Introduction

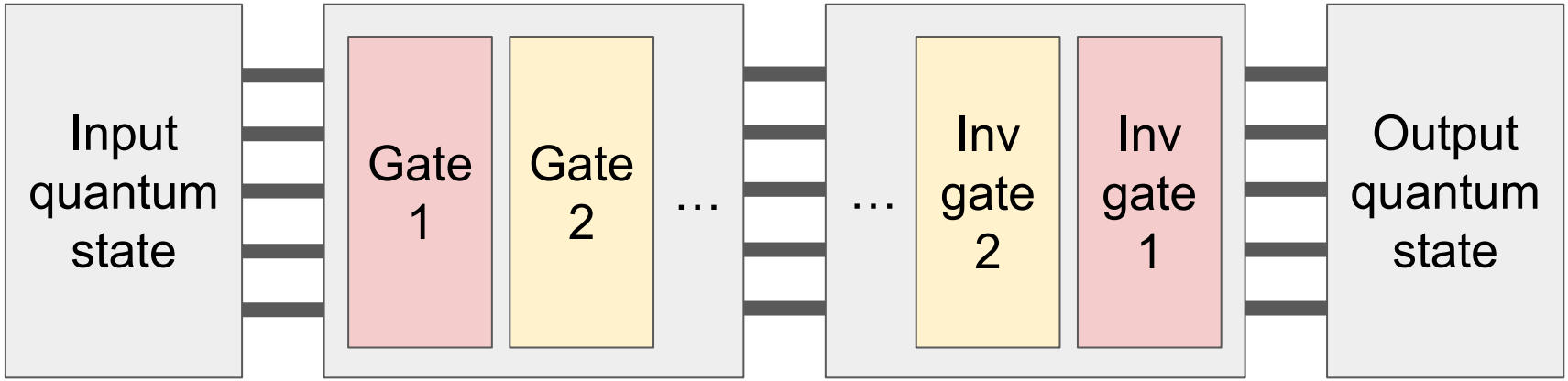
- Quantum information theory (QITh) involves encoding data in quantum states
- State of quantum bits (qubits) is manipulated with quantum gates
- Quantum gates can be represented by unitary matrices

Randomized benchmarking

- Current quantum “computers” are very error-prone
- Randomized benchmarking (RB) measures the average error rates of qubits

Randomized benchmarking

- Works by performing sequences of random quantum gates on the qubit, then measuring how close the output state is to the input



Random quantum gates

- Want to generate a set of random quantum gates from the uniform distribution
- Classical computers cannot perfectly generate Haar-random unitaries

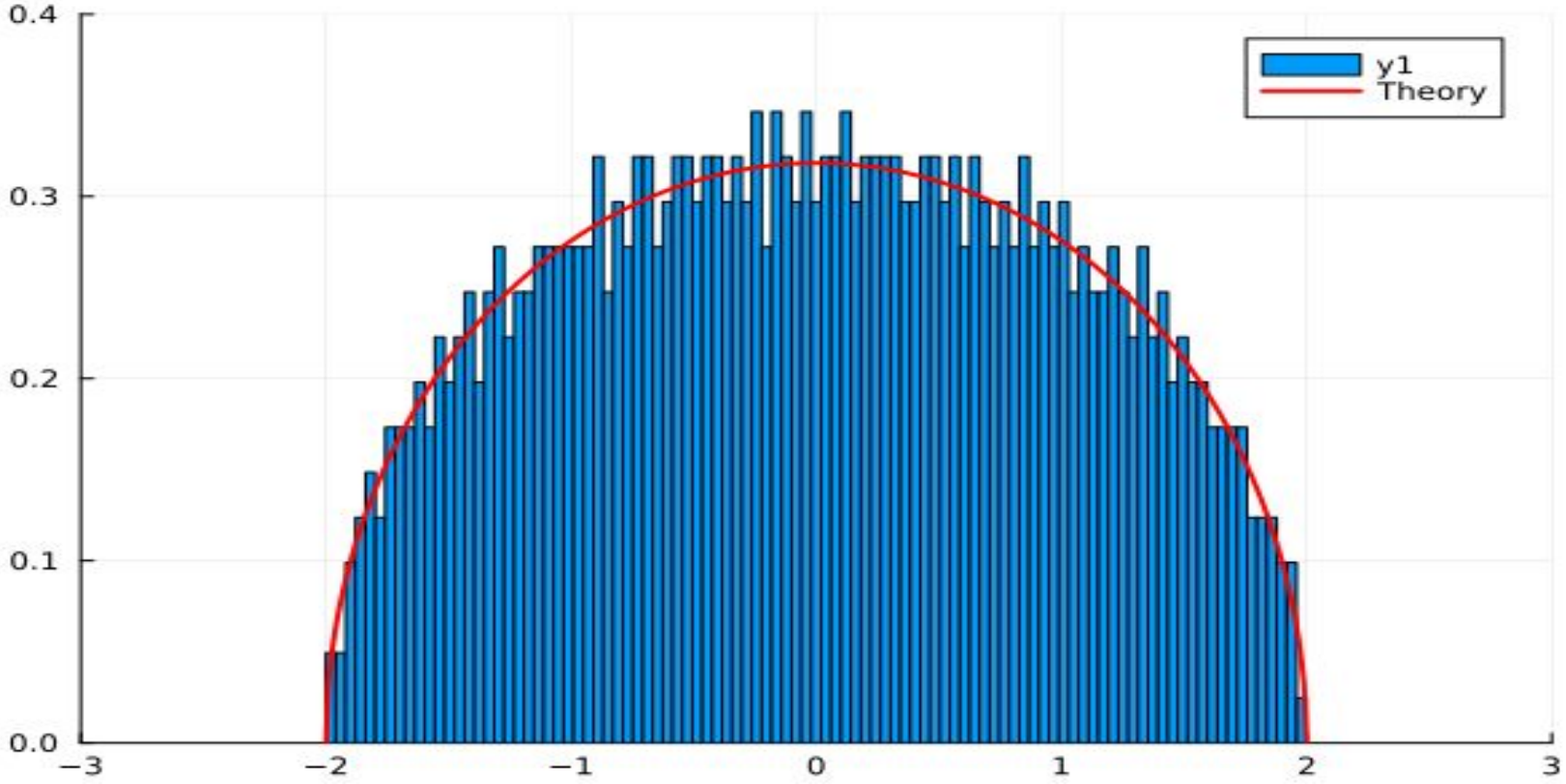
T-designs

- T-designs are unitaries with a distribution that approximates the uniform distribution
- Current constructions use products of unitaries drawn from random walks
- Would be more efficient to use sums

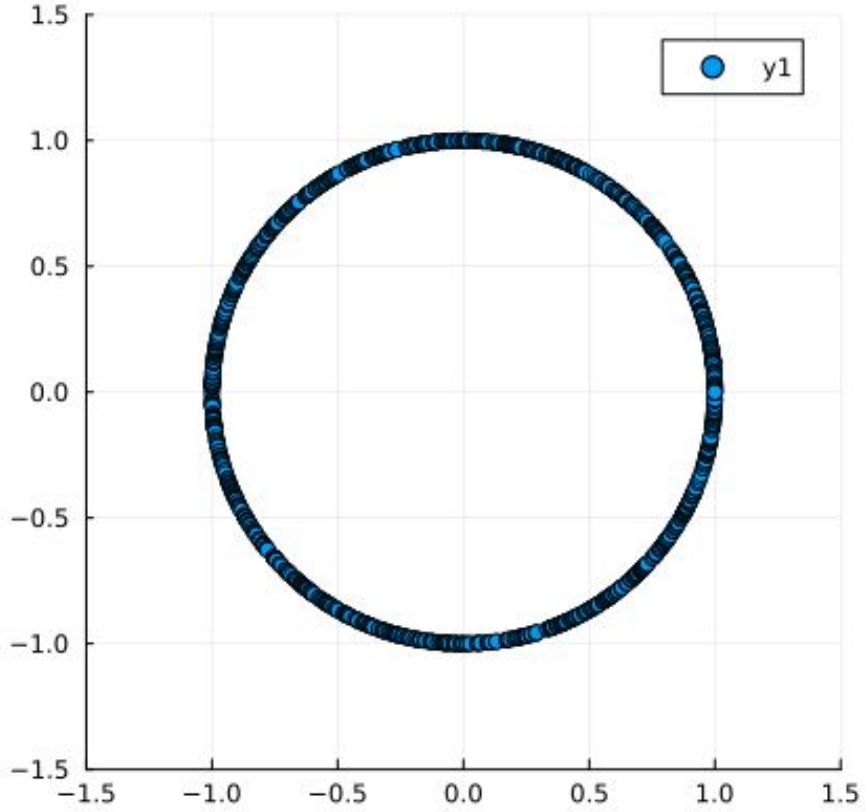
Efficient Unitary T-designs from Random Sums

Chi-Fang Chen, Jordan Docter, Michelle Xu, Adam Bouland, and Patrick Hayden

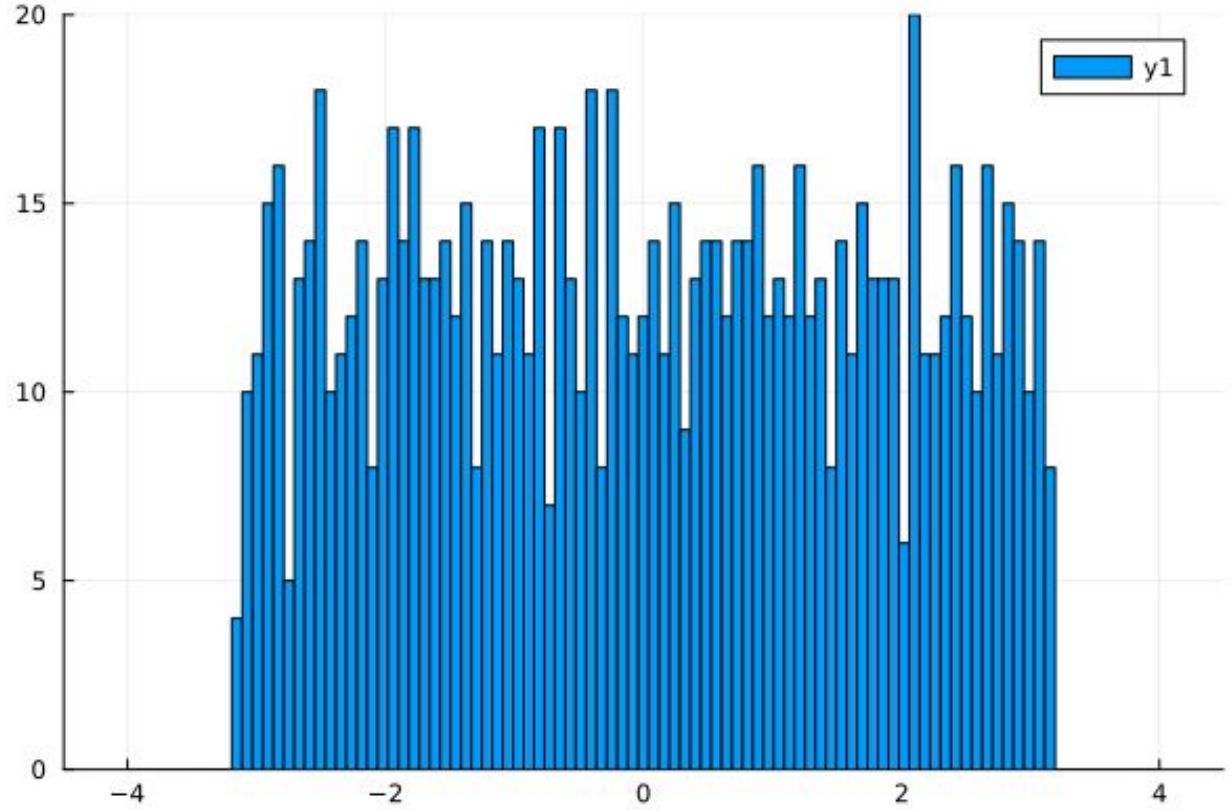
Distribution of GUE eigenvalues



Exp GUE eigenvalues



Distribution of angle of exp GUE eigenvalues



Distribution of angle of prod exp GUE eigenvalues