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Thesis: **"CERTIFICATION OF CONTINUOUS VARIABLE BIPARTITE AND TRIPARTITE QUANTUM ENTANGLEMENT AND STEERING IN A SYSTEM WITH A NONLINEAR INTERACTION"**

Summary:

In recent years, there has been great interest and effort to develop quantum technologies which enable quantum communication. Such technologies utilize quantum nonlocal correlations, such as entanglement and steering, as a resource for quantum information protocols. It has been demonstrated that the systems that generate quantum entanglement and steering are those that are based on nonlinear processes such as spontaneous parametric down conversion, four wave mixing, sum/difference frequency generation, second harmonic generation, and third harmonic generation.

Moreover, those systems can produce bipartite, tripartite or even multipartite quantum entanglement and steering. Recently, there have been proposals based on these nonlinear processes that takes place inside optical cavities which can also demonstrate the production of multipartite nonlocal correlations. In this work, we investigate quantum entanglement and steering generated by an intracavity down conversion process. We consider the interaction of three fields with a nonlinear medium inside an optical cavity. As a result, three down converted fields are obtained outside the cavity. We analyze this system by using the master equation, the phase-space methods and the linearized fluctuation formalisms. In particular, we consider the positive-P function and we obtain the intracavity spectrum in the frequency domain.

We certify bipartite, tripartite and genuine tripartite entanglement, as well as bipartite one-way and two-way steering, and full tripartite two-way steering inseparability in quadrature operators in the frequency domain by using different entanglement and steering criteria. We also investigate the distribution of these quantum corrrelations among the different parties of the system through the monogamy relations for the entanglement and steering witnesses that we use throughout this work. Our results determine frequency values where these correlations are present in the system under consideration.