Design and stability of quantum filters with measurement imperfections: discrete-time and continuous-time cases

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This talk starts with a detailed description of the discrete-time quantum filter used at Laboratoire Kastler Brossel (LKB) for nonlinear state feedbacks stabilizing photon-number states. This filter provides a real-time estimation of the density matrix of the photons trapped inside a cavity. This filter combines quantum probability and the usual Bayes law. It takes into account measurement imperfections, delays and also decoherence. Such kind of filters are shown to be always stable and tend to forget their initial conditions.

Since the seminal contributions of Belavkin, quantum filtering is usually developed in continuous time. We propose here a suggestive and direct path from discrete-time towards continuous-time filters. This path has been used in the thesis of Hadis Amini to derive a new set of continuous time filters driven simultaneously by Wiener and Poisson processes. Similarly to the discrete-time case, such continuous-time filters take into account measurement imperfections and decoherence. They are shown to be stable but their convergence analysis remains an open-problem.