Contribution ID: **38** Type: **Poster**

Accessing the properties of the elementary Higgs beyond perturbation theory

The description of the Higgs in the standard model is gauge-dependent, as for any elementary particle in a gauge theory. To extract the mass or running couplings from the correlation functions therefore requires gauge-fixing. If non-perturbative effects become relevant, e.g. for a very heavy Higgs, due to the presence of (hadronic) bound-states, or strong physics at or beyond the TeV scale, this is complicated by the Gribov problem. The consequence of the Gribov problem is that perturbative gauge definitions become ambiguous. In Yang-Mills theory this ambiguity affects the correlation functions even qualitatively. Thus it has to be resolved to obtain unique results. This problem can be addressed using lattice gauge theory and continuum methods. Using lattice gauge theory, a possible resolution of the ambiguity is presented. This yields that the ambiguous perturbative gauges become families of well-defined non-perturbative gauges. For scalar fields the propagator and gauge-boson-two-scalar interaction vertex are then presented for a particular non-perturbatively well-defined ‘t Hooft gauge. From these the properties of the scalar, like its mass and the running coupling, are obtained. It is outlined how this procedure can be generalized to other and higher correlation functions, constructing a general framework.

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Track Classification: 09 - Progress in Lattice Techniques and New Results