

## The Removal of the Quartic Potential in Gauge Theories and Asymptotic Freedom (Addendum).

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There is an interesting possibility of removing the scalar field  $\varphi_3$  from the theory (or the external states of a physical process) by adding a mass term  $-m^2\varphi_3^2/2$  to the effective Lagrangian  $\mathcal{L}_{\text{eff}} = \mathcal{L}_B + \mathcal{L}_F$  (cf. eqs. (10b), (11) and (12)) and taking the limit  $m_r$  (renormalized  $m$ )  $\rightarrow \infty$  eventually, similar to the spirit of the  $\xi$ -limiting formalism proposed by T. D. LEE and C. N. YANG (*Phys. Rev.*, **128**, 885 (1962)). In this way, the resultant theory involves only the physical vector fields  $\mathbf{B}_\mu$ :  $\mathcal{L}'_{\text{eff}}(\mathbf{B}_\mu) = \mathcal{L}_{\text{eff}} - \frac{1}{2}(m\varphi_3)^2$ . The Lagrangian  $\mathcal{L}'_{\text{eff}}(\mathbf{B}_\mu)$  is also manifestly renormalizable by power counting. It leads to unitary amplitudes in the limit  $m \rightarrow \infty$ ; this has been verified up to and including 2-loop diagrams (*e.g.* the processes in (13) and (14)). Also, it is interesting to note that the result (19) is in harmony with the result obtained by N. P. CHANG (*Phys. Rev. D*, **10**, 2706 (1974)) in a related but different theory based on the eigenvalue-condition considerations.

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