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## Massive Scattering Amplitudes for Standard Model: On-shell Massless-Massive Correspondence and the On-shell Higgsing

We present a comprehensive exploration of the on-shell Higgs mechanism using the massless-massive correspondence (MMC) applied to scattering amplitudes in the Standard Model. The MMC, integrated with power counting based on the v/E expansion (where v denotes the electroweak vacuum expectation value (VEV)), is derived from spinor splitting and energy scaling of massive amplitudes. For an n-point massive amplitude  $\mathcal{M}_n$ , its energy scaling is categorized as  $[\mathcal{M}_n]_l \sim E^{4-n}(v/E)^l$ , aligning it with an (n + l)-point massless amplitude  $\mathcal{A}_{n+l} \sim [\mathcal{M}_n]_l$ . The Higgs mechanism is reflected in all order matching  $(l \ge 0)$ . Notably, when l > 0, the additional l Higgs bosons in  $\mathcal{A}_{n+l}$  manifest as VEVs in the infrared (IR), thereby matching  $\mathcal{A}_{n+l}$  to  $[\mathcal{M}_n]_l$ . This transition, elucidating how the surplus Higgs bosons at high energy contribute to VEVs at low energy, is called the on-shell Higgsing mechanism.

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