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Traveling wave parametric amplifiers for microwave quantum optics

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Traveling wave parametric amplifiers (TWPAs) are not only promising candidates to achieve broadband amplification of small quantum signals at quantum limited noise. Beyond that, they have been successfully applied to realize quantum optics experiments in the microwave regime [Esposito et. al., PRL 128(15), 2022] and might even become key tools to generate multi-mode entanglement. However, in contrast to resonant devices traveling wave amplifiers can also allow for additional nonlinear processes involving higher sidebands which can have a detrimental impact on the entanglement of signal and idler mode. Therefore, an adequate theoretical description capturing the impact of sidebands as well as higher harmonics is crucial. Hence, our work focuses on extending the standard treatment of the mode dynamics at the first sideband and investigating the signature of sidebands and higher harmonics on gain and entanglement characteristics. Our results show that these unwanted sideband processes may even cause an unexpected entanglement breakdown at high gain which can be observed both, in theory and in the experiment.

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Category

Other

Authors: BÖHLING, Sina (KIT, Karlsruhe); ESPOSITO, Martina (CNR-SPIN, Napoli; Univ. Grenoble Alpes, Grenoble); RANADIVE, Arpit (Univ. Grenoble Alpes, Grenoble); PLANAT, Luca (Univ. Grenoble Alpes, Grenoble); CAPPELLI, Giulio (Univ. Grenoble Alpes, Grenoble); ROCH, Nicolas (Univ. Grenoble Alpes, Grenoble); METELMANN, Anja (KIT, Karlsruhe; FU Berlin, Berlin)

Presenter: BÖHLING, Sina (KIT, Karlsruhe)

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