1, S_1) = (\not{P}_1 - m_l)\frac{1 + \gamma^5 \not{S}_1}{2},$$
$$u(P_2, S_2)\bar{u}(P_2, S_2) = (\not{P}_2 + m_l)\frac{1 + \gamma^5 \not{S}_2}{2}$$

*Further details in the poster...*