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*State Transformation Problem in Quantum Information*

One of the fundamental problems quantum information scientists concerned with, is whether one can design and construct a quantum device that transforms certain quantum states into other quantum states. This task is physically possible if a specified quantum operation (transformation) of certain prescribed sets of input and output states can be found. The problem then becomes to determine an existence condition of a trace preserving completely positive map sending  $\rho_j$  to  $\sigma_j$  for all  $j$ , for certain given sets of quantum states  $\{\rho_1, \dots, \rho_k\}$  and  $\{\sigma_1, \dots, \sigma_k\}$ . This is called the problem of state transformation. In this talk, recent results on this problem will be presented.