Low-$p_T \mu^+ \mu^-$ pair production in Au + Au collisions at $\sqrt{s_{NN}} = 200$ GeV at STAR

Jian Zhou (for the STAR Collaboration)
State Key Laboratory of Particle Detection and Electronics,
Department of Modern Physics,
University of Science and Technology of China

Quark Matter 4-10.4.2022, KRAKOW, POLAND
**Motivation**

J.Adam et al. (STAR) 2018 Phys. Rev. Lett. 121 132301

- Excess relative to the hadronic cocktail concentrates below $p_T \approx 0.15 \text{ GeV/c}$.  
  - Evidence of photon interactions in hadronic heavy ion collisions.
- Linearly polarized photon-photon collisions will lead to azimuthal angular modulation which is related to vacuum birefringence.
  - 4$^{th}$-order azimuthal angular modulation of $e^+e^-$ pairs has been observed by the STAR Collaboration.
  - 2$^{nd}$-order azimuthal asymmetry is only sizable for $\mu^+\mu^-$ pair production.

---

---

-- C.Li et al., 2020 Phys.Rev.D 101, 034015
A significant enhancement with respect to the cocktail.

\( \eta, \omega, \) and \( c\bar{c} \) are the main sources of the cocktail.

Consistent with the EPA-QED calculations in different centralities.
$p_T$, $t$, and $\Delta \phi$ distributions

- Excesses concentrate below $p_T \approx 0.1$ GeV/c.
- Data in favor of EPA-QED calculation.
- The $\sqrt{\langle p_T^2 \rangle}$ is consistent with the EPA-QED calculation.
- Indication of the 4th-order azimuthal angular modulation of $\mu^+ \mu^-$ pairs.
- The hint of 2nd-order azimuthal angular modulation.
Summary

● First cross-section measurements of photo-produced $\mu^+\mu^-$ pair at very low $p_T$ in peripheral heavy-ion collisions.
  ○ A significant $\mu^+\mu^-$ enhancement w.r.t. cocktail is observed.
  ○ The $p_T$ and $t$ distributions are consistent with the EPA-QED calculation.
● The hint of the azimuthal angular modulation from the dimuon channel.