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Event-by-event jet-induced medium response from machine learning

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In high-energy heavy-ion collisions, jets traverse the quark-gluon plasma (QGP) and deposit energy into the medium, leading to jet-induced medium response. The medium response takes the form of Mach-cone-like excitations and can modify the internal structure of the jet, affecting many observables, such as jet shape and jet fragmentation function and so on. However, Simulation of jet-induced medium response requires not only a complete model that can accurately describe the evolution of hard and soft partons concurrently, but also substantial computational resources for full-scale simulations. In this study, we trained a generative neural network using a flow model with gamma jet events from Pb + Pb collisions of centrality $0-10\%$ at 5.02 TeV to estimate the final-state effects of jet-induced medium response. Our findings indicate that with only the initial jet information—namely, the energy-momentum of gamma and the jet, along with their initial positions—the network can accurately predict the positions of the front wake and diffusion wake, and maintain the particle spectrum within the same order of magnitude as the actual data.

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