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Electro-weak splitting functions and electro-weak shower

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We derive the electroweak (EW) collinear splitting functions up to single logs. Especially we systematically incorporate EW symmetry breaking (EWSB), by imposing a particularly convenient gauge choice (dubbed “Goldstone Equivalence Gauge”) that disentangles the effects of Goldstone bosons and gauge fields in the presence of EWSB. As a result, we are able to derive splitting functions up to leading power corrections in v/kT . We also implement a comprehensive, practical EW showering scheme based on these splitting functions using a Sudakov evolution formalism. The implementation of EW showering includes novel features such as “ultra-collinear” splitting, matching between shower and decay, and mixed-state evolution of neutral bosons ($\gamma/Z/h$) using density-matrices, kinematic back-reaction corrections in multi-stage showers. We demonstrate those new phenomena and features at $O(1-10 \text{ TeV})$ energies with some examples.

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