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Next-to-minimal Vectorlike Quark models at the LHC: Bounds and Prospects

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Non-observation of vectorlike quarks (VLQs) at the LHC motivates us to look for possible gaps in their collider searches. We discuss a scenario where the VLQs decay substantially to a new singlet scalar (or pseudoscalar) that couples dominantly to the VLQs. Such a singlet state can be motivated in various BSM scenarios. The current mass limits on the VLQs (1.2–1.6 TeV, for various weak representations and decays) relax significantly if the VLQs have such additional decay(s). We present the current bounds on VLQs for this scenario and chart a model-independent roadmap to look for such VLQ decays. We also identify the possible signatures for pair-production searches and present a projection study for some promising channels for the weak-singlet top and bottom partner extensions at the HL-LHC.

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