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ABSTRACT

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On Irreducibility of Gaussian Quantum Markov Semigroups

Abstract: The generator of a Gaussian quantum Markov semigroup on the algebra of bounded operator on a d-mode Fock space is represented in a generalized Gorini-Kossakowski-Lindblad-Sudharsan form

$$x \mapsto G^* x + \sum_\ell L_\ell^* \, x L_\ell + x \, G$$

with an operator G quadratic in creation and annihilation operators and Kraus operators $L_1, \dots, L_m$ linear in creation and annihilation operators. Kraus operators, commutators $[G, L_\ell]$ and iterated commutators $[G, [G, L_\ell]], \dots$ up to the order $2d - m$, as linear combinations of creation and annihilation operators determine a vector in $\mathbb{C}^{2d}$. We show that a Gaussian quantum Markov semigroup is irreducible if such vectors generate $\mathbb{C}^{2d}$, under the technical condition that the domains of G and the number operator coincide. Conversely, we show that this condition is also necessary if the linear space generated by Kraus operators and their iterated commutator with G is fully non-commutative.

We discuss open problems and illustrate them by examples.

[1] J. Agredo, F. Fagnola and D. Poletti, The decoherence-free subalgebra of Gaussian QMSs. *Milan J. Math.* **90** (2022) 257–289 doi.org/10.1007/s00032-022-00355-0 arxiv.org/abs/2112.13781.

[2] F. Fagnola and D. Poletti, On Irreducibility of Gaussian Quantum Markov Semigroups. *Infin. Dimens. Anal. Quantum Probab. Relat. Top.* **25** (2022) To appear.