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Dissecting Jets and Missing Energy Searches Using n-body Extended Simplified Models

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New physics scenarios for the LHC are often characterized by Simplified Models, where the decay of a given particle is represented by an operator involving a minimal number of fields. Such decay operators can be generalized beyond the standard cases to describe a wide variety of final state multiplicities. This approach, which we dub the n-body extension of Simplified Models, provides a unifying treatment of the signal phase space resulting from a large class of new physics scenarios. In this talk, we present its first application, in the context of multijet plus missing energy searches. We present a global performance study aiming at identifying which set of observables yields the best discriminating power against the largest Standard Model backgrounds for a wide range of signal jet multiplicities. Our analysis compares combinations of one, two and three variables, placing emphasis on the enhanced sensitivity gain resulting from non-trivial correlations. To this end, machine-learning techniques known as boosted decision trees are employed. We compare and classify performance of combinations of missing energy, energy scale and energy structure observables, and we demonstrate that observables from each of the three classes are required to achieve optimal performance. This work additionally serves to demonstrate the utility of n-body extended Simplified Models as a diagnostic for unpacking the relative merits of different search strategies, thereby motivating their application to other signatures of new physics beyond jets and missing energy.

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