https://us02web.zoom.us/j/

Quarta 13/05 16.00

James Brandenburg (BNL)

Title: Probing Ultra-strong Electromagnetic Fields with the Breit-Wheeler Process (BNL)

Nota GT: Como você pode ver na referências. esta é a observação experimental de um efeito básico da teoria quântica de campos, teorizado por Heisenberg nos anos 30. Se publicado chamará bastante atenção. Não é totalmente inconcebível que será um prêmio Nobel algum dia.

Ultra-relativistic heavy ion collisions are expected to produce some of the strongest magnetic fields ($10^{13}-10^{16}$ Tesla) in the Universe[1]. Recently, there has been increased interest in the magnetic fields produced by heavy ion collisions and their possible observational impacts through emergent magnetohydrodynamical phenomena in Quantum Chromodynamics, like the Chiral Magnetic Effect[2]. The initial strong electromagnetic fields produced in heavy-ion collisions have been proposed as a source of linearly-polarized, quasi-real photons[3] that can interact via the Breit-Wheeler process to produce $e^+ e^-$ pairs[4].

In this talk I will present STAR measurements of $e^+ e^-$ pair production in ultra-peripheral and peripheral Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV. A comprehensive study of the pair kinematics is presented to distinguish the $\gamma\gamma \rightarrow e^+ e^-$ process from other possible production mechanisms.
Further, the measured distribution of $e^+e^-$ pairs reveals a striking fourth-order angular modulation which is a direct result of vacuum birefringence[5], a phenomenon predicted in 1936 in which empty space can split light according to its polarization components when subjected to a strong magnetic field.

Together these measurements provide the first direct experimental evidence of QED phenomena that have waited nearly a century for confirmation. Additionally, they show that ultra-relativistic heavy-ion collisions are capable of producing magnetic fields approximately 10,000 times stronger than the those in the magnetosphere of neutron stars (inferred to be $\approx 10^{10}-10^{12}$ Tesla), the strongest magnetic fields in the known Universe until now.

[1] V. Skokov, A. Illarionov, and V. Toneev. International Journal of Modern Physics A 24 (2009): 5925–32.
[2] Kharzeev, D. E., et al. Prog. Part. Nucl. Phys., 88 (2016)1–28
[3] C. Weizsäcker, Zeitschrift für Physik 88 (1934): 612–25.
[4] G. Breit and J. A. Wheeler. Physical Review 46 (1934): 1087
[5] Heisenberg, W., and H. Euler. Zeitschrift für Physik, (1936) arXiv: physics/0605038