# An introduction

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# Young's Double Slit Experiment

## Particles behave like waves

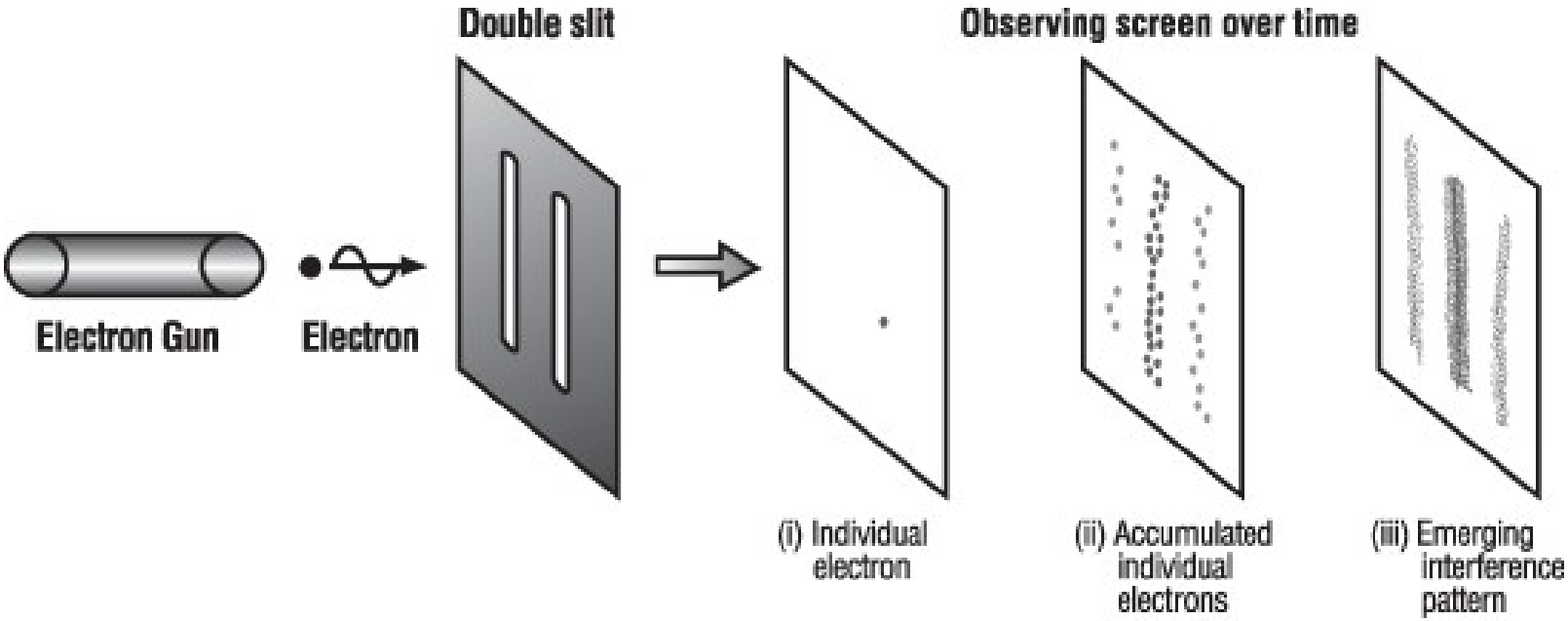
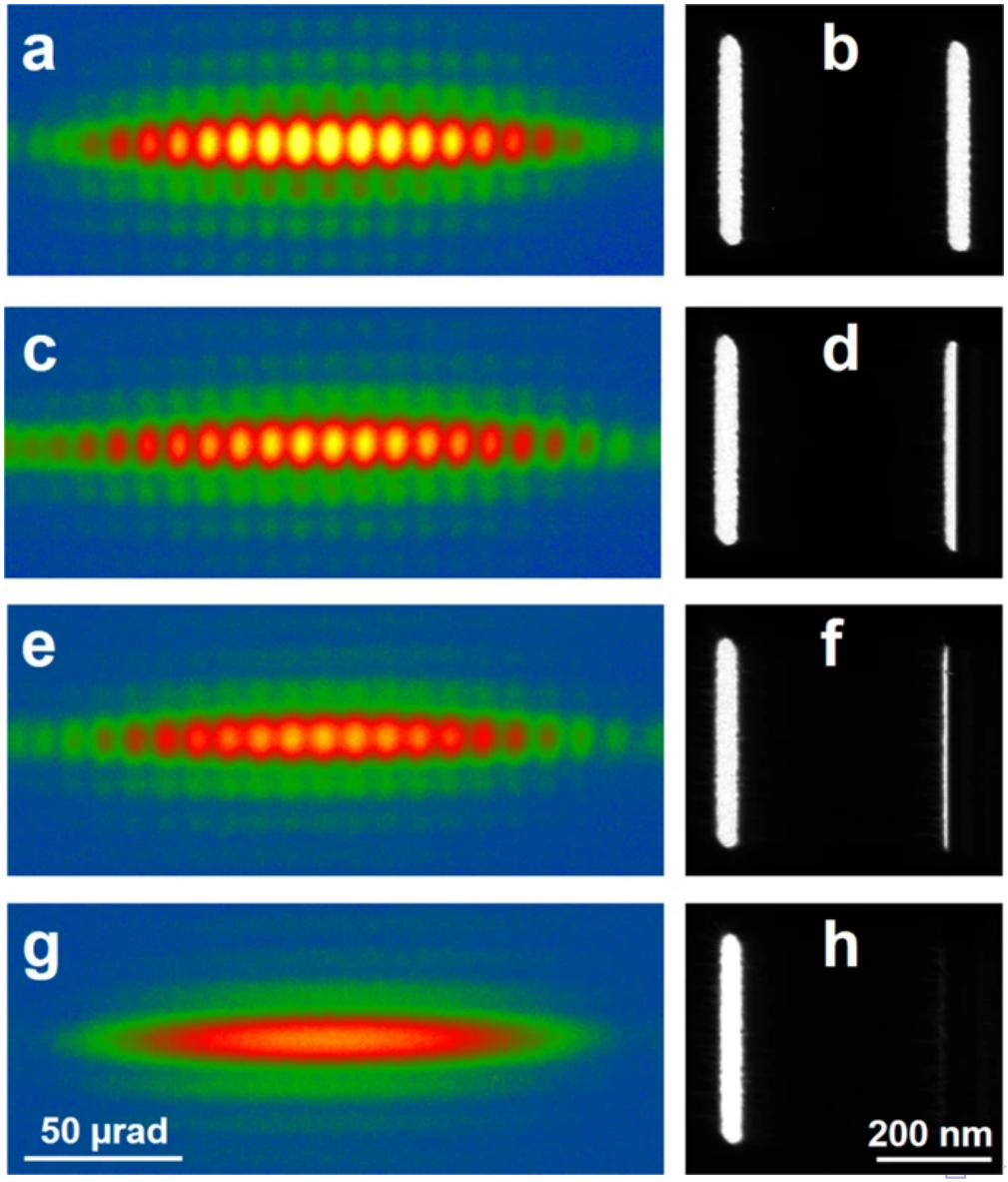



Figure: Image credit: ©2012 Perimeter Institute for Theoretical Physics, via https://www.perimeterinstitute.ca/research/research-areas/quantum-foundations/more-quantum-foundations.

# Quantum world if fascinating

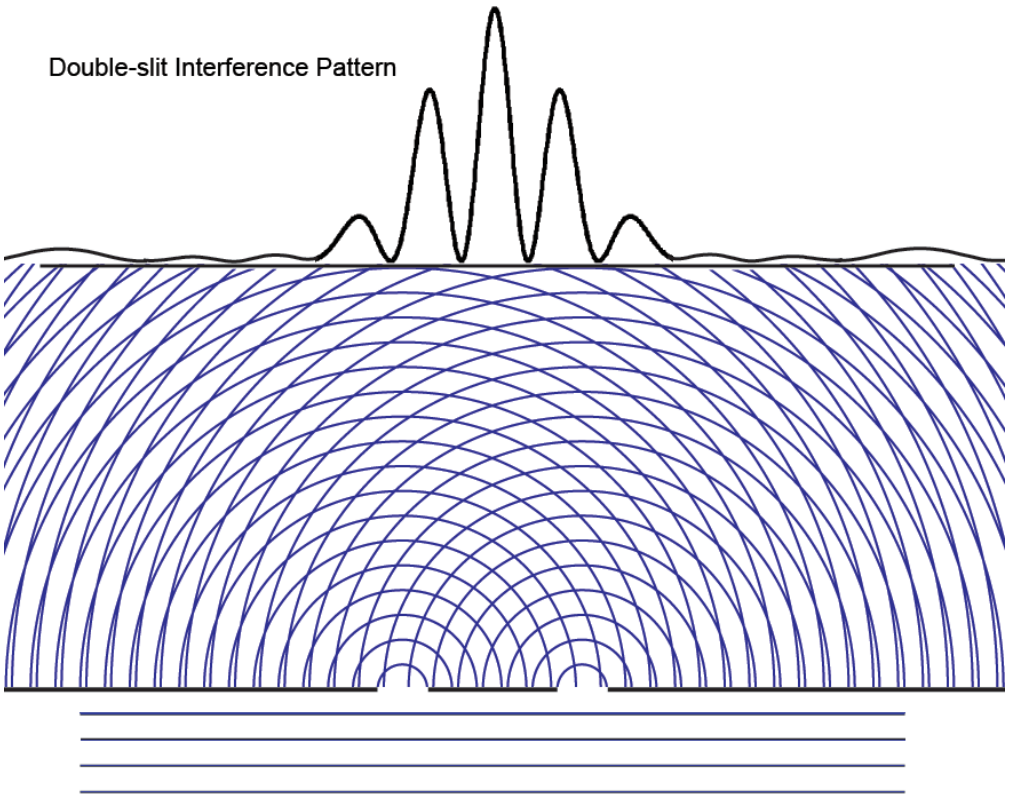
## Particles behave like waves



# Quantum world if fascinating

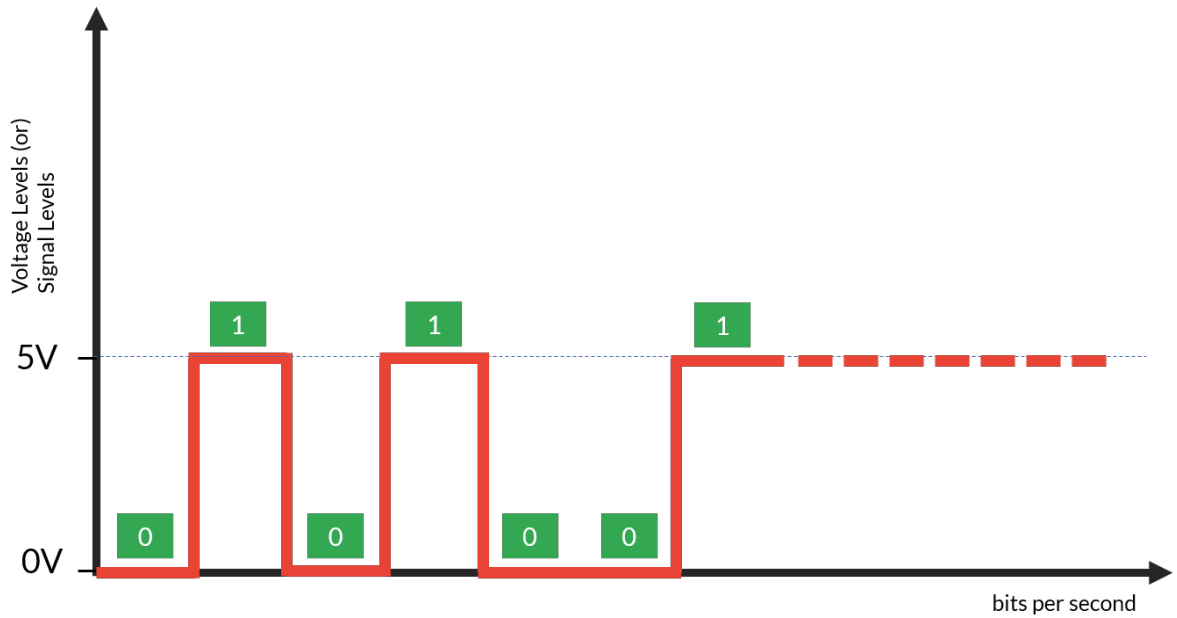
## Particles behave like waves

The state of a particle after passing through either one of the slits can be described as a *wave* function (probability distribution) namely $\Psi = (\alpha_0\psi_0 + \alpha_1\psi_1)$ with $\{\alpha_0, \alpha_1\} \in \mathbb{C}$



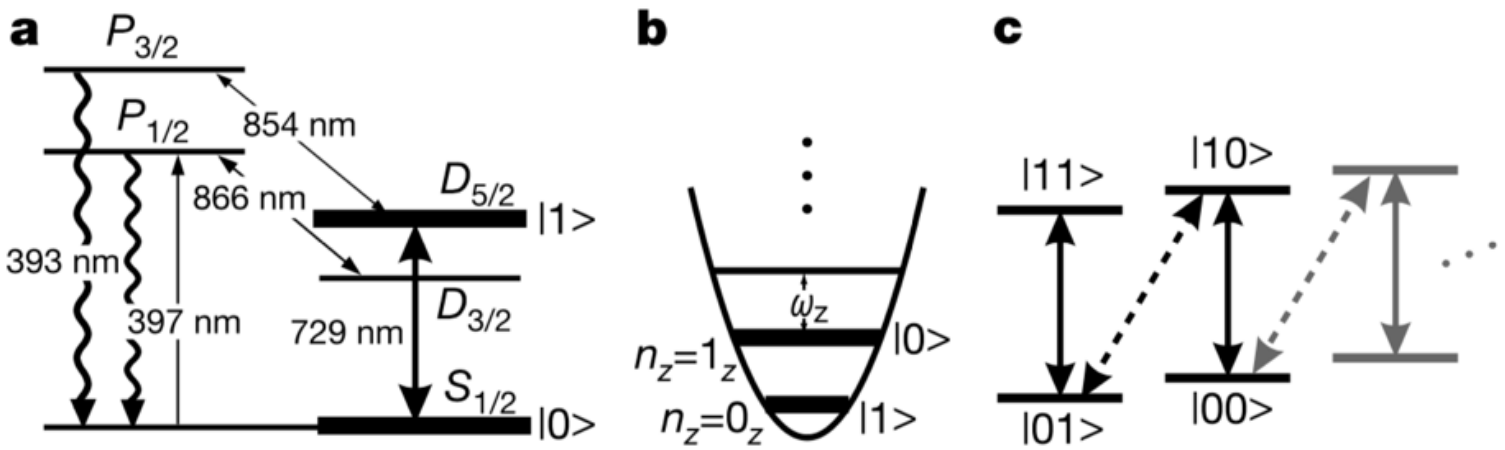
# Basic Unit of information: Bits

Traditional computation works with 0 and 1 as basic units of information. A physical realization of this is voltage from 0V to 5V



# Basic Unit of information: Qubits

Quantum computation works with $|0\rangle$ and $|1\rangle$ as basic units of information. A physical realization of this would be a spin 1/2 particle.



# Dirac notation and linear algebra

# Computational basis states

Qubits can be in different states *other* than $|0\rangle$ or $|1\rangle$. It is possible to form *linear combinations* of states, called superpositions:

$$|\psi\rangle = \alpha_0 |0\rangle + \alpha_1 |1\rangle$$

The numbers $\alpha_0$ and $\alpha_1$ are complex numbers and $|\alpha_0|^2 + |\alpha_1|^2 = 1$.

Where $|0\rangle$ and $|1\rangle$ are vectors $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$ and $\begin{pmatrix} 0 \\ 1 \end{pmatrix}$ in $\mathbb{C}^2$.

A superposition state is a linear combination $\psi = \alpha_0 \begin{pmatrix} 1 \\ 0 \end{pmatrix} + \alpha_1 \begin{pmatrix} 0 \\ 1 \end{pmatrix}$

# Bibliografía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