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Baryon stopping from the bremsstrahlung photon spectrum

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In ultra-relativistic heavy-ion collisions, the colliding nuclei are decelerated and kinetic energy is converted into new particles. This energy loss is referred to as baryon stopping. A fundamental question one can ask in the study of high energy heavy-ion collisions is how much baryon stopping there is. This can be quantified by measuring the net proton rapidity distributions. Previous measurements at RHIC and in fixed target experiments have shown that the amount of stopping decreases with increasing collision energy. At LHC energies, there are no experimental constraints beyond the central rapidity region, where there are no net protons.

In order to investigate the net proton distribution at LHC energies beyond mid-rapidity, we propose using the bremsstrahlung photons emitted from the nuclei as they slow down. In our recent study [1], we investigated stopping scenarios which are based on model calculations or phenomenology and consistent with existing data. Furthermore, we performed a detailed estimate of the background from hadronically produced photons, using the PYTHIA 8.3 event generator, aiming to investigate in which areas of phase space the bremsstrahlung photons constitute a viable observable for baryon stopping. The bremsstrahlung spectra are highly sensitive to the amount of nuclear stopping, and depending on the scenario, a significant signal over background is obtained for pseudorapidities $\eta>\sim4-5$ and for photon energies $\omega<\sim300-500$MeV.

Here, we expand our investigation to include the baryon stopping predicted by the EPOS4 event generator for PbPb collisions at sqrt(sNN)=5.02TeV. EPOS4 gives zero net protons at mid-rapidity, making the bremsstrahlung spectrum from this stopping scenario plausible.

Furthermore, we discuss the bremsstrahlung spectrum coming from proton-proton collisions, which gives insight into the charge dependence of the signal to background ratio of bremsstrahlung photons in hadron collisions.

[1] S. Nese and J. Nystrand, Eur. Phys. J. C 83 (2013) 14. arXiv:2210.16200.

Category

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Primary authors: NYSTRAND, Joakim (University of Bergen (NO)); NESE, Sigurd (University of Oslo (NO))

Presenter: NESE, Sigurd (University of Oslo (NO))

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