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Particle creation by strong fields and quantum anomalies

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Particle creation by strong and time-varying backgrounds is a robust prediction of quantum field theory. Another well-stablished feature of QFT is that classical symmetries do not always extend to the quantized theory. When this occurs, we speak of quantum anomalies. In this talk we discuss the intwining relationship between both predictions. First, we point out that the particle number (which can be rigorously proved to be an adiabatic invariant in an isotropic expanding universe) is not longer an adiabatic invariant in some special situations, which turn out to be those for which the chiral symmetry is also broken. Furthermore, we also argue that the symmetry under electric-magnetic duality rotations of the source-free Maxwell theory is anomalous. This implies that the net polarization of photons propagating in a strong gravitational field could change in time. This is a quantum effect, and it can be understood as the generalization of the fermion chiral anomaly to fields of spin one.

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