Contribution ID: **10** Type: **not specified**

Gauge Anomalies in an Effective Field Theory, the On-Shell Way

Wednesday, 15 January 2020 10:00 (30 minutes)

In a seminal paper, John Preskill showed how gauge theories in the Higgs phase can couple consistently to anomalous matter content. This formulation is complementary to the traditional approach in which gauge theories with an anomalous fermion content necessitate gauged-WZW terms that cancel the fermion anomaly. The gauge invariant statement that follows is that anomalous theories in the Higgs phase are completely consistent with unitarity, when considered as EFTs.

In this work we shed more light on the consistency of anomalous gauge theories in the Higgs phase, using the recently discovered, on-shell notion of gauge anomalies as tension between locality and unitarity at 1-loop. We demonstrate how this tension is reconciled in the Higgs phase by calculating the 1-loop contribution of massless chiral fermions to the massive 4-vector amplitude. This is the one of the first full 1-loop calculations that combine the method of generalized unitarity with Nima Arkani-Hamed's massive amplitude formalism.

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