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Goldstone Boson Decays and Chiral Anomalies

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Martinus Veltman was the first to point out the inconsistency of the experimental value for the decay rate of $\pi^0 \rightarrow \gamma\gamma$

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$\rightarrow \gamma\gamma$ and its calculation by J. Steinberger with the very successful concept of the pion as the (pseudo)Nambu-Goldstone boson of the spontaneously broken global axial symmetry of strong interactions. That inconsistency has been resolved by J. Bell and R. Jackiw in their famous paper on the chiral anomalies. We review the connection between the decay amplitudes of an axion into two gauge bosons in Abelian vector-like and chiral gauge theories. The axion is the Nambu-Goldstone boson of a spontaneously broken axial global symmetry of the theory. Similarly as for the vector-like gauge theory, also in the chiral one the axion decay amplitude is determined by the anomaly of the current of the axial symmetry in its non-linear realization. Certain subtlety in the calculation of the anomaly in chiral gauge theories is emphasised.

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