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Probing the multi-scale dynamical interaction between heavy quarks and the QGP using JETSCAPE

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The dynamics of shower development for a jet traveling through the QGP involves a variety of scales, one of them being the mass for heavy flavors residing inside jets. Though the mass of the heavy quarks plays a subdominant role during the high virtuality portion of the jet, it does affect longitudinal drag and diffusion, stimulating additional radiation from heavy quarks [1]. These emissions partially compensate the reduction in radiation from the dead cone effect. In the lower virtuality part of the shower, when the mass is comparable to the transverse momenta of the parton, scattering and radiation processes off heavy quarks are different than off light quarks. All these factors result in a different nuclear modification factor for heavy versus light flavors and thus for heavy-flavor tagged jets.

The heavy quark shower development and the fluid dynamical medium are modeled on an event by event basis using the JETSCAPE Framework [2]. We present a multi-stage calculation that explores the importance of differences between various heavy quark energy-loss mechanisms within a realistically expanding quark-gluon plasma (QGP). Inside the QGP, the highly virtual and very energetic portion of the shower is modeled using the MATTER generator, while the LBT generator models the energetic and close-to-on-shell heavy quarks'showering. Energy-momentum exchange with the medium, essential for the study of jet modification, proceeds using a weak coupling recoil approach. The JETSCAPE framework admits transitions, on the level of individual partons, from one energy-loss prescription to the other depending on the parton's energy and virtuality and the local density. This allows us to explore the effect and interplay between the different regimes of energy loss on the propagation and radiation from hard heavy quarks in a dense medium. The boundary between these stages can be extracted from a comparison with data. We will explore this boundary, via comparisons to experiment, for both charm and bottom quarks.

[1] R. Abir, M. Majumder, Phys. Rev. C 94, 054902 (2016)
[2] J.H. Putschke et al., arXiv:1903.07706

Collaboration (if applicable)

JETSCAPE

Track

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Author: Dr VUJANOVIC, Gojko (Wayne State University)

Presenter: FAN, Wenkai (Duke University)

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