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Jet Performance studies on Dark jet resonance searches

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The present work aims to carry out a comparative study of jet reconstruction algorithms when employed to analyze events originating from a dark QCD model. Specifically, it focuses on two definitions used in the ATLAS experiment: LCTopo Trimmed, which has been established as the standard for jet reconstruction, and UFOCSSK SoftDrop, a more sophisticated method expected to become the new standard. The impact of calibration and grooming algorithms on the agreement between the reconstructed quantities and those at the truth level is investigated. The results highlight the importance of calibration, with definitions like EMPFlow and LCTopo Trimmed showing positive agreement between reconstruction levels and truth. In contrast, other definitions exhibited some degree of deviation. In particular, the UFOCSSK algorithms without grooming and with Trimming showed discrepancies due to the presence of low p_T components that were effectively removed only by UFOCSSK SoftDrop.

The analysis of variables such as the dijet system's mass shows that calibration and grooming algorithms have a significant impact on the final event distribution. Grooming algorithms slightly improved the location of the resonance of the dark sector mediator in the LCTopo-based definitions. However, in the UFOCSSK algorithms, each grooming algorithm shifted the resonance to different positions, with Trimming being the least effective, resulting in greater dispersion. Metrics reflecting pile-up resistance, such as the average dijet mass as a function of the number of primary vertices and the mass response as a function of true p_T, are examined. Overall, the transition from LCTopo Trimming to UFOCSSK SoftDrop is depicted as a positive enhancement for the search for resonances in dark QCD.

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