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Magnon-antimagnon pair production by magnetic field inhomogeneities and the bosonic Klein effect

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Similar to Dirac models of nanostructures, low-energy excitations in spin systems –magnons– can be described in terms of effective field theories. The theory describing antiferromagnets can be mapped into scalar massless electrodynamics with an external electromagnetic potential. Here, we consider the case of a constant inhomogeneous magnetic field applied to an antiferromagnet, whose characteristic magnetic moment plays the role of the electric charge, and magnons and antimagnons differ by the sign of the magnetic moment. In the framework of the effective description, we discuss how vacuum instability (the Schwinger effect) due to magnon-anti magnon production arises in this context. In particular, we show how to use the strong field QED with x-steps developed by the authors (SPG and DMG) to study magnon-anti magnon pair production characteristics by magnetic field inhomogeneities. Finally, we will examine specific examples and investigate the impact of the external field inhomogeneity on magnon pair production.

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