Title: PSI 2015/2016 Explorations in Quantum Information - David Cory - 1

Date: Mar 21, 2016 09:00 AM

URL: http://pirsa.org/16030000

Abstract:

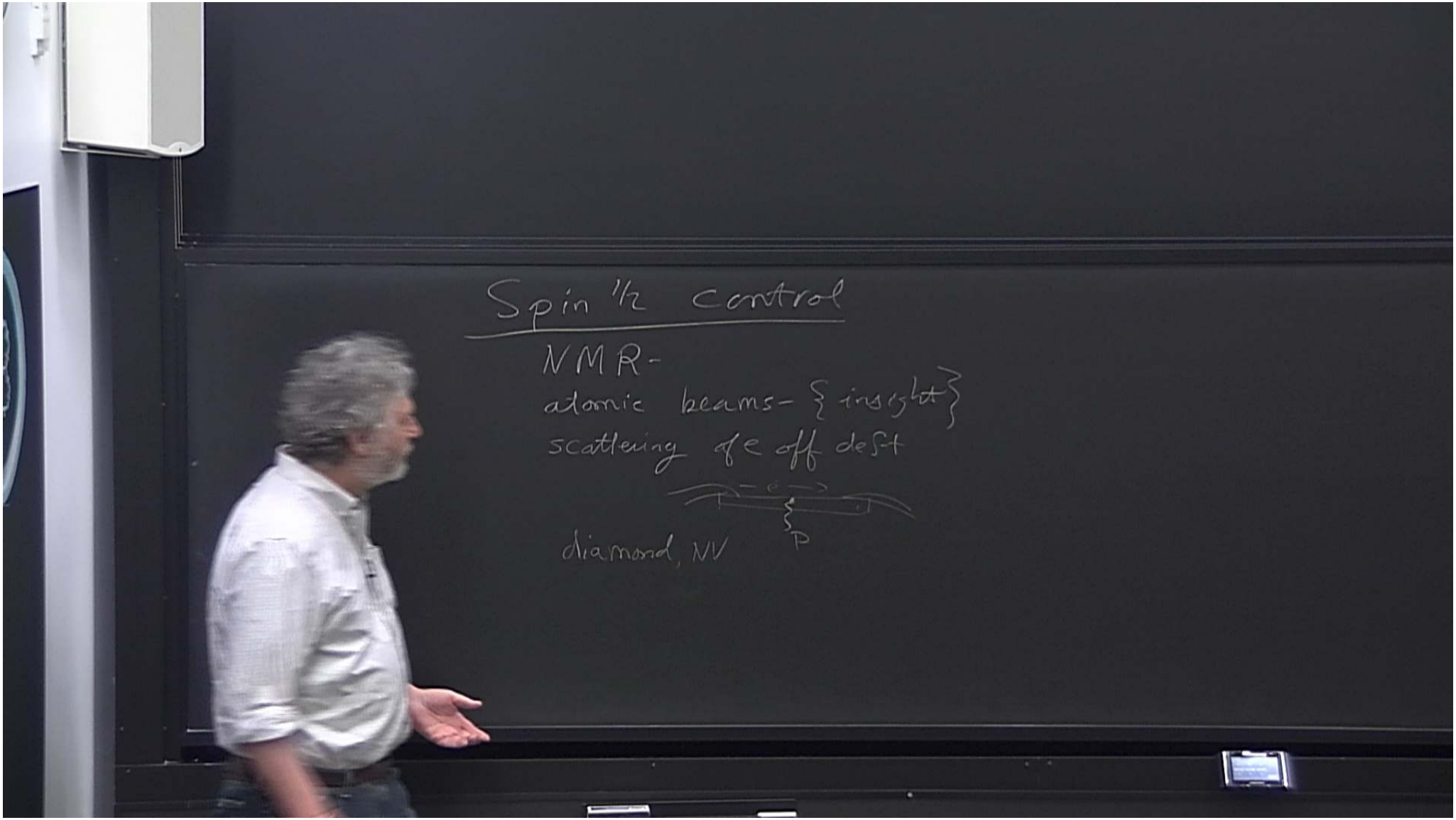
Spin 1/2 control

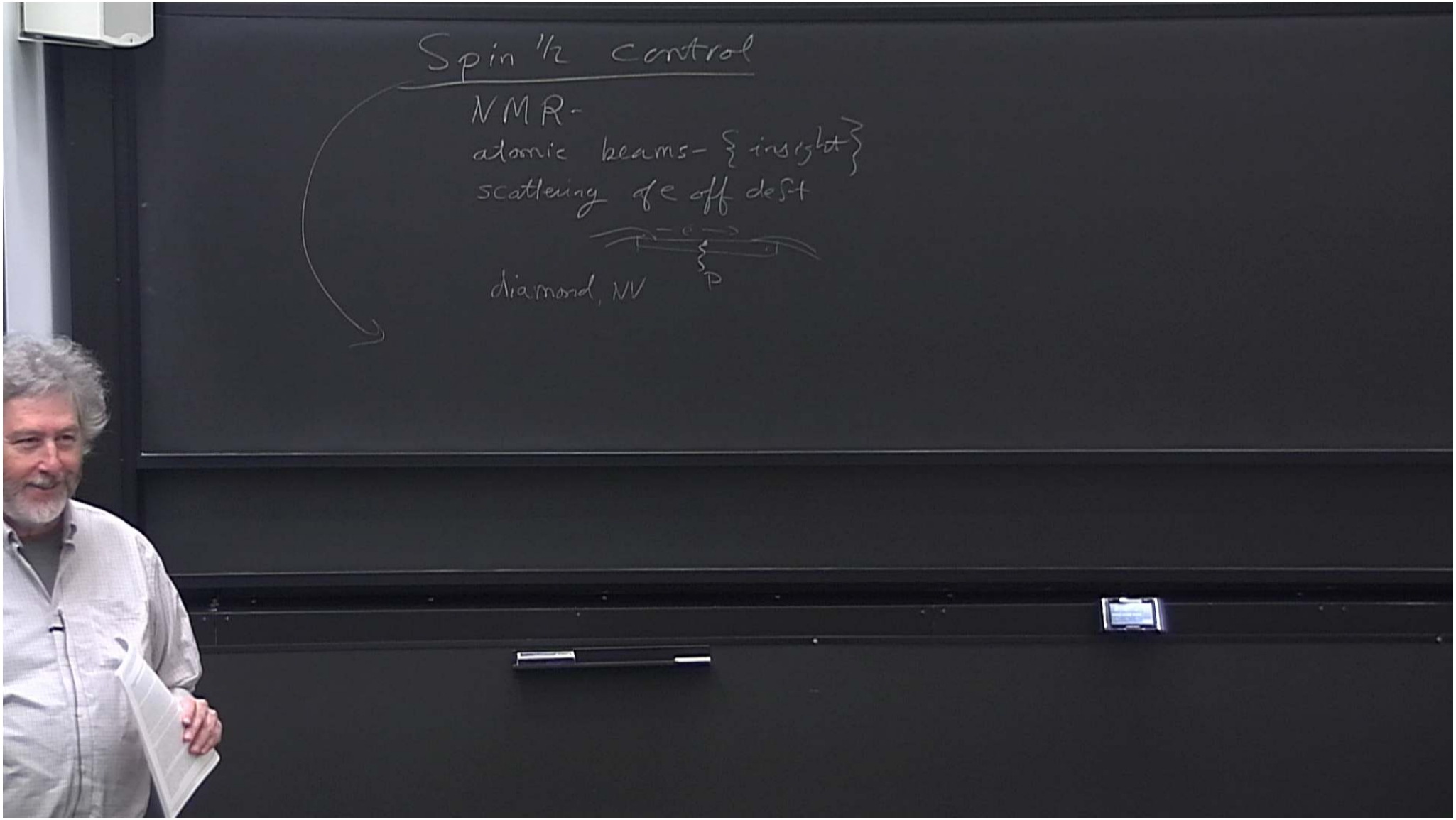
NMR -

atomic beams - {insight}

scattering of e off defect

diamond, NV


Spin 1/2 control
NMR-
atomic beams- {insight}
scattering qe off defect
P
diamond, NV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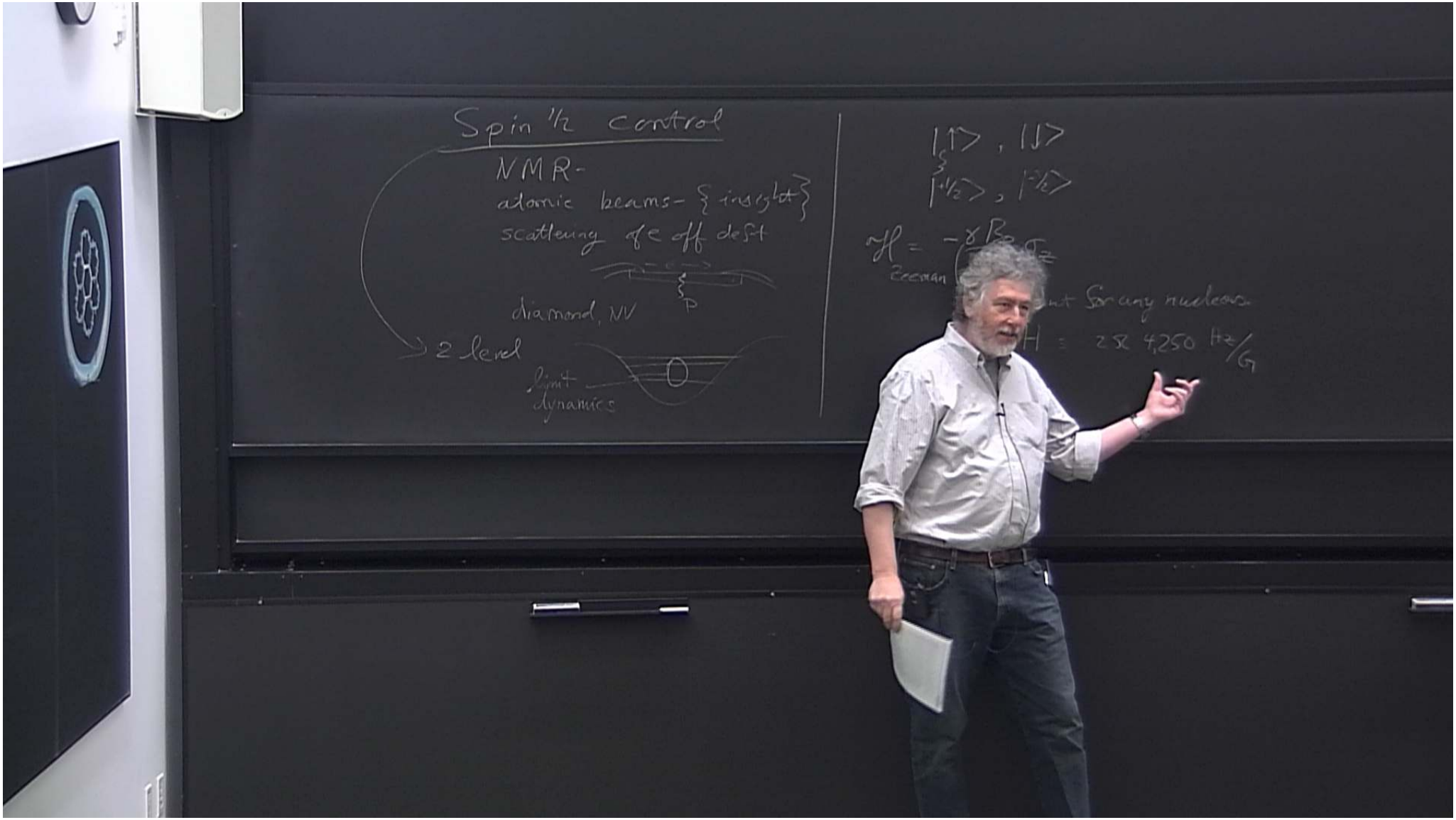

Spin 1/2 control
NMR-
atomic beams- {insight}
scattering of e off defect
diamond, NV
2 level
limit
dynamics
|↑⟩ , |↓⟩
|+1/2⟩ , |-1/2⟩
Zeeman
nt Sorting nuclear
H = 2π 4,250 Hz/G

$|\uparrow\rangle$, $|\downarrow\rangle$

$|+1/2\rangle$, $|-1/2\rangle$

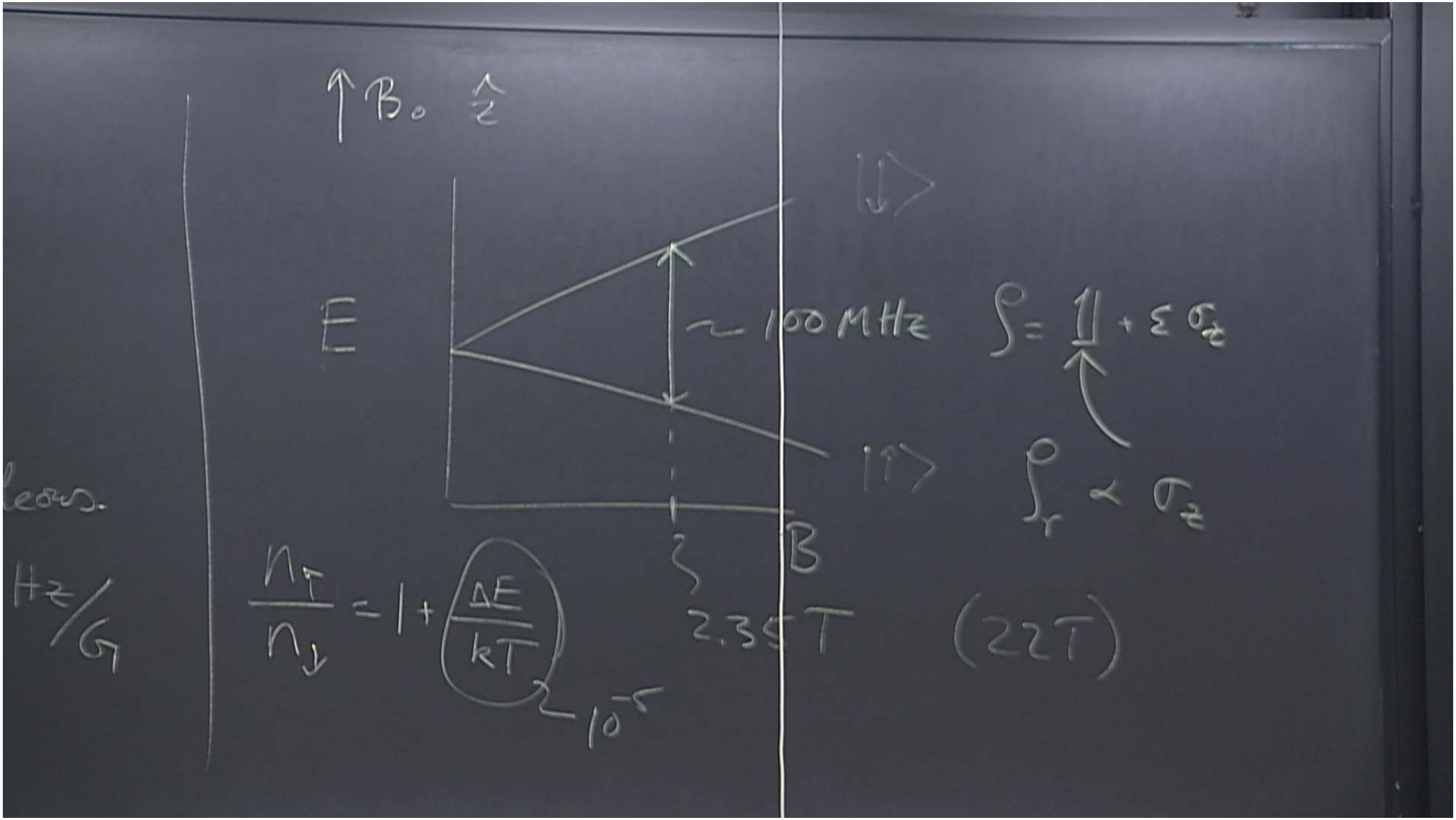
$$\mathcal{H}_{\text{Zeeman}} = -\frac{\gamma B_0}{2}\sigma_z \quad ; \quad \hbar = 1$$

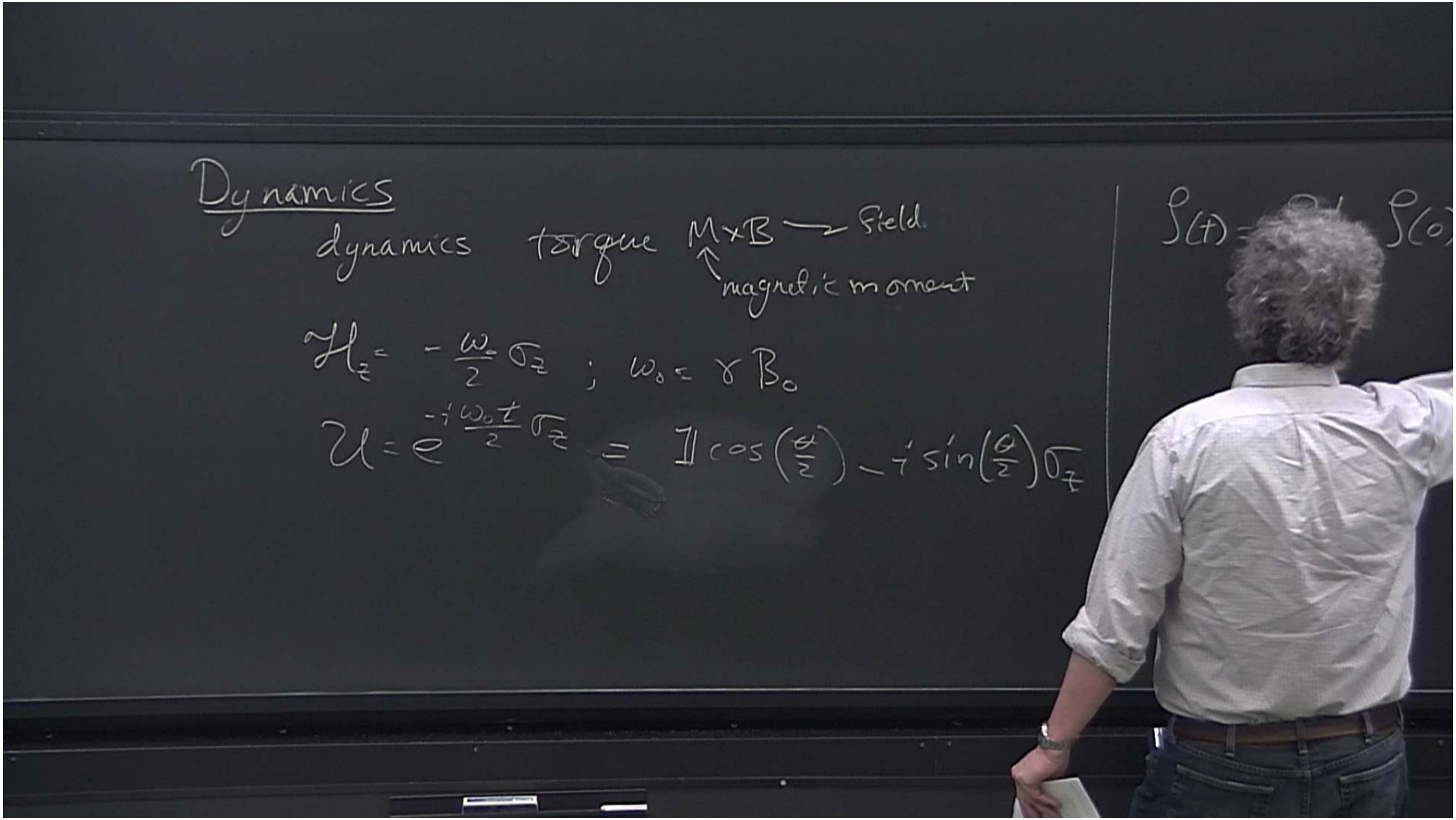
constant for any nucleus.

$^1H \equiv 258\ 4{,}250\ \text{Hz/G}$

$1\ \text{G} = 10^{-4}\ \text{T}$

$\frac{n_\uparrow}{n_\downarrow}$


↑ B₀ ẑ
|↓⟩
E
~ 100 MHz
ρ = 1/1 + ε σz
|↑⟩
ρ_r ∝ σz
B
2.35 T
(2T)
n↑/n↓ = 1 + ΔE/kT
~ 10⁻⁵
leous.
Hz/G

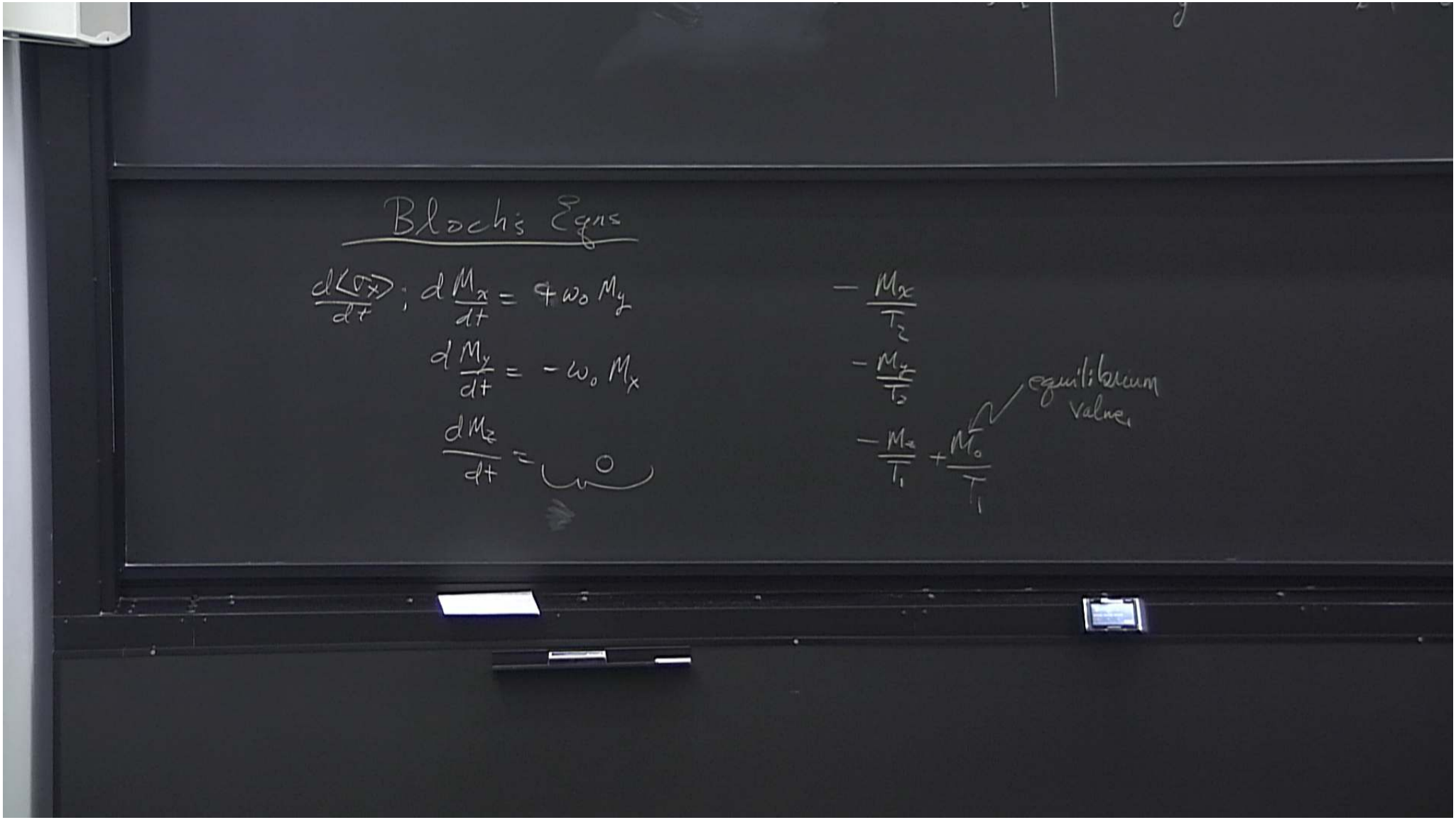

Dynamics
dynamics torque M×B → field
magnetic moment
$\mathcal{H}_z = -\frac{\omega_0}{2}\sigma_z$; $\omega_0 = \gamma B_0$
$U = e^{-i\frac{\omega_0 t}{2}\sigma_z} = \mathbb{1}\cos\left(\frac{\theta}{2}\right) - i\sin\left(\frac{\theta}{2}\right)\sigma_z$
$\rho(t) = \rho(0)$

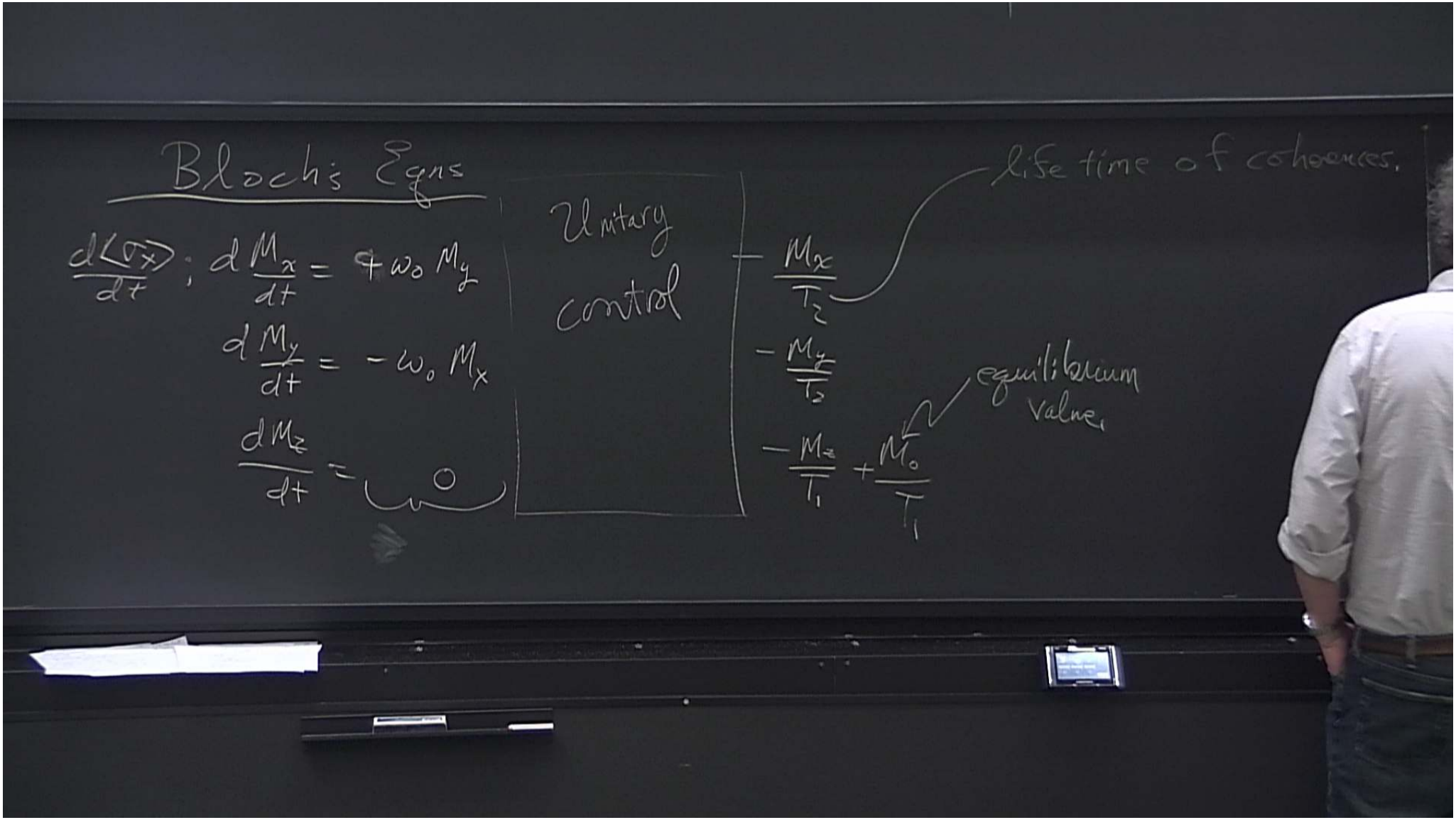
Bloch's Eqns

$$\frac{d\langle \vec{\sigma} \rangle}{dt}: \quad \frac{dM_x}{dt} = +\omega_0 M_y$$

$$\frac{dM_y}{dt} = -\omega_0 M_x$$

$$\frac{dM_z}{dt} = 0$$


Bloch's Eqns
$\frac{d\langle \sigma_x \rangle}{dt}$; $\frac{dM_x}{dt} = +\omega_0 M_y - \frac{M_x}{T_2}$
$\frac{dM_y}{dt} = -\omega_0 M_x - \frac{M_y}{T_2}$
$\frac{dM_z}{dt} = \omega - \frac{M_z}{T_1} + \frac{M_0}{T_1}$
equilibrium value


Bloch's Eqns
Unitary control
life time of coherences.
equilibrium value

$= \mathbb{I}\cos\left(\frac{\theta}{2}\right) - i\sin\left(\frac{\theta}{2}\right)\sigma_z$

$\sigma_y \longrightarrow \sigma_x \; ; \; \sigma_y\cos(\theta) - \sigma_x\sin(\theta)$

dynamics

M_y

M_x

Unitary control

life time of coherences.

$-\frac{M_x}{T_2}$

$-\frac{M_z}{T_2}$

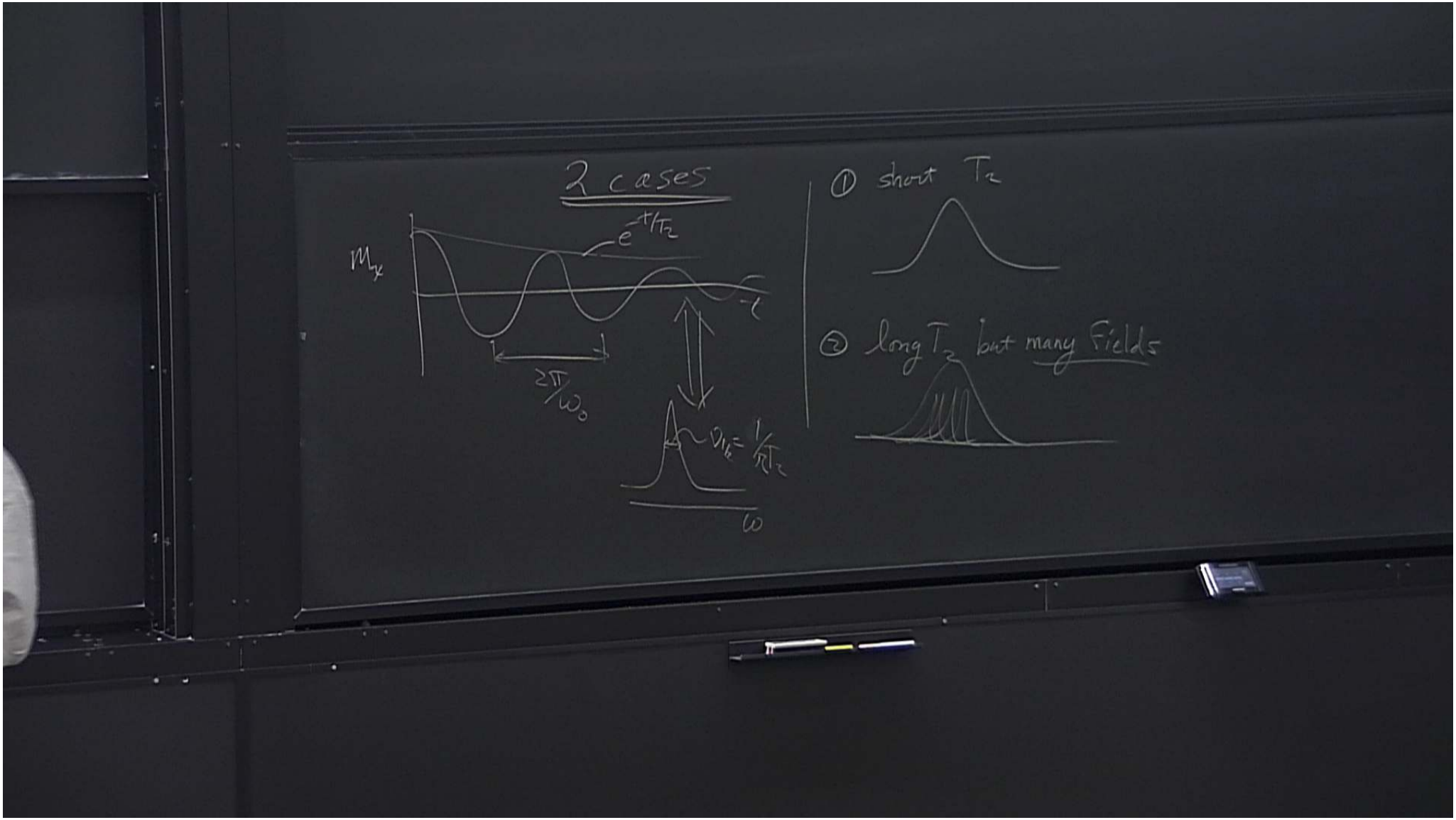
$-\frac{M_z}{T_1} + \frac{M_0}{T_1}$ ← equilibrium value

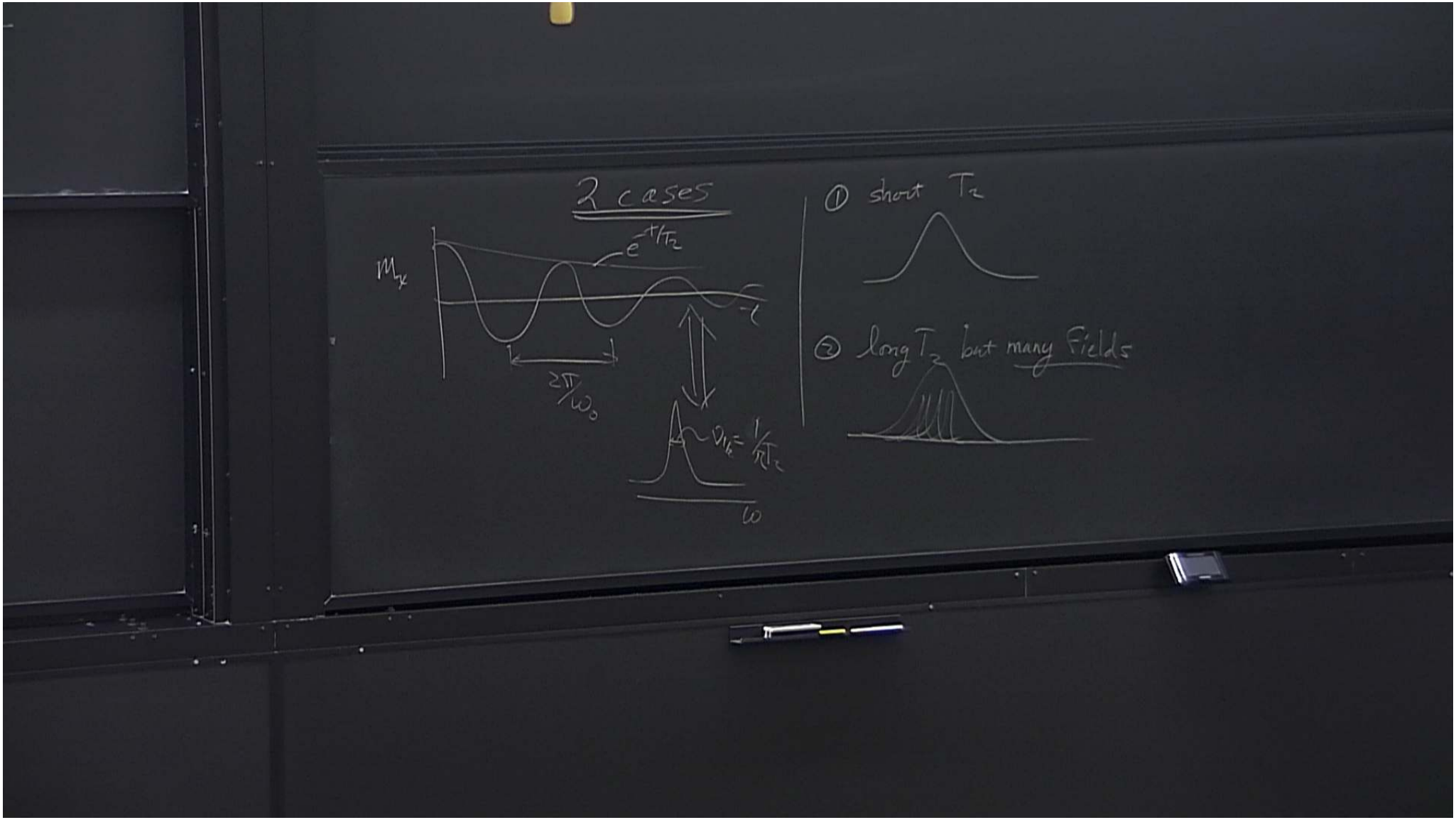
$|\Gamma\rangle$

$\frac{1}{\sqrt{2}}(|\Gamma\rangle - |\downarrow\rangle)$

$|\downarrow\rangle$

ω_0


2 cases
M_x
e^{-t/T_2}
$2\pi/\omega_0$
$\Delta\nu_{1/2} = 1/\pi T_2$
ω
① short T_2
② long T_2 but many fields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