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Physical spectra and the limits of perturbative estimates in a theory with a Higgs

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The spectacular success of perturbation theory in electroweak physics hinges on the validity of the Froehlich-Morchio-Strocchi mechanism. This mechanism allows the determination of the spectrum of physical, gauge-invariant states using perturbation theory if a Brout-Englert-Higgs effect is present. For this mechanism to work two preconditions have to be met. One is the structural requirement that the perturbative multiplet structure can be mapped to the physical one. The other requires that dynamically the pole structure of gauge-dependent correlation functions is not qualitatively altered. To assess the validity of perturbation theory to describe the spectrum in beyond-the-standard model calculations requires to understand when these conditions are fulfilled.

The second condition will be investigated in the Yang-Mills-Higgs case on the lattice. It is found that it depends crucially on the parameters whether this condition is fulfilled. Even in cases where perturbation theory should be expected to work well it turns out that it does not. Various possibilities for a criterion for this breakdown will be discussed. As a side-effect the physical spectrum of the theory in a wide range of the phase diagram is uncovered, which is also valuable for several other research directions.

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