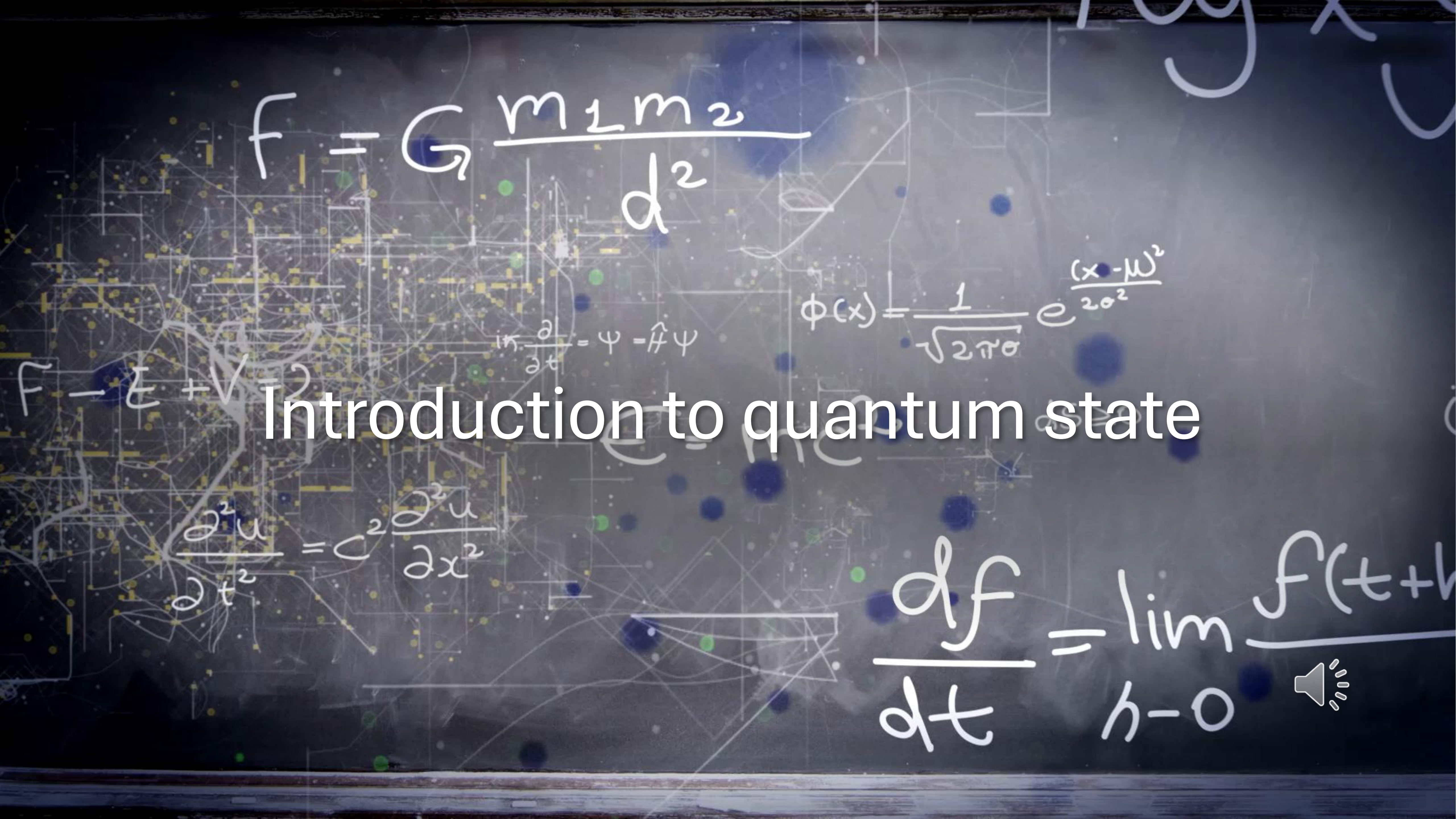
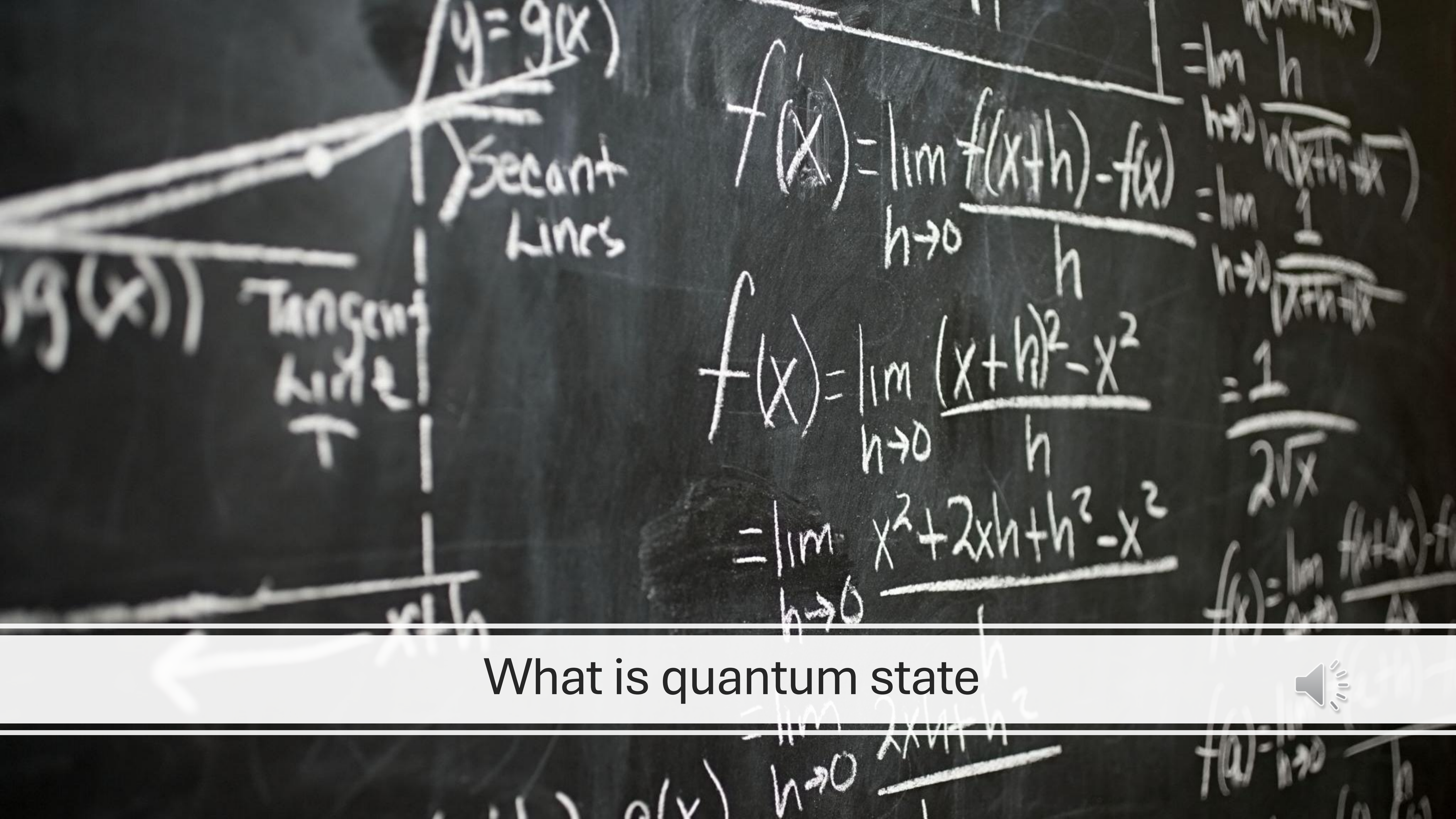


Introduction to quantum state



What is quantum state

Key Concepts of a Quantum State

SUPERPOSITION

ENTANGLEMENT

WAVEFUNCTION (Ψ)

COLLAPSE UPON MEASUREMENT

PROBABILITY AND AMPLITUDES

Mathematical Representation of a Quantum State

A quantum state $|\psi\rangle$ is generally expressed as a combination of basis states:

$$|\psi\rangle = \alpha|0\rangle + \beta|1\rangle$$

where:

- α and β are complex probability amplitudes.
- The total probability must always be **1**:

$$|\alpha|^2 + |\beta|^2 = 1$$

For larger systems, quantum states can describe **multi-qubit** systems or even entire quantum systems in **higher dimensions.**

Example of a Quantum State

- **Single-Qubit State:** A qubit in a superposition might be:

$$\frac{1}{\sqrt{2}}|0\rangle + \frac{1}{\sqrt{2}}|1\rangle$$

This means the qubit has **equal probability (50%)** of being measured as **|0⟩ or |1⟩**.

- **Entangled State:** Two entangled qubits could be in the **Bell state:**

$$\frac{1}{\sqrt{2}}(|00\rangle + |11\rangle)$$

This means that if one qubit is measured as **|0⟩**, the other must also be **|0⟩**, and the same for **|1⟩**.

Why Is the Quantum State Important?