讲座主题： Sample efficient quantum state tomography

讲座人：俞能昆

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讲座内容简介：

It is fundamental to decide how many copies of an unknown mixed quantum state are necessary and sufficient to determine the state. 1. We give a theoretical measurement scheme (POVM) that requires $O(dr/\delta)\ln(d/\delta)$ copies to estimate ρ to error δ in infidelity, and a matching lower bound up to logarithmic factors. This implies $O((dr/\epsilon^2)\ln(d/\epsilon))$ copies suffice to achieve error ϵ in trace distance. 2. For independent (product) measurements, we show $\Omega(dr^2/\delta^2)\ln(1/\delta)$ copies are necessary in order to achieve error δ in infidelity. 3. For Pauli measurements, we provide a scheme using $O(\frac{10^n}{\epsilon^2})$ copies to achieve error ϵ in trace distance. 4. We also study the "quantum overlapping tomography" problem for the recovery of all k-body reduced density operators and show the sample complexity is $O(\frac{10^k\cdot\log(\binom{n}{k}/\beta)}{\epsilon^2})$ for $1-\delta$ being the confidential level, and ϵ being the trace distance error. Moreover, we prove that $\Omega(\frac{\log(n/\delta)}{\epsilon^2})$ copies are needed. In other words, for constant k, highly entangled measurements are not asymptotically more efficient than Pauli measurements, even one has access to all copies at once.

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俞能昆：悉尼科技大学量子计算中心高级讲师，毕业于清华大学计算机科学与技术系。曾获得澳大利亚科学院拉塞尔奖，华莱士奖，oopsla 杰出论文奖，和 pldi 杰出论文奖。