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Differentiating Energy-Energy Correlators with Charged Particle Multiplicities within a Jet

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Recent CMS results reveal that jets with extremely high multiplicity exhibit novel substructure patterns not seen in ordinary jets, including long-range correlations. However, standard Monte Carlo tools struggle to access this regime due to its rarity and complexity. In this work, we develop a theoretical framework to study high-multiplicity jets, incorporating both multiplicity evolution and Energy-Energy Correlators (EEC) as key probes of jet substructure. Using the normalized multiplicity ratio m=n/⟨n⟩, we investigate how jet properties evolve across multiplicity classes and compare our findings with Pythia8 simulations. This provides new insights into perturbative QCD dynamics in extreme jet events.

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