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Symmetries, Safety, and Self-Supervision

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Collider searches face the challenge of defining a representation of high-dimensional data such that (i) physical symmetries are manifest, (ii) the discriminating features are retained, and (iii) the choice of representation is data-driven and new-physics agnostic. We introduce JetCLR (Contrastive Learning of Jet Representations) to solve the mapping from low-level jet constituent data to optimized observables through self-supervised contrastive learning. Using a permutation-invariant transformer-encoder network, physical symmetries such as rotations and translations are encoded as augmentations in a contrastive learning framework. As an example, we construct a data representation for top and QCD jets and visualize its symmetry properties. We benchmark the JetCLR representation against other widely-used jet representations, such as jet images and energy flow polynomials (EFPs).

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