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Geometrical Foundations of BRST Quantization in Gauged Nonlinear Sigma Models and Beyond

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We develop a geometric formulation of gauged nonlinear sigma models based on the coset target space $O(N+1)/O(N)$, emphasizing the interplay between target-space geometry and gauge symmetries. Using Killing vector fields, we construct the BRST transformations and investigate the geometric conditions underlying their nilpotency. We show how the closure of the Killing algebra provides a natural geometric interpretation of the BRST structure within the quantization framework. Finally, we examine representative realizations in electroweak chiral effective field theories and Skyrme-type models, exploring their implications for topological dark matter and physics beyond the Standard Model.

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