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Constant Gap for Self-embezzlement

W. van Dam and P. Hayden proved that in the standard tensor model for representing bipartite quantum systems, it is impossible to catalytically produce an entangled state. But that as one allowed the dimensions of the state spaces to increase one could carry out this process to arbitrary precision. They referred to this process as "embezzlement" since if one knew the accuracy to which a third party could make observations, then one could "appear" to carry out an impossible task. Later in joint work with Cleve and Liu, we proved that one could not carry out this catalytic production of entangled states in the tensor model even if one allowed infinite dimensional state spaces, but one could carry it out exactly in the commuting model for bipartite systems. In this work we consider the task of not just producing any entangled state but producing the entangled state that is itself the catalyst. We prove that in finite dimensions, there is a constant gap, independent of the dimension, on how "nearly" one can carry out this task. We then prove that this task can be carried out exactly in infinite dimensions in the commuting model.

In this way we obtain a "task" that can be done in infinite dimensions but can not be done approximately in finite dimensions. This talk is based on joint work with B. Collins, R. Cleve and L. Liu.