## Phenomenology 2018 Symposium



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## Global SU(2)<sub>L</sub>⊗BRST symmetry and its LSS theorem: Ward-Takahashi identities governing Green's functions, on-shell T-Matrix elements, and the effective potential, in the scalar-sector of certain spontaneously broken non-Abelian gauge theories

Monday 7 May 2018 14:30 (15 minutes)

A gauge theory with the gauge group  $SU(2)_L$  is the simplest non-abelian spontaneous symmetry breaking theory. Its'simplest bosonic representation is a complex scalar doublet in the linear representation with a scalar h, pseudoscalars  $\vec{\pi}$  and vector gauge bosons  $\vec{W}_{\mu}$ . We observe that the on-shell T matrix elements of physical states are independent of global  $SU(2)_L$  global transformations and the current corresponding to these global transformations is conserved exactly on the amplitudes of physical states. We identify two towers of 1-soft-pion Ward-Takahashi Identities which govern the scalar sector, and represent a symmetry which we call  $SU(2)_L \otimes BRST$ , a symmetry not of the Lagrangian but the physical states. The first tower gives relations among  $1-\phi$ -I off-shell Green's functions and the second tower governs on-shell T-matrix elements and replaces Adler self-consistency conditions with those for gauge theories. The T-matrix identities ensure IR finiteness of the theory despite zero Goldstone boson mass and include the LSS theorem which enforces the condition of masslessness on the pseudoscalars, a far stronger statement than the usual masslessness of the Goldstone bosons. The global  $SU(2)_L$  and BRST transformations commute in  $R_{\xi}$  gauges. With the on-shell constraints, the physics therefore has more symmetry than does its BRST invariant Lagrangian. In a previous work, some of us have shown that the above results hold for the Abelian Higgs Model.

References: arXiv: 1711.07349 (submitted to Phys. Rev. D) Phys. Rev. D 96, 065006 (2017)

## Summary

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