Certification of Temporal Quantum Correlations

H Shrotriya[1], L C Kwek[1,2], and K Bharti[3,4]

[1]*Department of Physics, Centre for Quantum Technologies, National University of Singapore, Singapore, Singapore*
[2]*MajuLab, CNRS-UNS-NUS-NTU International Joint Research Unit, Singapore, Singapore*
[3]*JQI, Joint Quantum Institute, University of Maryland and National Institute of Standards and Technology, College Park MD, USA*
[4]*IHPC A∗STAR, Institute of High Performance Computing, A∗ STAR, Singapore, Singapore*
Contact Email: harshankiitb2014@gmail.com

Self-testing has been established as a major approach for quantum device certification based on experimental statistics with minimal assumptions. However, despite more than 20 years of research effort, most of the self-testing protocols are restricted to spatial scenarios (Bell scenarios), without many temporal generalizations known. Under the scenario of sequential measurements performed on a single quantum system, semi-definite optimization based techniques have been applied to bound sequential measurement inequalities. Building upon this formalism, we show that the optimizer matrix that saturates such sequential inequalities is unique and, moreover, this uniqueness is robust to small deviations from the quantum bound. Furthermore, we consider a generalized scenario in the presence of quantum channels and highlight analogies between the structure of Bell and sequential inequalities using the pseudo-density matrix formalism. These analogies allow us to show a practical use of maximal violations of sequential inequalities in the form of certification of quantum channels up to isometries.