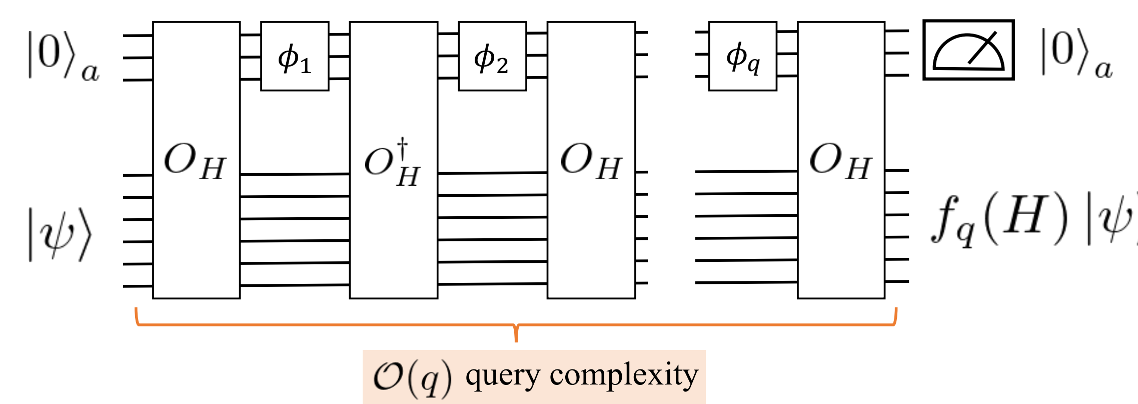
1. Intro: Time-independent case

■ Quantum Singular Value Transformation (QSVT)

Apply matrix polynomials of
Hermitian, time-independent H

$$|\psi\rangle \to f_q(H)\,|\psi\rangle\,, \quad f_q(H) = \sum_{n=0}^{q} c_n H^n$$



<u>QSVT provides optimal algorithms for time-independent *H*</u>

Hamiltonian simulation

$$f_q(H) \equiv \sum_{n=0}^{q} \frac{(-iHt)^n}{n!} \simeq e^{-iHt} + \mathcal{O}(\varepsilon)$$

Query complexity:

$$q \sim Nt + o(\log(1/\varepsilon))$$

Best scaling in
Time t, Error ε

Quantum Phase Estimation

$$f_q(H) \simeq \theta\left(H - 1/\sqrt{2}\right)$$

Query complexity:

$$q \sim \frac{N}{\varepsilon}\log(1/\delta)$$

Best scaling in
Error ε

[Problem] Optimal quantum algorithms for time-dependent $H(t)$