

Holographic photon production and flow in heavy ion collisions

Thermal-photon production from the quark gluon plasma (QGP) phase plays an imperative role for direct photon production in heavy ion collisions. In most of theoretical approaches, the emission rate from the perturbative calculation with hard thermal loop resummation is applied. In order to facilitate our understandings for the impact from coupling dependence on the photons from QGP phase, we resort to the AdS/CFT correspondence. Despite the distinction between holographic duals and strongly coupled QCD, former studies in holography have not incorporated the medium evolution and the contributions from other phases, which make the results difficult to be compared with experiments. We thus perform the state-of-the-art computations to embed the photon emission rates from holography into medium evolution and include other contributions for direct-photon production.

In this work, the thermal-photon emission from strongly coupled gauge theories at finite temperature is calculated using holographic models for QCD in the Veneziano limit (V-QCD). The emission rates are then embedded in hydrodynamic simulations combined with prompt photons from hard scattering and the thermal photons from hadron gas to analyze the spectra and anisotropic flow of direct photons at RHIC and LHC. The results from different sources responsible for the thermal photons in QGP including the weakly coupled QGP (wQGP) from perturbative calculations, strongly coupled $\mathcal{N} = 4$ super Yang-Mills (SYM) plasma (as a benchmark for reference), and Gubser's phenomenological holographic model are then compared. It is found that the direct-photon spectra are enhanced in the strongly coupled scenario compared with the ones in the wQGP, especially at intermediate and high momenta, which improve the agreements with data. Moreover, by using IP-glassma initial states, both the elliptic flow and triangular flow of direct photons are amplified at high momenta ($p_T > 2.5$ GeV) for V-QCD, while they are suppressed at low momenta compared to wQGP. The distinct results in holography stem from the blue-shift of emission rates in strong coupling. In general, compared to experiments, the theoretical results still underestimate the flow in RHIC. In addition, we further evaluate the spectra and flow in small collision systems for future comparisons. We emphasize that thermal photons from the deconfined phase are substantial to reconcile the spectra and flow at high momenta.

The presentation is based on arXiv:1609.07208.

Preferred Track

Electromagnetic Probes

Collaboration

Not applicable

Primary authors: Dr SHEN, Chun (McGill University); YANG, Di-Lun (RIKEN)

Presenter: YANG, Di-Lun (RIKEN)

Session Classification: Poster Session