

Title: Explorations in Quantum Information-1

Date: Mar 16, 2015 09:00 AM

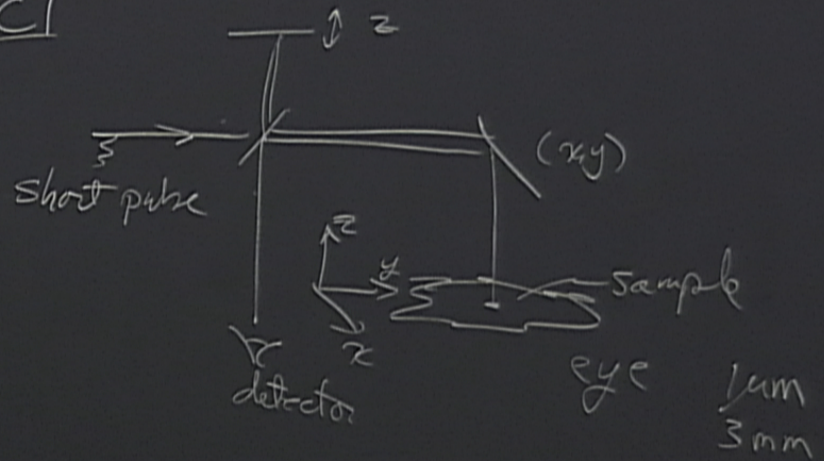
URL: <http://pirsa.org/15030018>

Abstract:

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RAC 2

1 gabit
optical interferometer.

OCT



sensors }
actuator } 1 qubit

Simulators ←

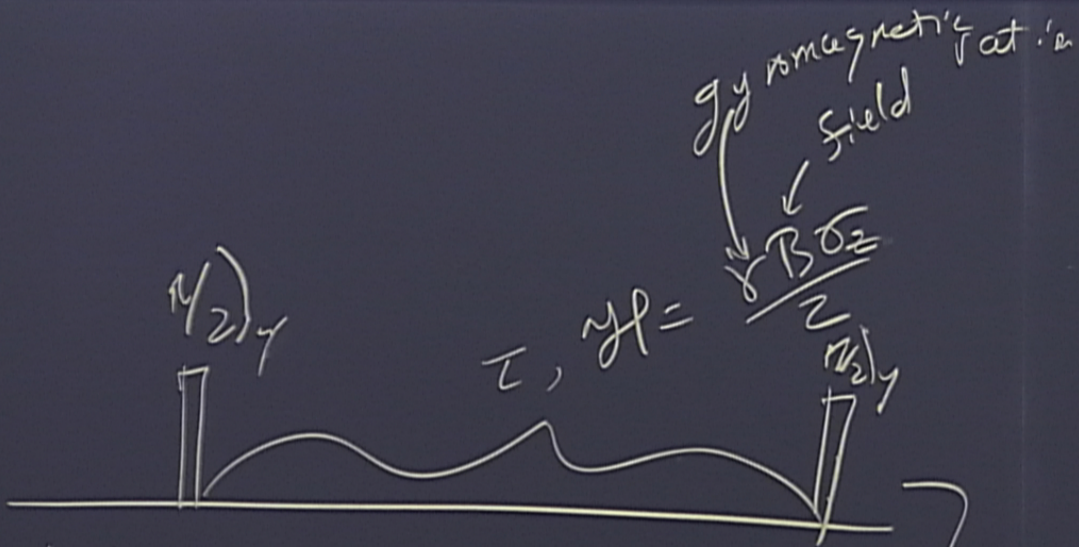
Communication } 1 qubit

Processors

10+ groups

100 qubits

1 qubit
optical



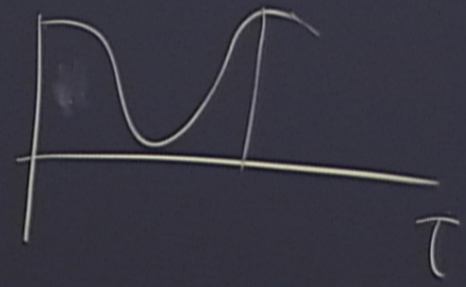
$$\gamma_H = 2\pi \cdot 4250 \text{ Hz/G}$$

$$\gamma_E = 2\pi \cdot 2.3 \text{ MHz/G}$$

$$|+1/2\rangle$$

$$\frac{1}{\sqrt{2}} (|+1/2\rangle + |-1/2\rangle)$$

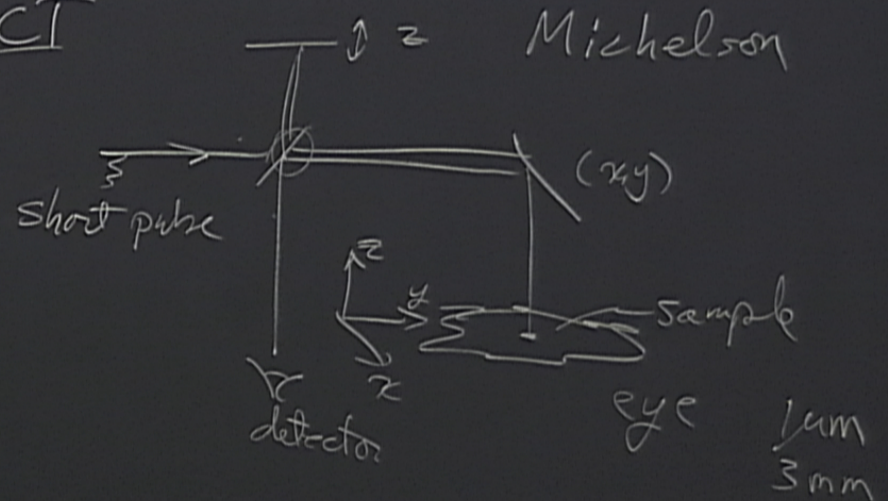
$$P_{|+1/2\rangle} = \sin^2\left(\frac{\gamma B_0 \tau}{2}\right)$$

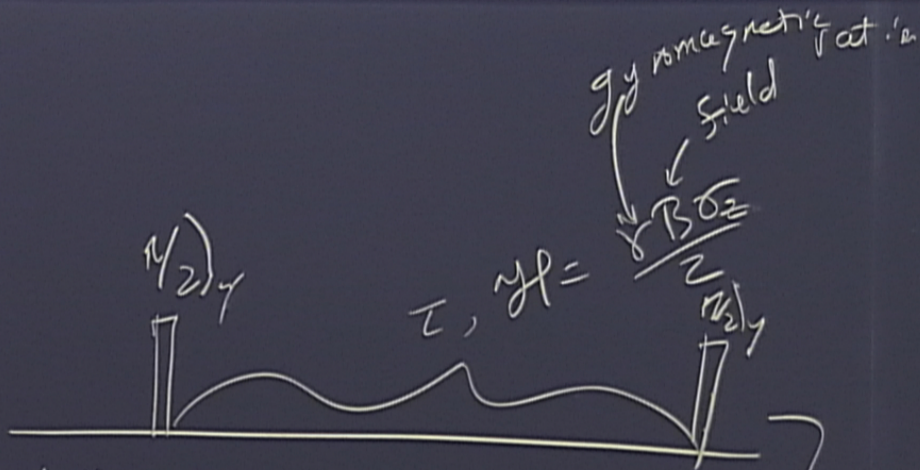


1 gabit
optical interferometers.

magnetic resonance (Fields)
↑
→ MRI, water
cheese, water

OCT



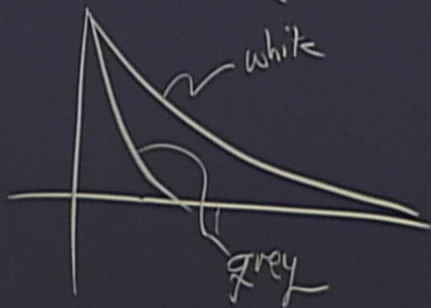


$$\gamma_H = 2\pi \cdot 4250 \text{ Hz/G}$$

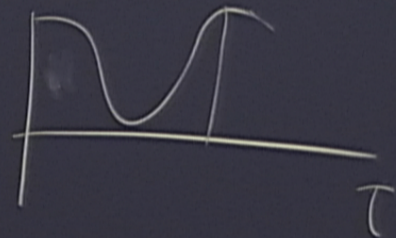
$$\gamma_E = 2\pi \cdot 2.3 \text{ MHz/G}$$

$$|+1/2\rangle \quad \frac{1}{\sqrt{2}} (|+1/2\rangle + |-1/2\rangle)$$

$T_2 \equiv$ coherence time



$$P_{|+1/2\rangle} = \sin^2\left(\frac{\delta B T}{2}\right)$$

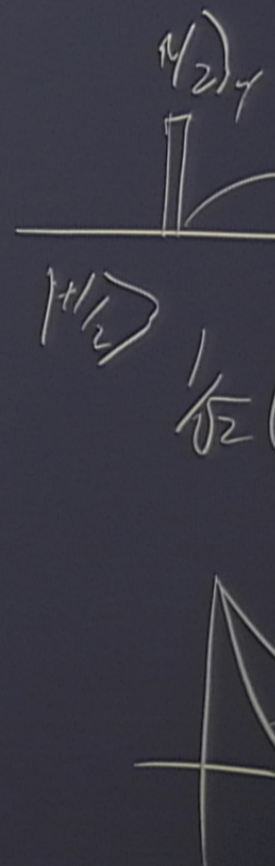


Field resolution

$$\tau_{\text{avg}} \delta \Delta B \sim 2\pi$$

mins

$$2\pi \cdot 4258 \frac{\text{Hz}}{\text{G}}$$
$$\Delta B \sim 10 \rightarrow 100 \mu\text{G}$$



1 qubit

optical interferometers.

magnetic resonance (Fields)

SQUID

Gyroscopes

- MZ interferometer
- spins
- trapped ions

→ MRI, water

cheese, water

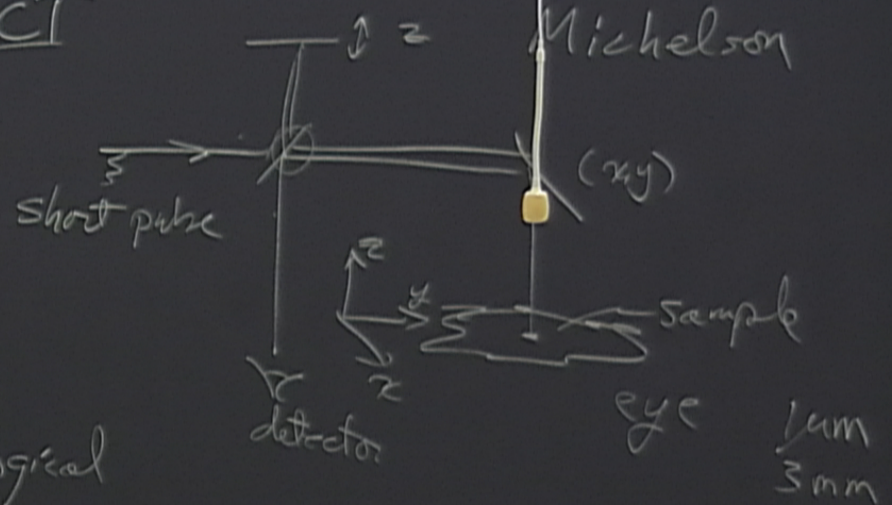
oil/water, geological

2 qubit

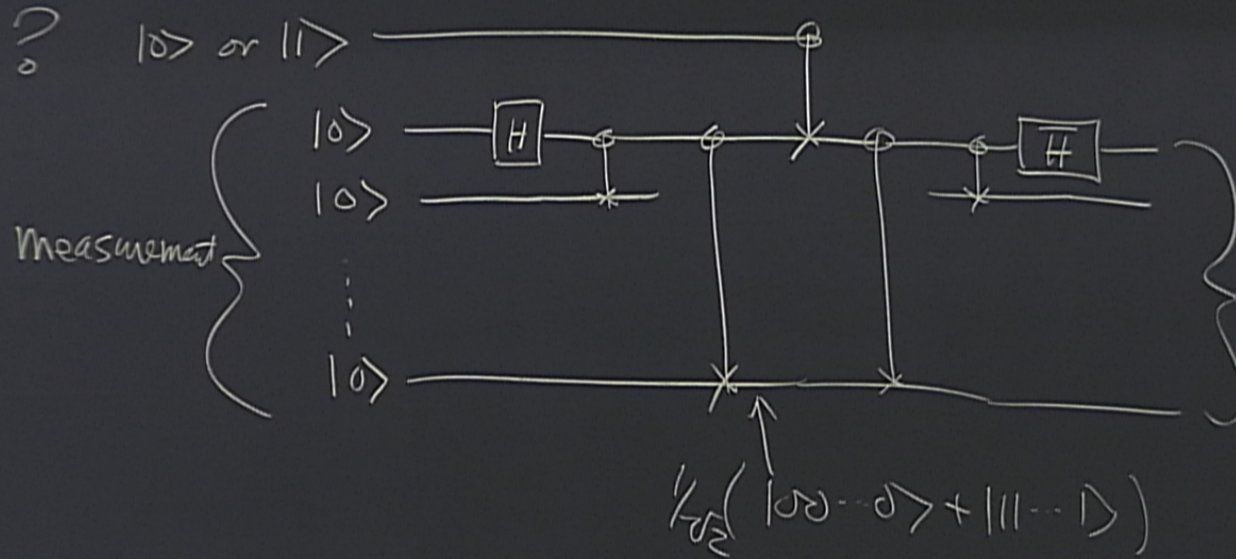
- robust 1 qubits

~ protein
~ 1e

OCT



Entanglement



$|00\rangle \dots |0\rangle$ if $|0\rangle$

$|11\rangle \dots |1\rangle$ if $|1\rangle$

$$\mathcal{H}_1 = \sum_i b_i (\sigma_+^i \sigma_-^i + \sigma_-^i \sigma_+^i)$$

$$\mathcal{H}_2 = \sum_{i \neq j} (\sigma_+^i \sigma_-^j + \sigma_-^i \sigma_+^j)$$

\rightarrow if $|0\rangle$

\rightarrow if $|1\rangle$

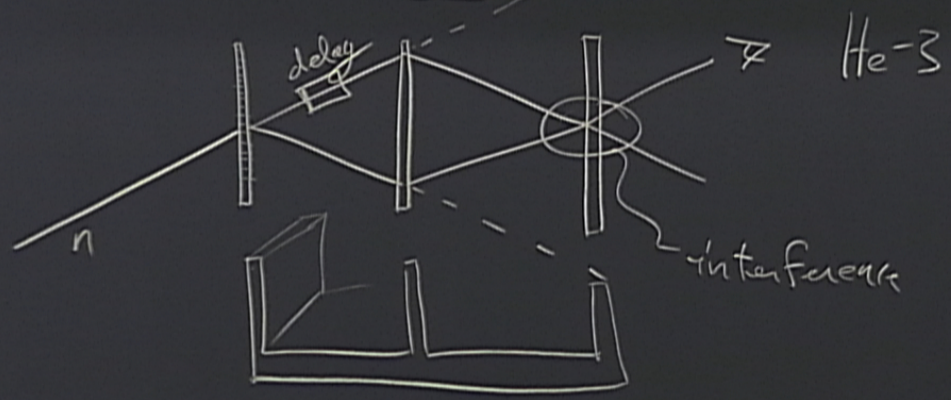
$$u = (u_1, u_2)^T; \quad u_2 = e^{i\mathcal{H}_2 t}$$

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1. question
2. analysis + connect to question
3. results + what did you learn,

$$\frac{1}{\sqrt{2}}(|00\dots 0\rangle + |11\dots 1\rangle)$$

neutron interferometry



qubits

1. path
2. spin
3. displacement
4. delay
5. orbital angular momentum