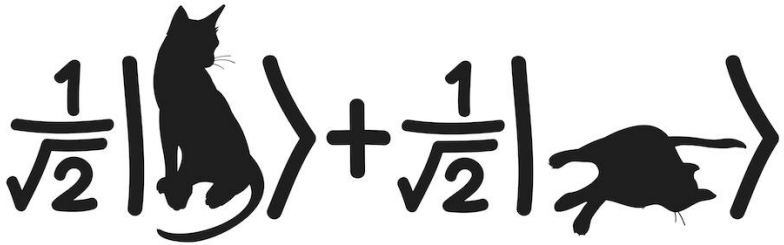
Quantum Mechanics & Quantum Computation



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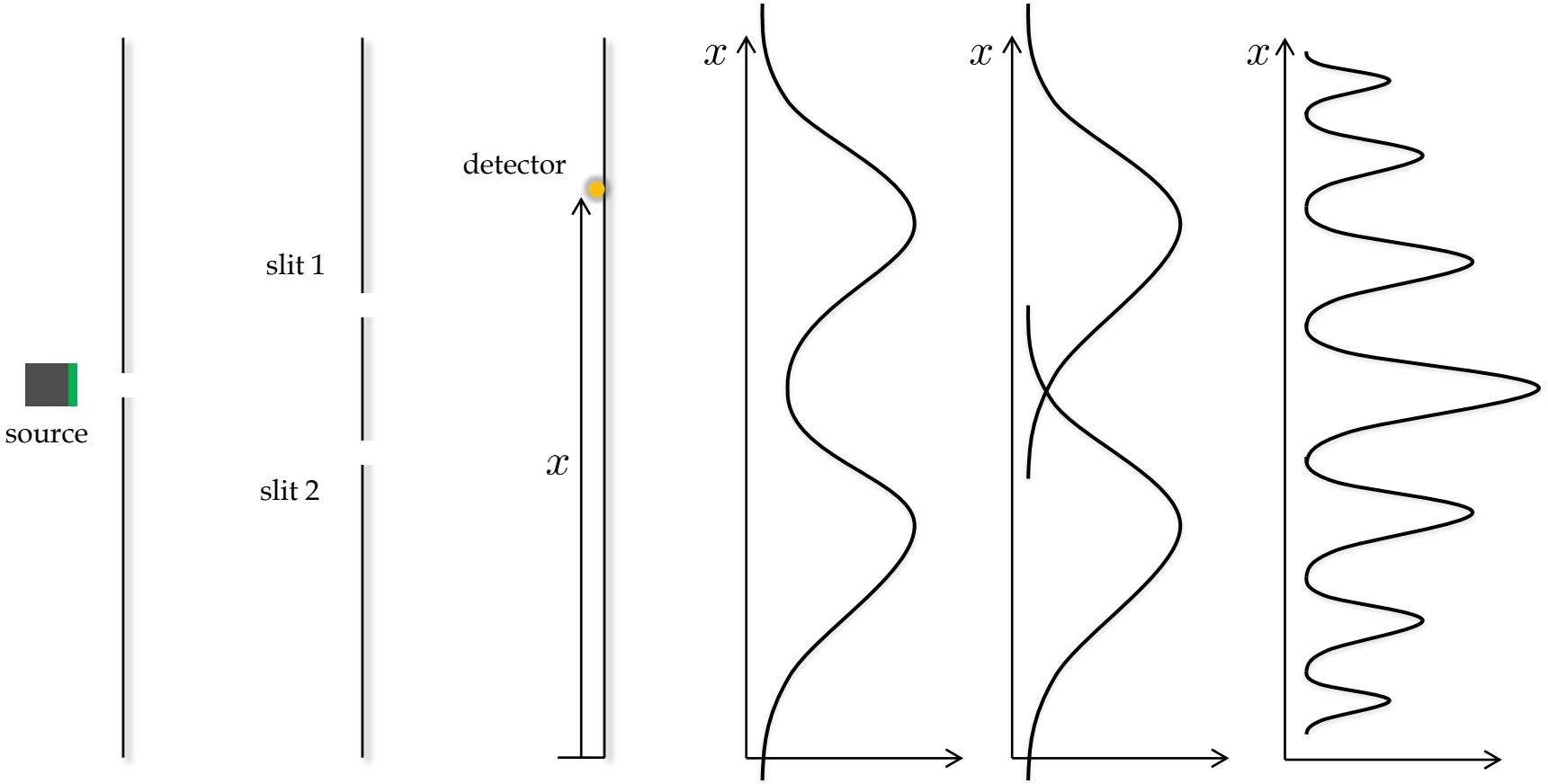
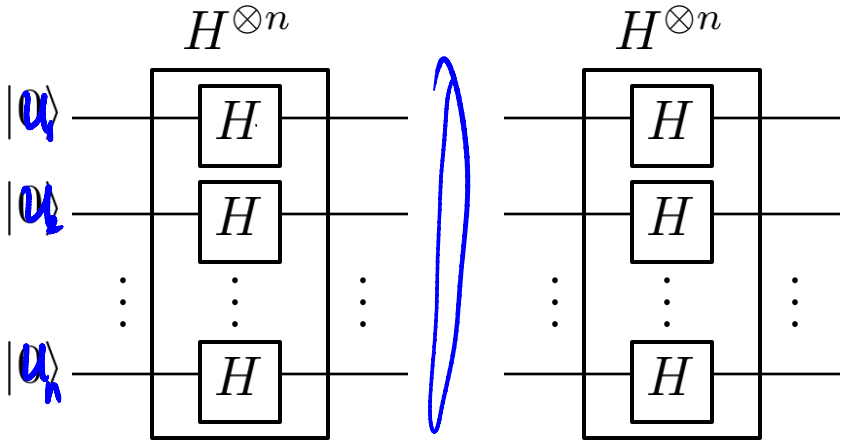
Lecture 12: Early Quantum Algorithms

Double Slit Expt.

Double-slit experiment



Quantum algorithms



$u = u_1 \cdots u_n$

$$\sum_{x \in \{0,1\}^n} \frac{(-1)^{u \cdot x}}{2^{n/2}} |x\rangle \xrightarrow{H^{\otimes n}} \sum_y \beta_y |y\rangle$$

$$\beta_y = \sum_x \frac{(-1)^{u \cdot x}}{2^{n/2}} \cdot \frac{(-1)^{x \cdot y}}{2^{n/2}}$$

Case 1: $y = u$

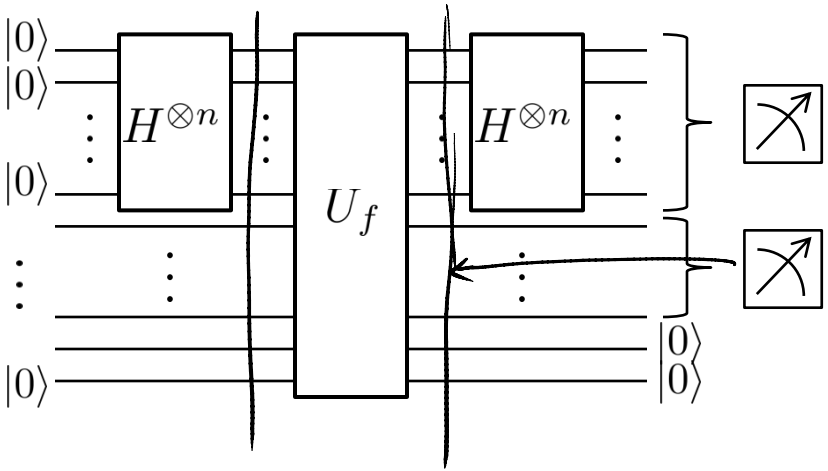
$$\beta_y = \sum_x \frac{1}{2^n} = 1.$$

Case 2: $y \neq u$

$$\beta_y = 0$$

U_f & virtual slits

We are given a function $f : \{0,1\}^n \to \{0,1\}^n$ as a black box.
We know that f is a 2-1 function. (There is a secret string $s \in \{0,1\}^n$ such that $f(x) = f(x \oplus s)$)



$y \cdot s = 0$

$\sum_x |x\rangle$

$\frac{1}{\sqrt{2}}|r\rangle + \frac{1}{\sqrt{2}}|r \oplus s\rangle$