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Enhancing di-jet Resonance Searches at the (HL)-LHC via FSR Tagging

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In this article, we investigate the possibility of enhancing the di-jet resonance
search by tagging the final state radiation (FSR) jets, using an event-level deep neural network. It is found that solely relying on the 4-momenta of the leading three jets allows the algorithm to achieve good discriminating power that can identify the hardest FSR jet in signal, while rejecting that in background. Once the invariant mass is corrected using the tagged FSR jet, the mass resolution of the signal is greatly enhanced, and the sensitivity of the search is also improved by 10-20%. By crafting the input variables carefully, the algorithm introduces minimal mass sculpting for the background, and its applicability extends to a broad mass range. This work proves that FSR tagging can potentially enhance the di-jet resonance searches, suiting various stages of the physics programmes at the Large Hadron Collider (LHC) and High-Luminosity LHC (HL-LHC).

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