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Jet-Tagged Back-Scattering Photons For Quark Gluon Plasma Tomography

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We investigate the correlations of photons produced by Compton back scattering and annihilation of fast quarks in quark gluon plasma with their away-side jets. Compton back scattering and quark annihilation into photons effectively act as jet-photon conversion mechanisms and were originally proposed as novel electromagnetic sources in heavy ion collisions in Phys. Rev. Lett. 90, 132301 (2003). The unique appeal of these processes lies in the fact that their photons carry information about both the medium via a T^2 log 1/T dependence of the yield, and about the energy loss of partons before the back scattering occurs. Attempts to identify these photons in experiment through inclusive direct photon spectra or direct photon v_2 measurements at intermediate PT at RHIC have been inconclusive so far. We show that the capability to measure jets in coincidence with photons at the upgraded STAR and SPHENIX experiments, or at one of the LHC experiments, offers a unique opportunity to identify back scattering photons at large photon momenta. Jet-triggered back-scattering photons can be distinguished from bremsstrahlung through their strong correlation with the given trigger ET, and they are set apart from prompt hard photons through the energy loss of their parent parton. We demonstrate with leading and next-to-leading order calculations that jet-triggered direct photon spectra and nuclear modification factors in nuclear collisions as a function of photon PT show a distinct feature around the trigger ET due to back-scattering photons. The height and width of this structure are correlated with the medium temperature and parton energy loss spectrum, respectively.

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