Title: PSI 2016/2017 Explorations in Quantum Information - Lecture 15

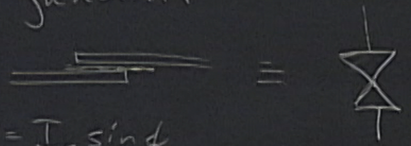
Date: Apr 07, 2017 09:00 AM

URL: http://pirsa.org/17040014

Abstract:

$\Phi_0 = \frac{h}{2e}$, flux quantum.

tunnel junction

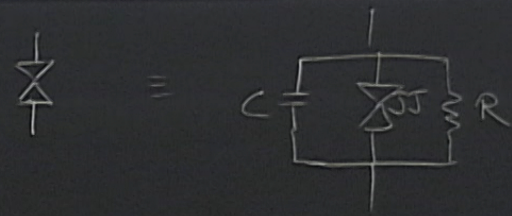


$I = I_c \sin\phi$

critical current

phase difference over the junction.

$$\frac{d\phi}{dt} = \frac{2e}{\hbar} V = \frac{2\pi}{\Phi_0} V$$



$I_J = I_c \sin\phi$

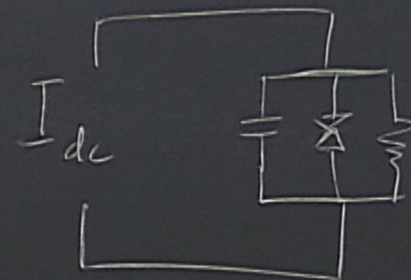
$$I_R = \frac{V}{R} \; ; \; V = \frac{\hbar}{2e}\frac{d\phi}{dt} , \therefore I_R = \frac{\hbar}{2eR}\frac{d\phi}{dt}$$

$$I_c = C\frac{dV}{dt} \; ; \; \frac{dV}{dt} = \frac{\hbar}{2e}\frac{d^2\phi}{dt^2} , \therefore I_{cap} = \frac{\hbar C}{2e}\frac{d^2\phi}{dt^2}$$

R

$$\frac{\hbar}{2e}\frac{d\phi}{dt}, \therefore I_R = \frac{\hbar}{2eR}\frac{d\phi}{dt}$$

$$\frac{\hbar}{2e}\frac{d^2\phi}{dt^2}, \therefore I_{cap} = \frac{\hbar C}{2e}\frac{d^2\phi}{dt^2}$$



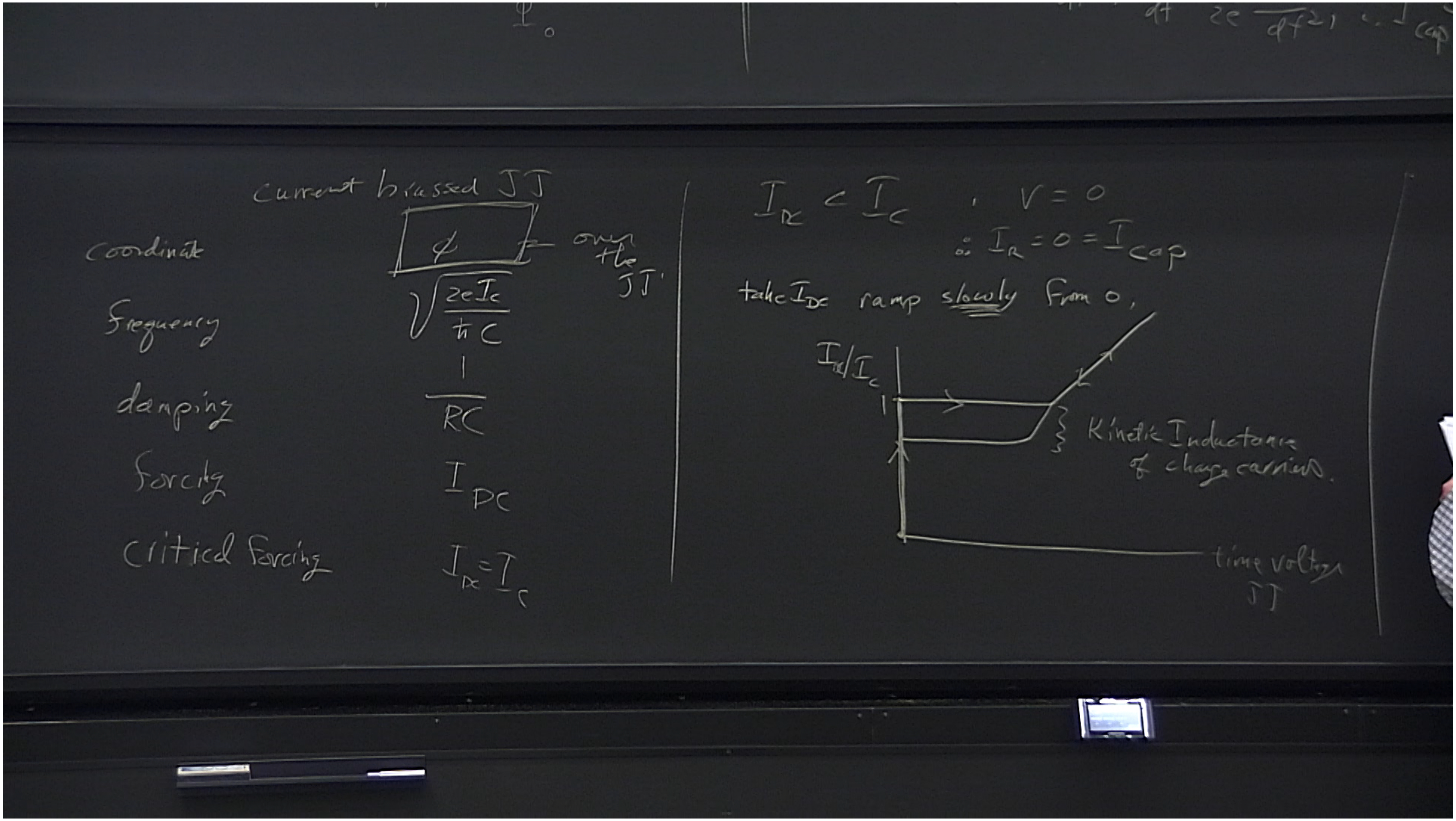
$$I_{dc} = I_{cap} + I_J + I_R$$

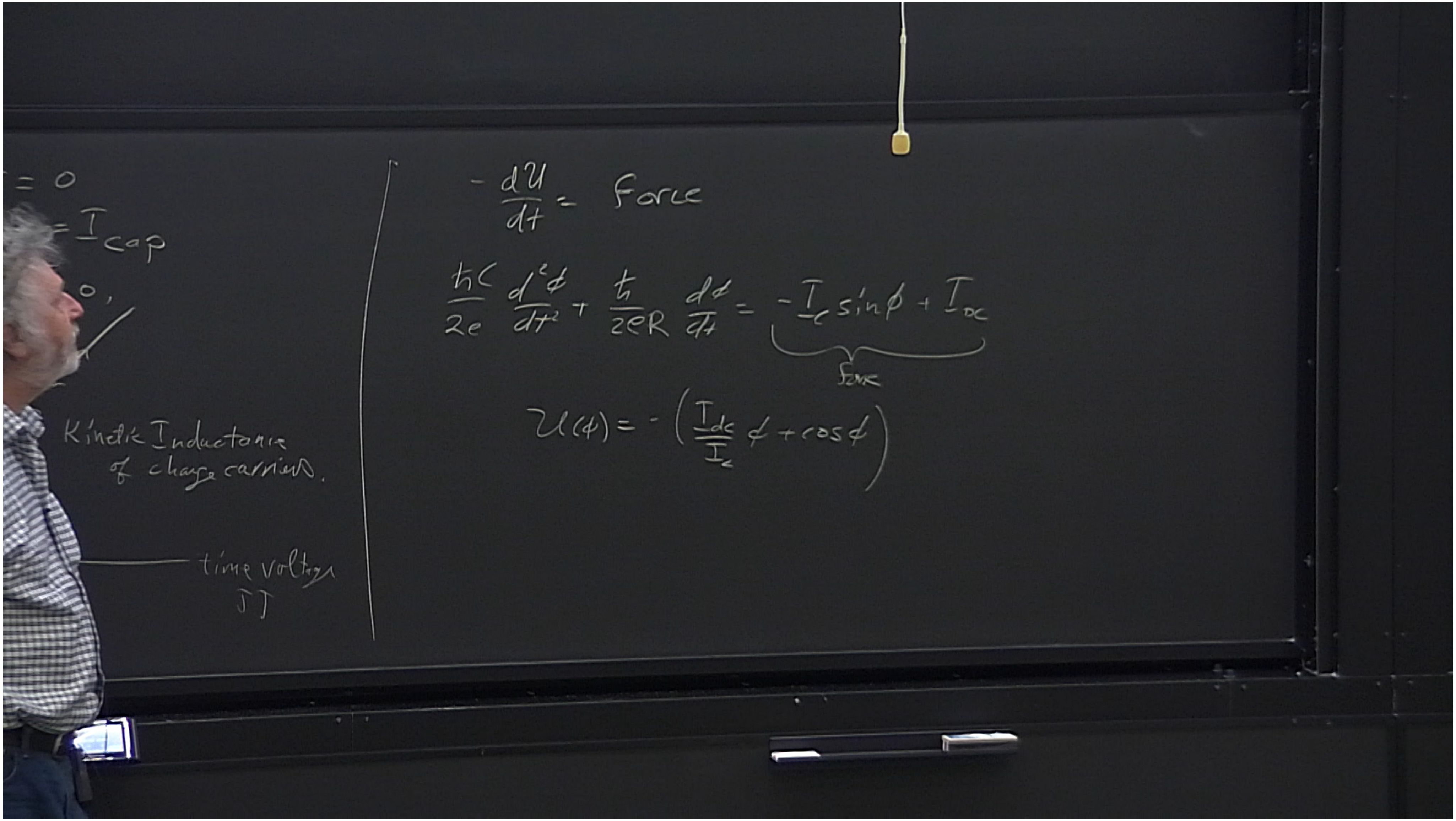
$$\boxed{I_{dc} = \frac{\hbar C}{2e}\frac{d^2\phi}{dt^2} + \frac{\hbar}{2eR}\frac{d\phi}{dt} + I_c \sin\phi}$$

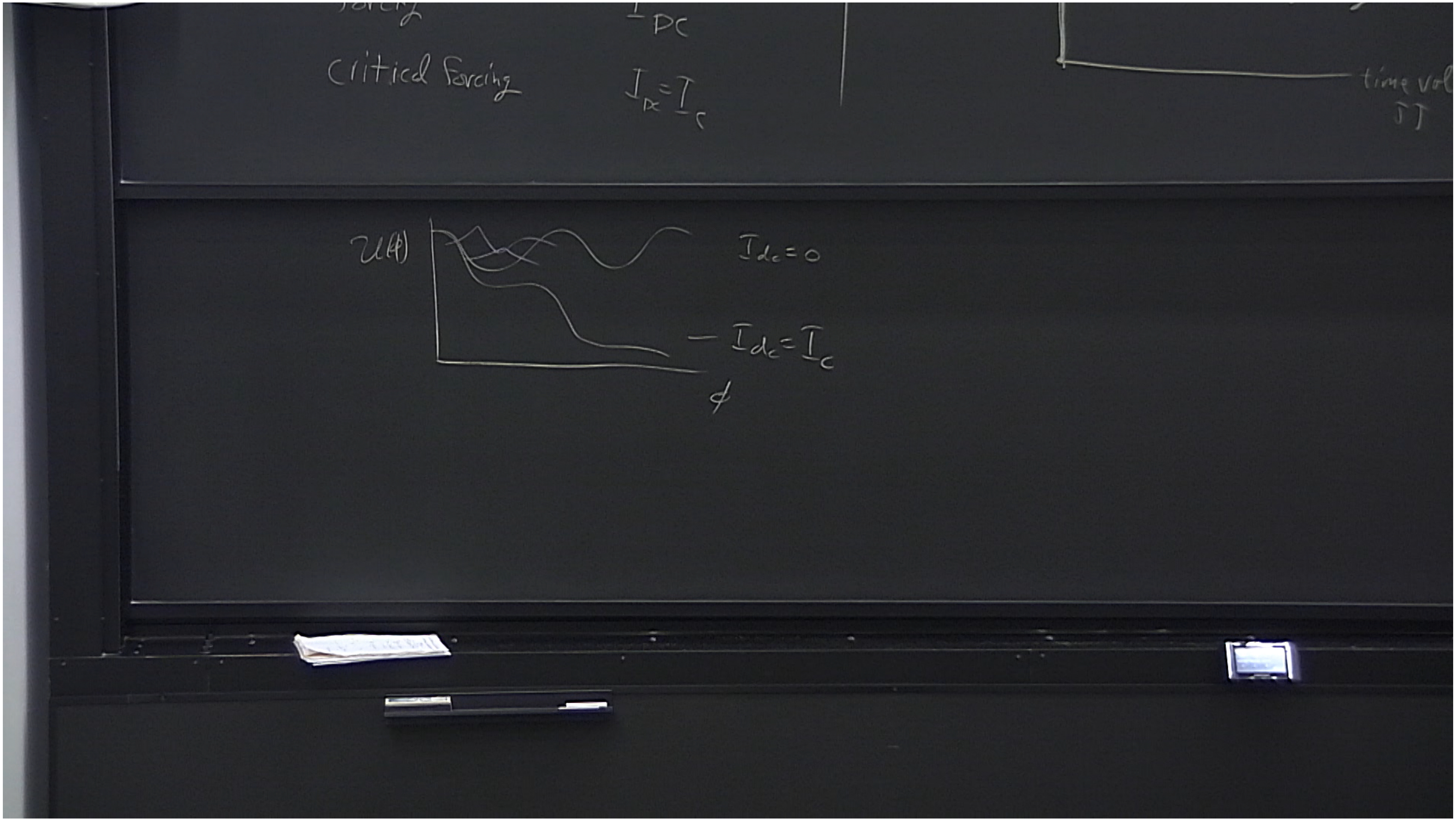
driven pendulum

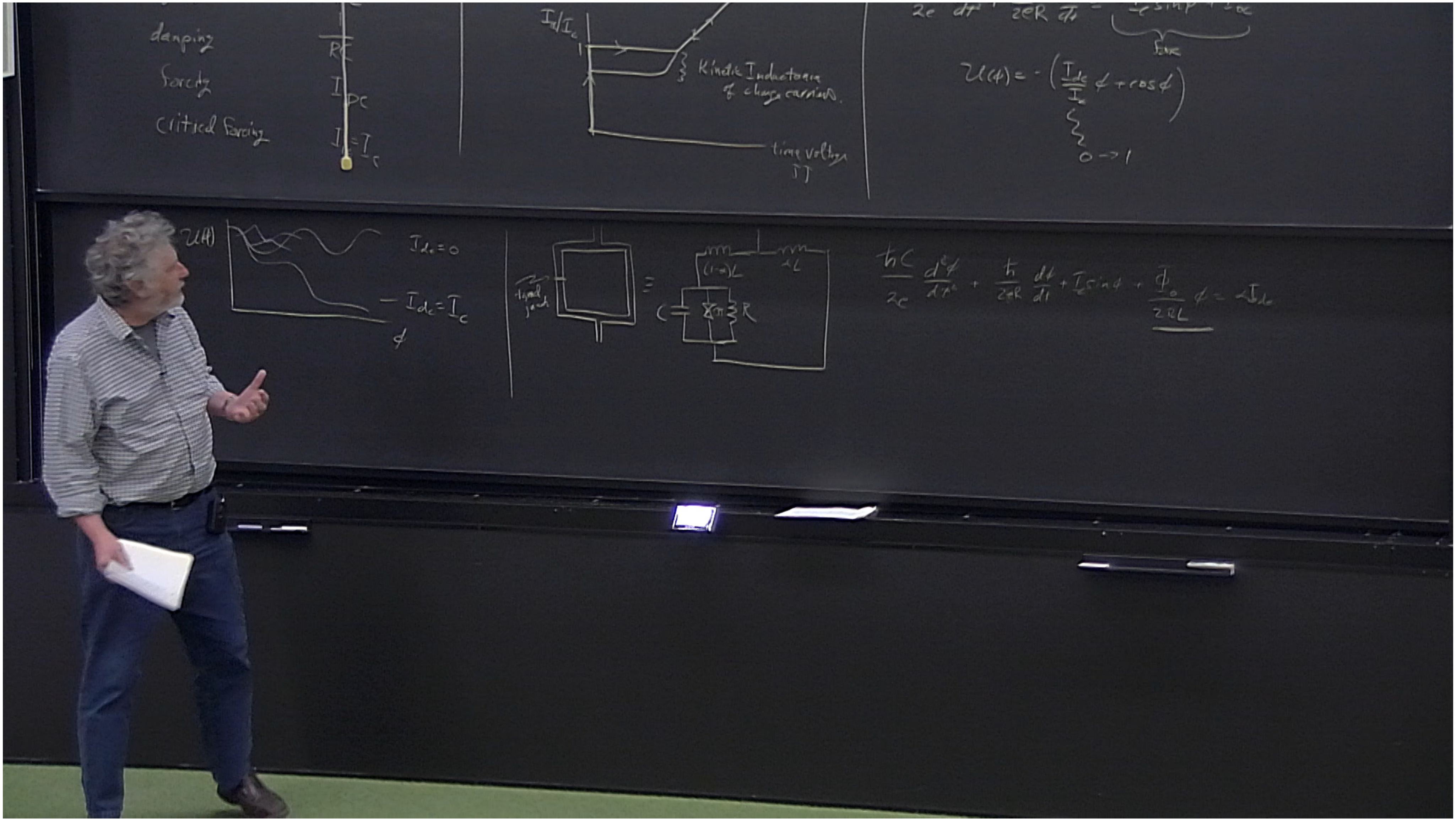
current biassed JJ

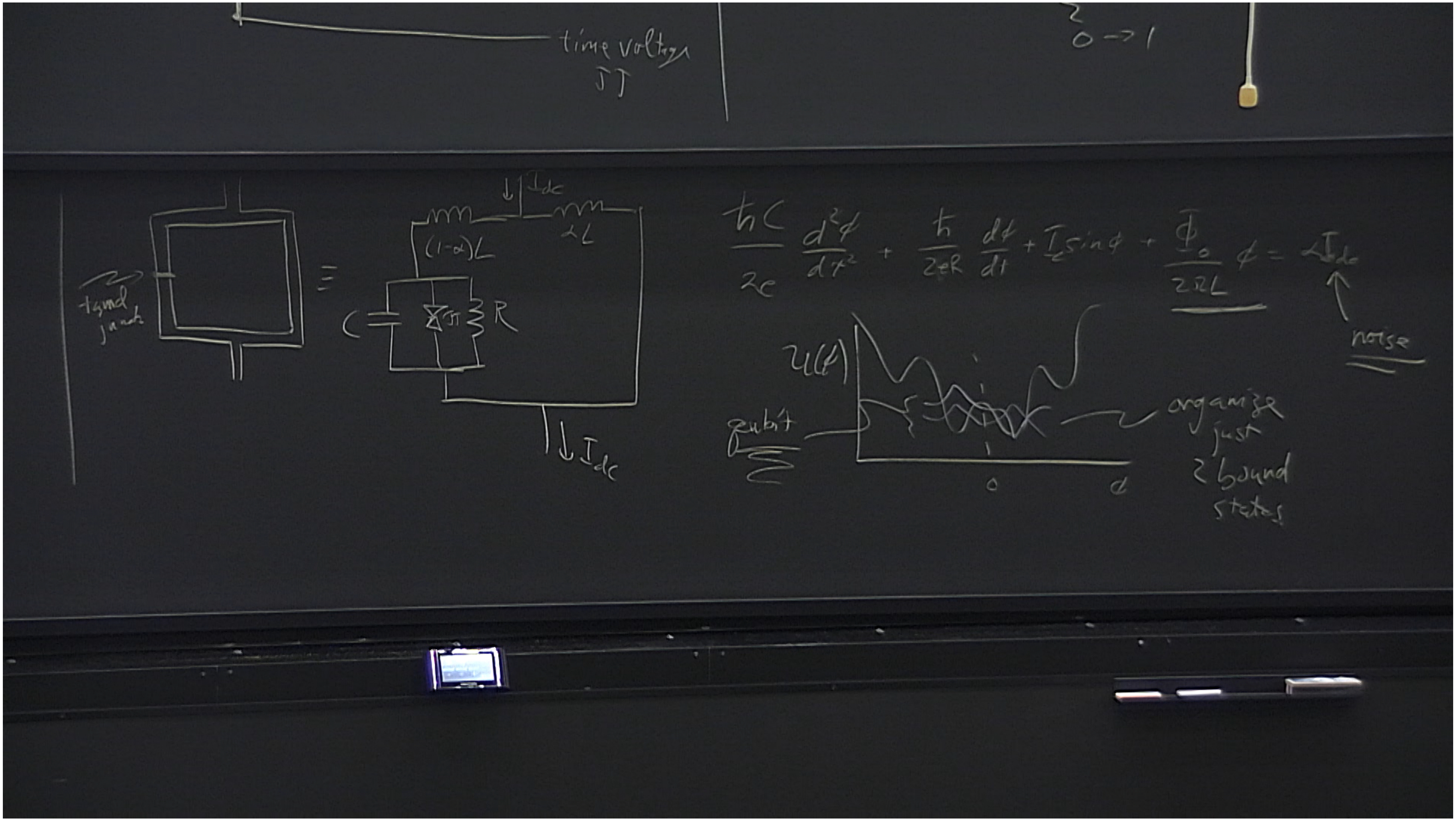
coordinate	ϕ
frequency	$\sqrt{\frac{2eI_c}{\hbar C}}$
damping	$\frac{1}{RC}$
forcing	I_{DC}
critical forcing	


current biased JJ
coordinate
φ
over the JJ
frequency
√(2eI_c / ħC)
damping
1/RC
forcing
I_DC
critical forcing
I_DC = I_c
I_DC < I_c , V = 0
∴ I_R = 0 = I_cap
take I_DC ramp slowly from 0,
I_DC/I_c
1
Kinetic Inductance of charge carriers.
time voltage
JJ

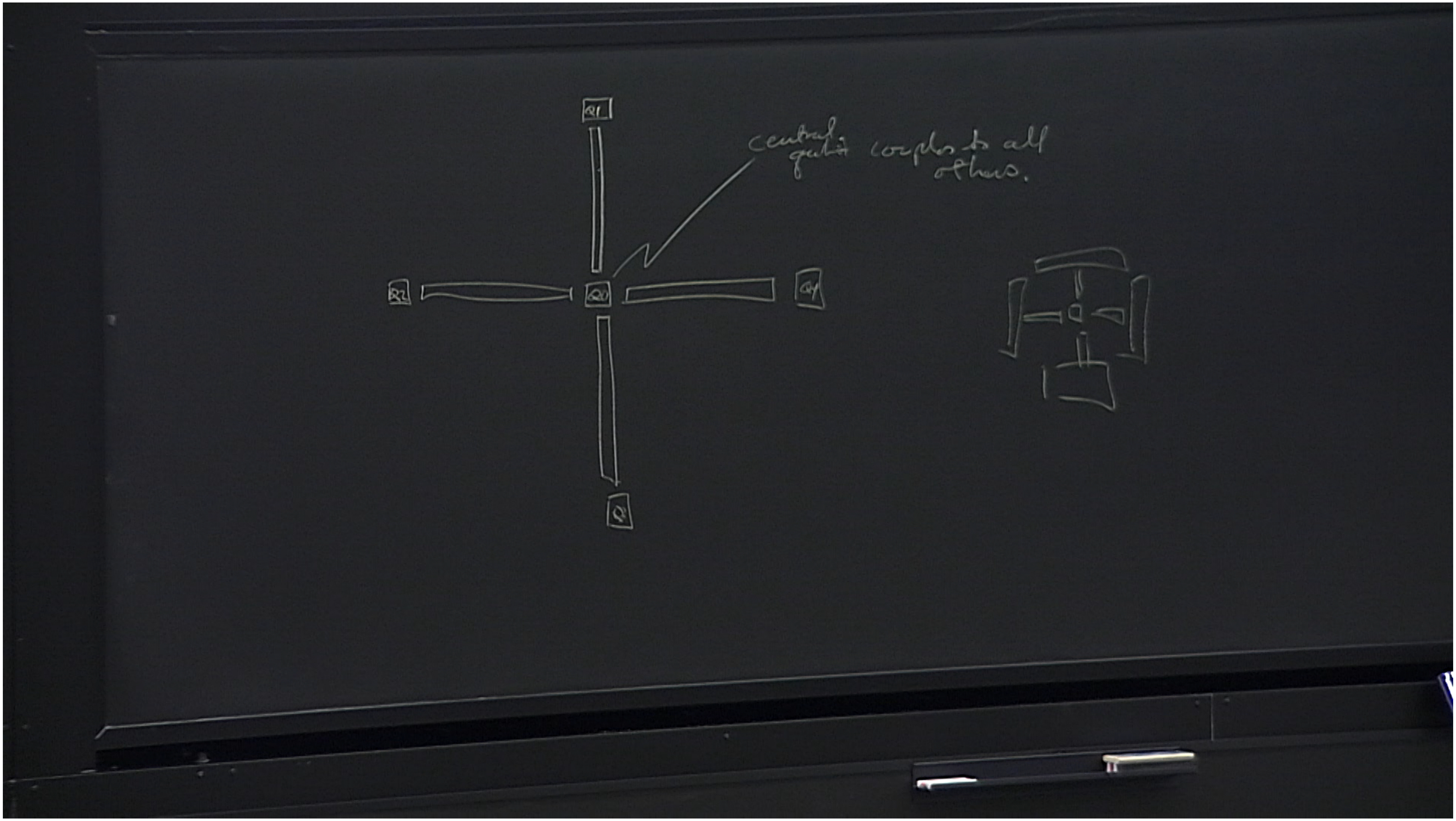

= 0
= I_{cap}
$-\frac{dU}{dt}$ = Force
$\frac{\hbar C}{2e}\frac{d^2\phi}{dt^2} + \frac{\hbar}{2eR}\frac{d\phi}{dt} = -I_c \sin\phi + I_{DC}$
Force
$U(\phi) = -\left(\frac{I_{dc}}{I_c}\phi + \cos\phi\right)$
Kinetic Inductance of charge carriers.
time voltage
JJ


critical forcing
$I_{DC} = I_c$
$U(\phi)$
$I_{dc} = 0$
$I_{dc} = I_c$
ϕ
time vol


damping
forcing
critical forcing
Kinetic Inductance of charge carriers.
time voltage
$U(\phi) = -\left(\frac{I_{dc}}{I_c}\phi + \cos\phi\right)$
$0 \to 1$
$I_{dc} = 0$
$I_{dc} = I_c$



time voltage
JJ
(1-α)L
αL
Idc
C
JJ
R
U(φ)
qubit
noise
organize
just
2 bound
states


Q1
Q2
Q0
Q4
central qubit couples to all others.