Title: Fault Tolerance via Mixed-State Phases

Speakers: Amirreza Negari

Collection/Series: Training Programs (TEOSP)

Subject: Other

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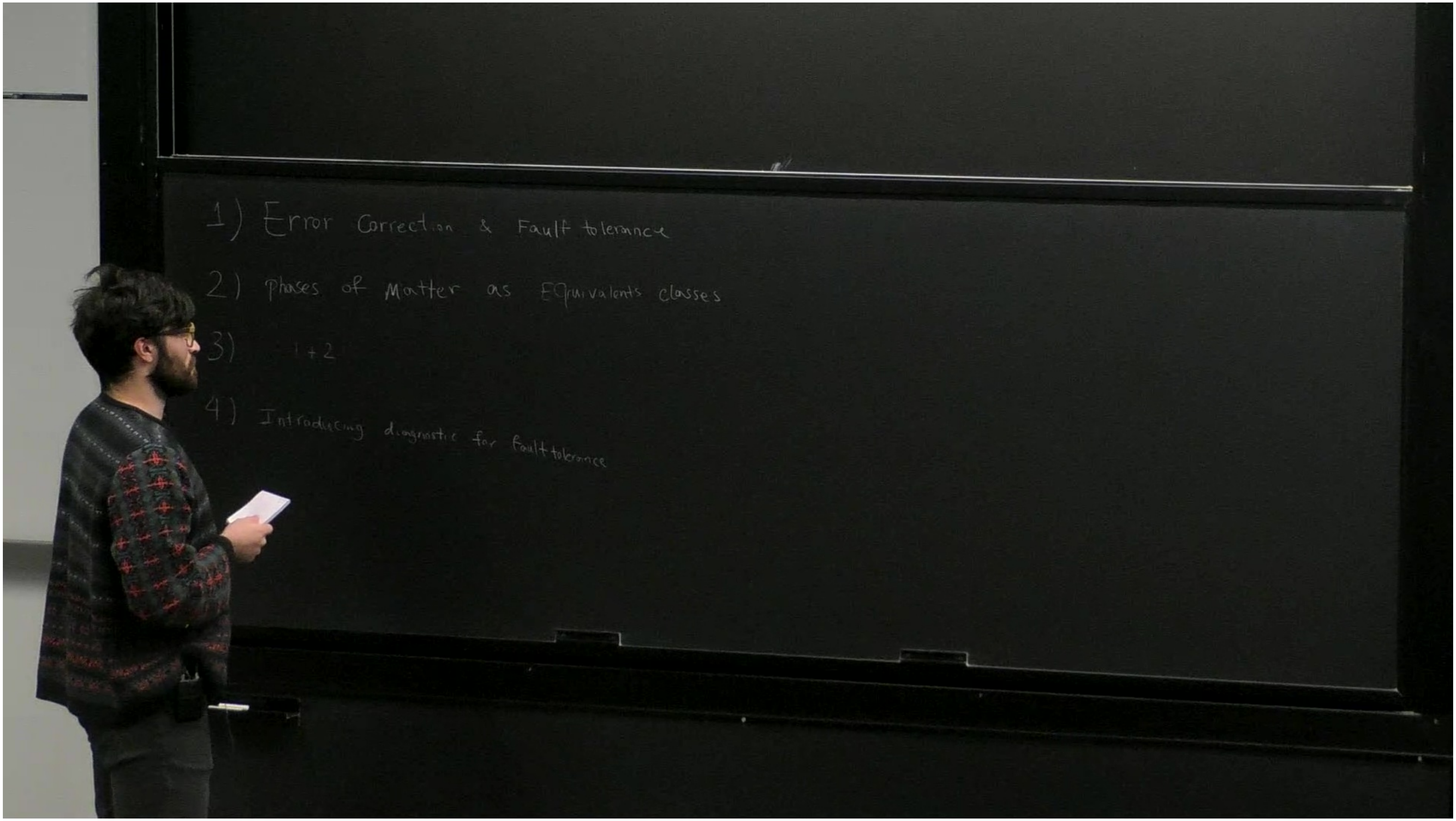
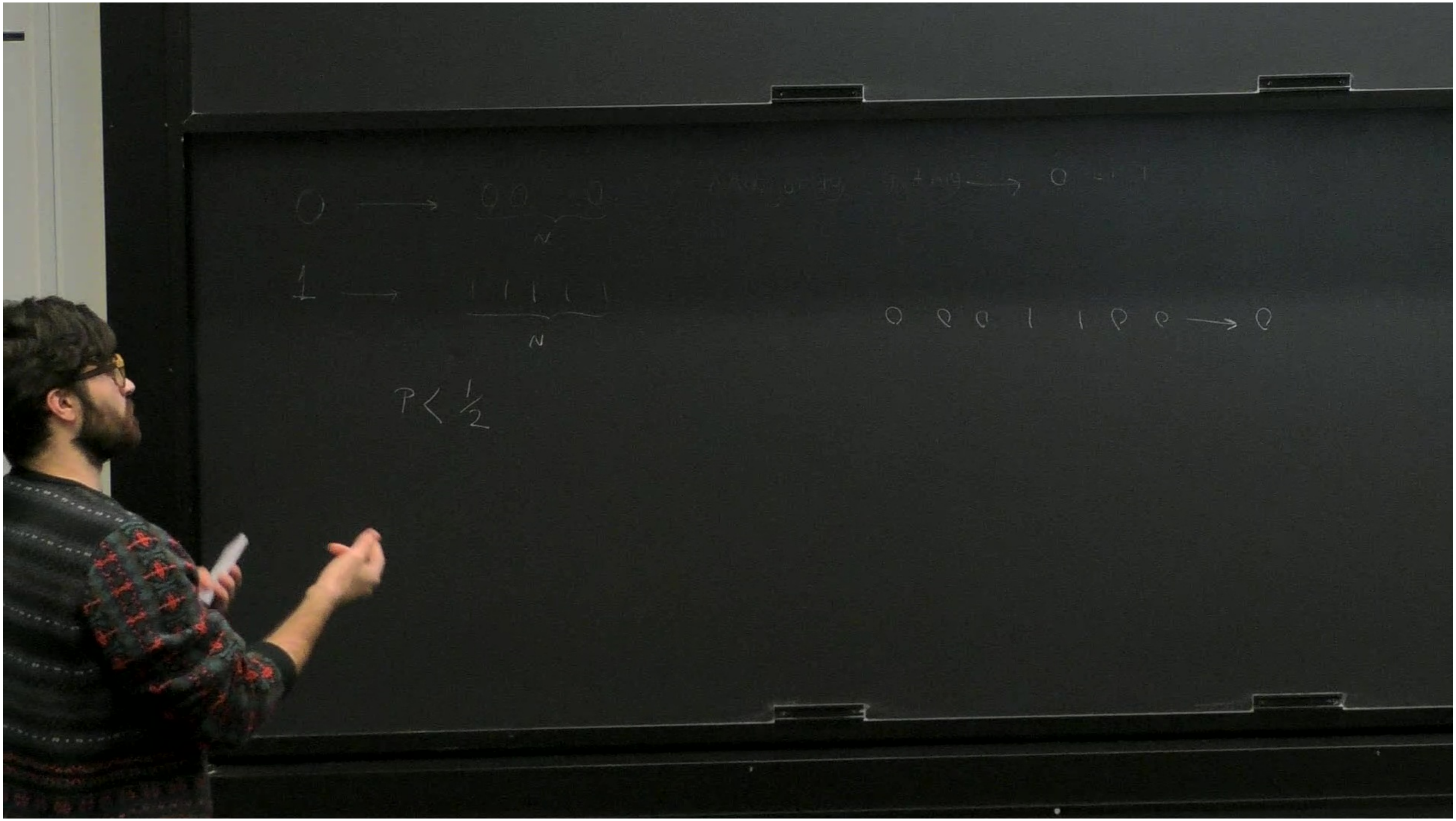
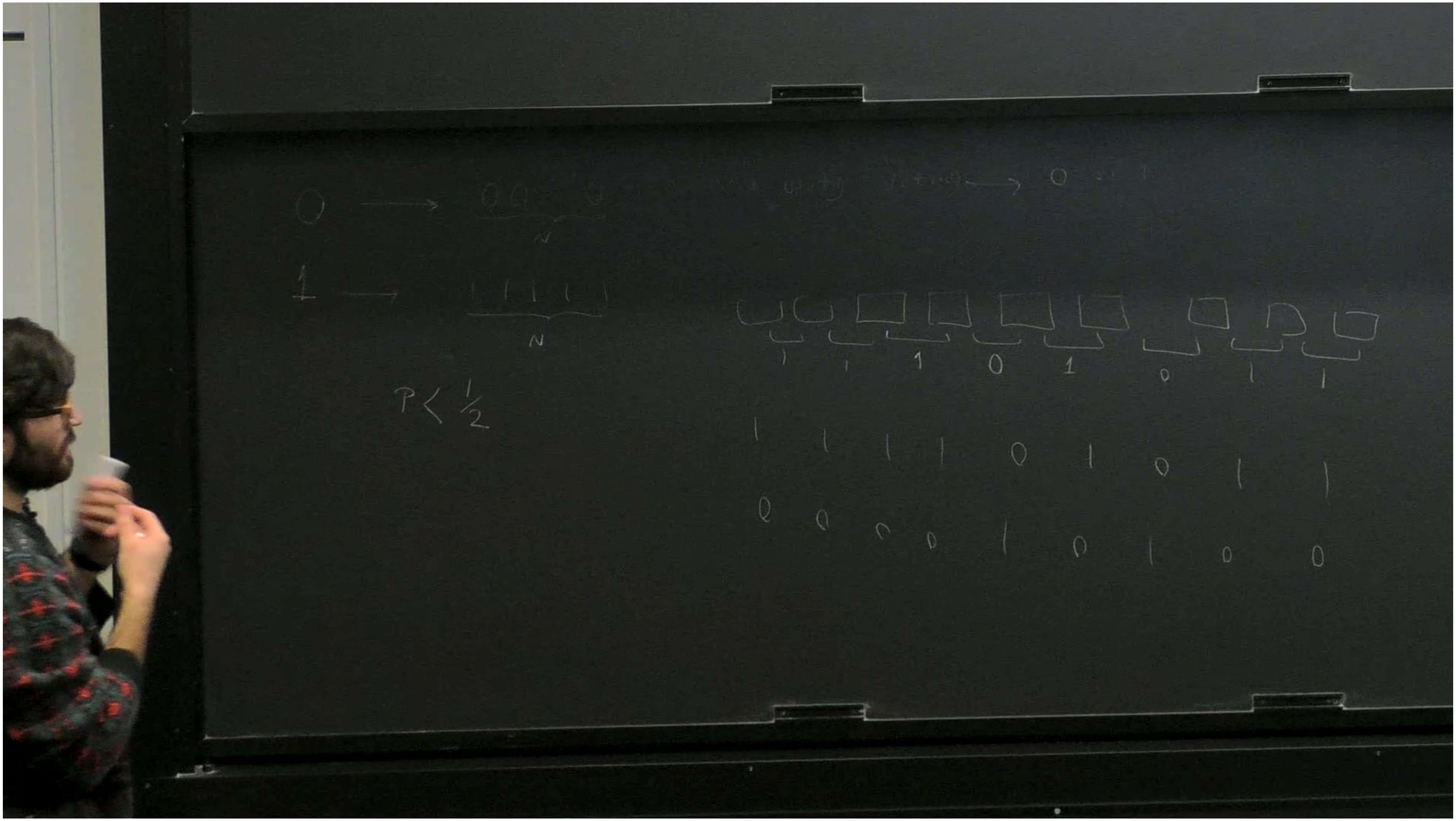
URL: https://pirsa.org/25020056

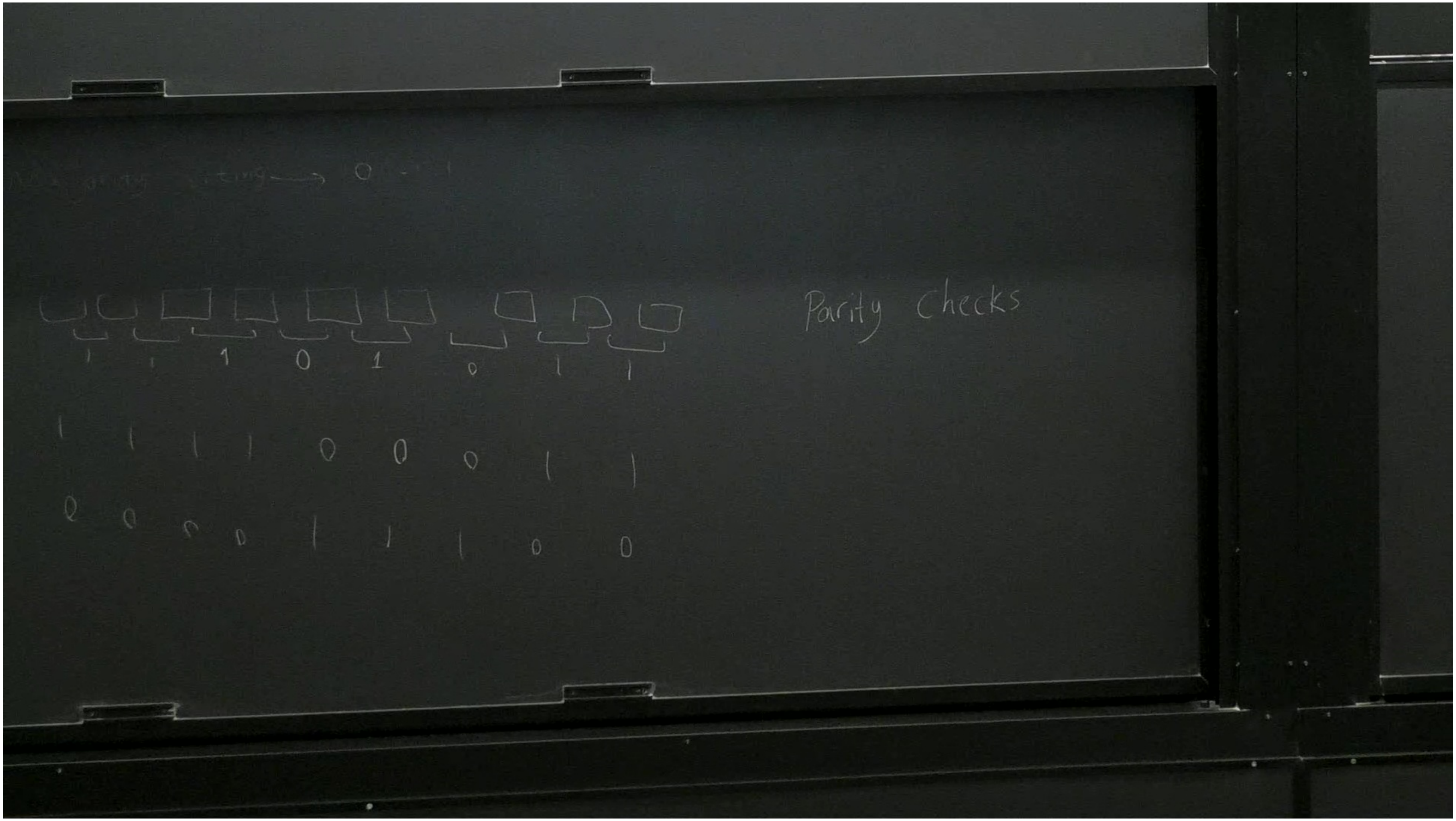
Abstract:

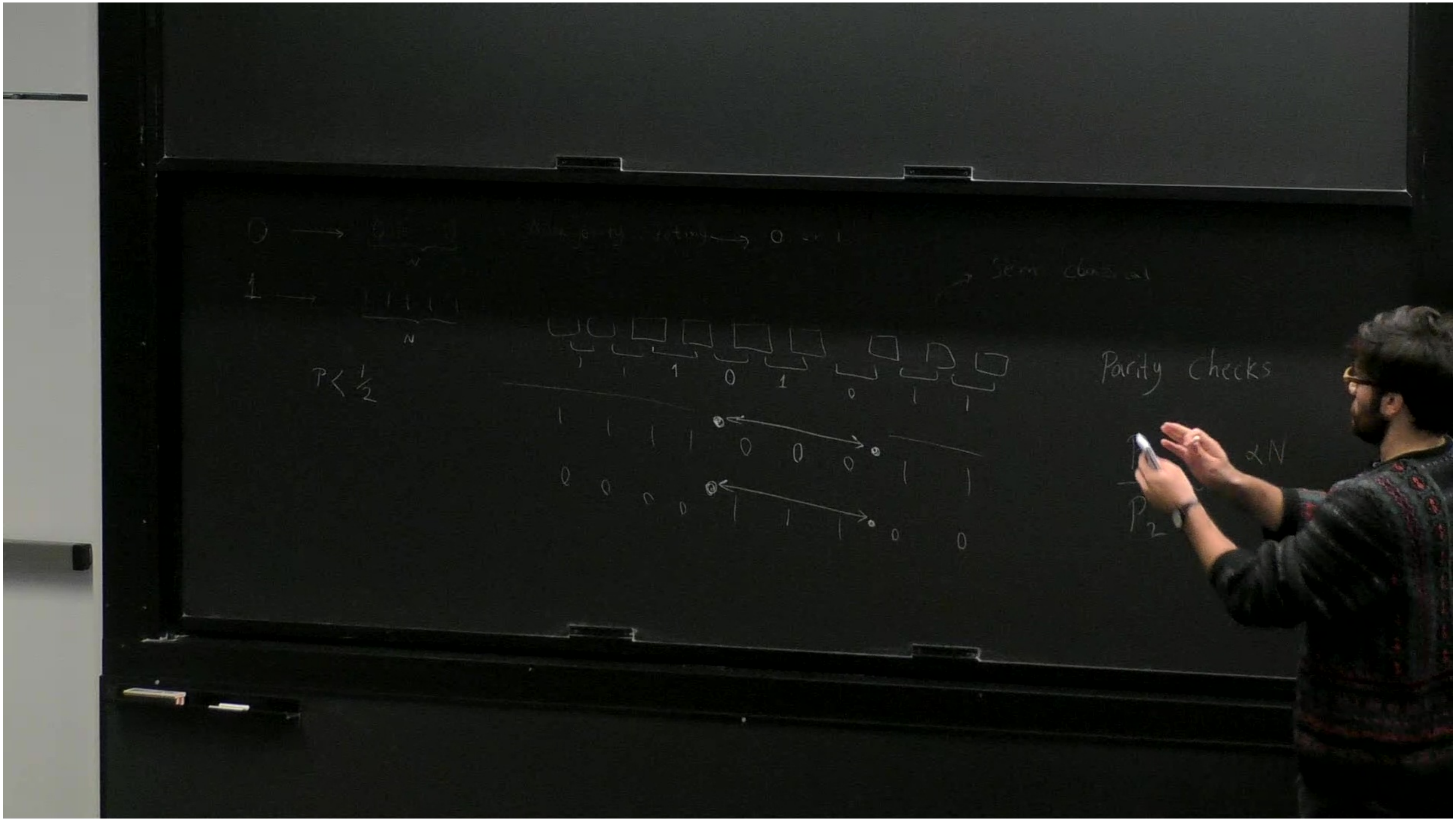
In this talk, I will explain the concept of fault tolerance, which ensures reliable quantum computation. Building on recent advancements in mixed-state phases of matter, I introduce a new diagnostic called the spacetime Markov length. The divergence of this length scale signals the intrinsic breakdown of fault tolerance.


1) Error Correction & Fault tolerance
2) phases of Matter as Equivalents classes
3) 1 + 2
4) Introducing diagnostic for fault tolerance

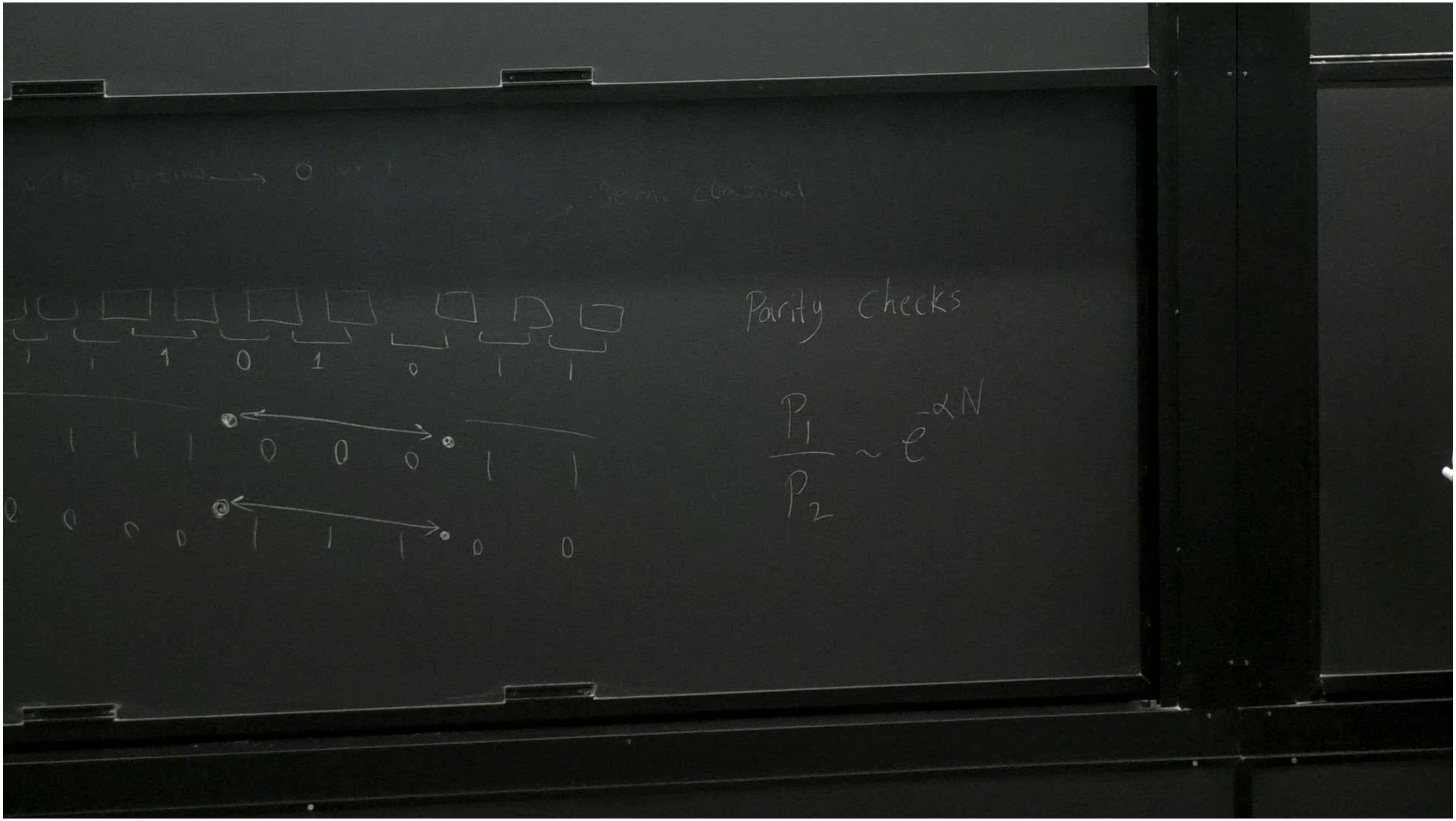

N
N
P< 1/2

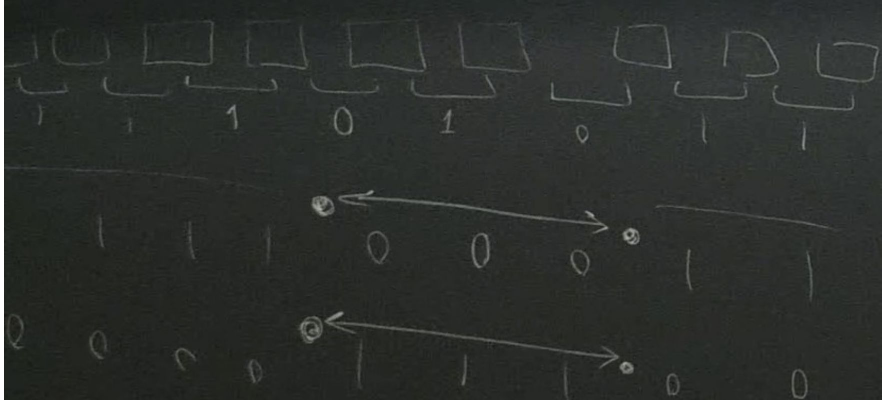

N
N
P < ½


Parity checks
1 1 1 0 1 0 1 1
1 1 1 1 0 0 0 1 1
0 0 0 0 1 1 1 0 0



Parity checks
$P < \frac{1}{2}$

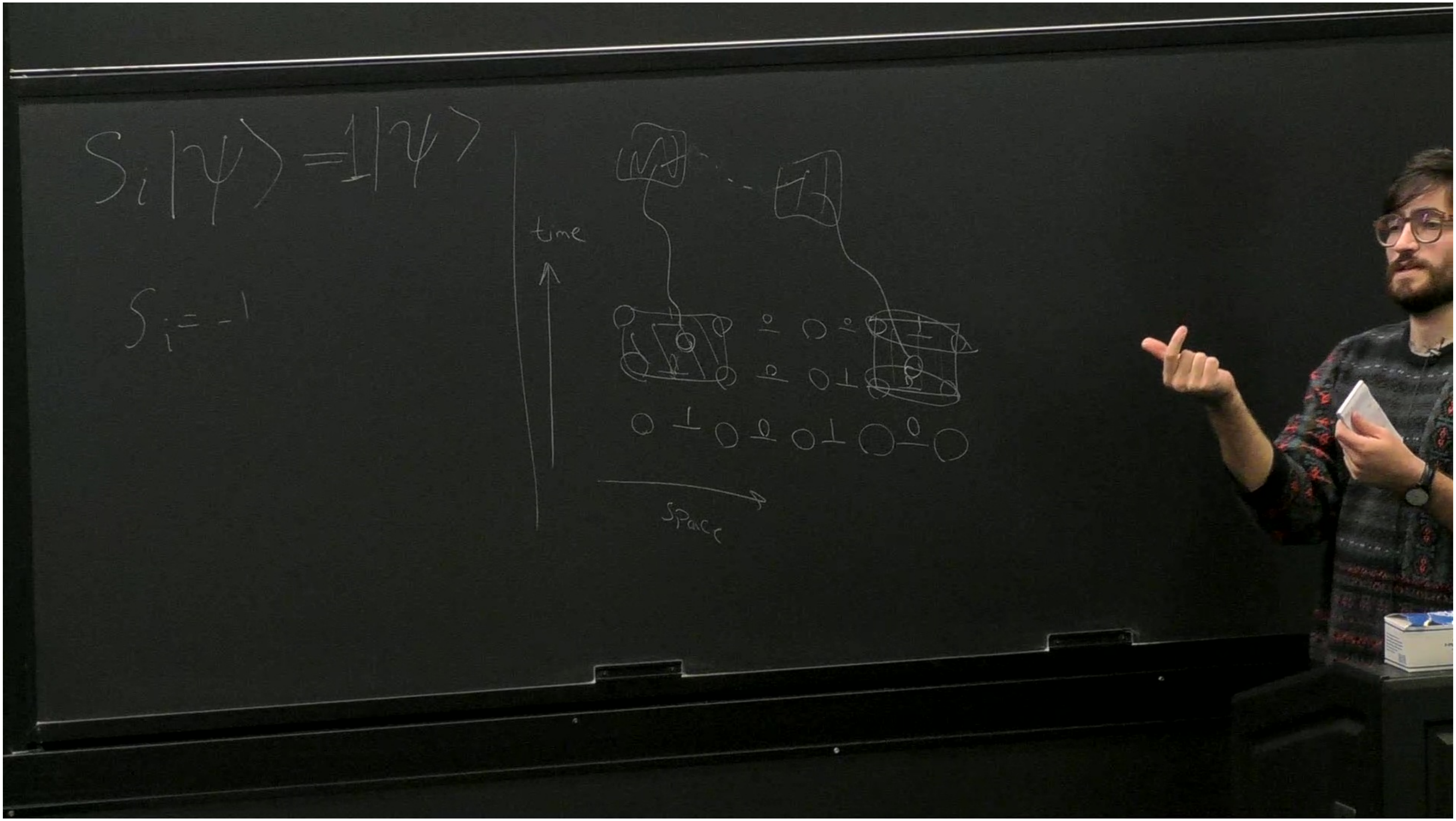

semi classical
1 1 1 0 1 0 1 1
1 1 1 0 0 0 1 1
0 0 0 0 1 1 1 0 0
Parity checks
$\frac{P_1}{P_2} \sim e^{-\alpha N}$

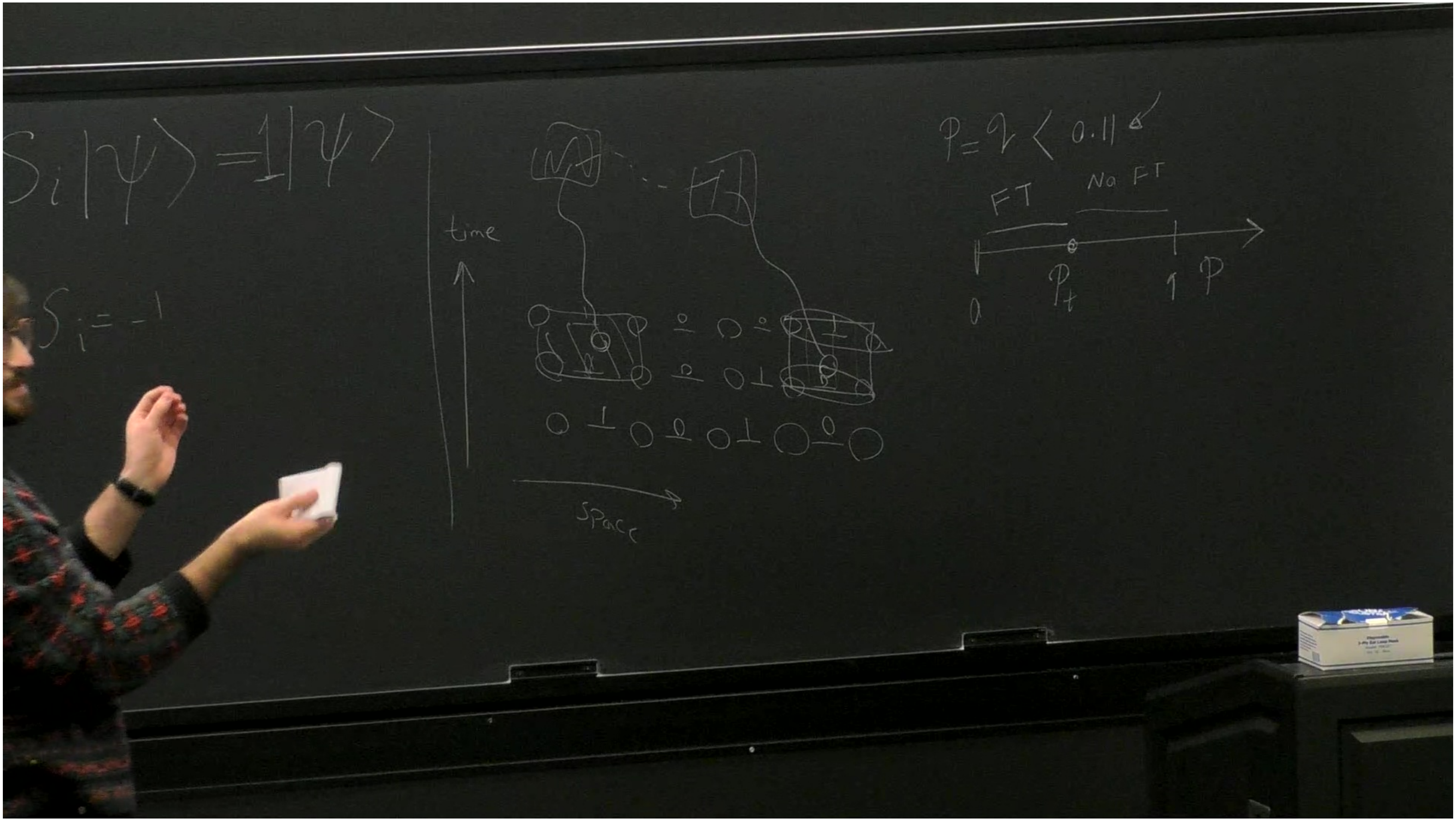


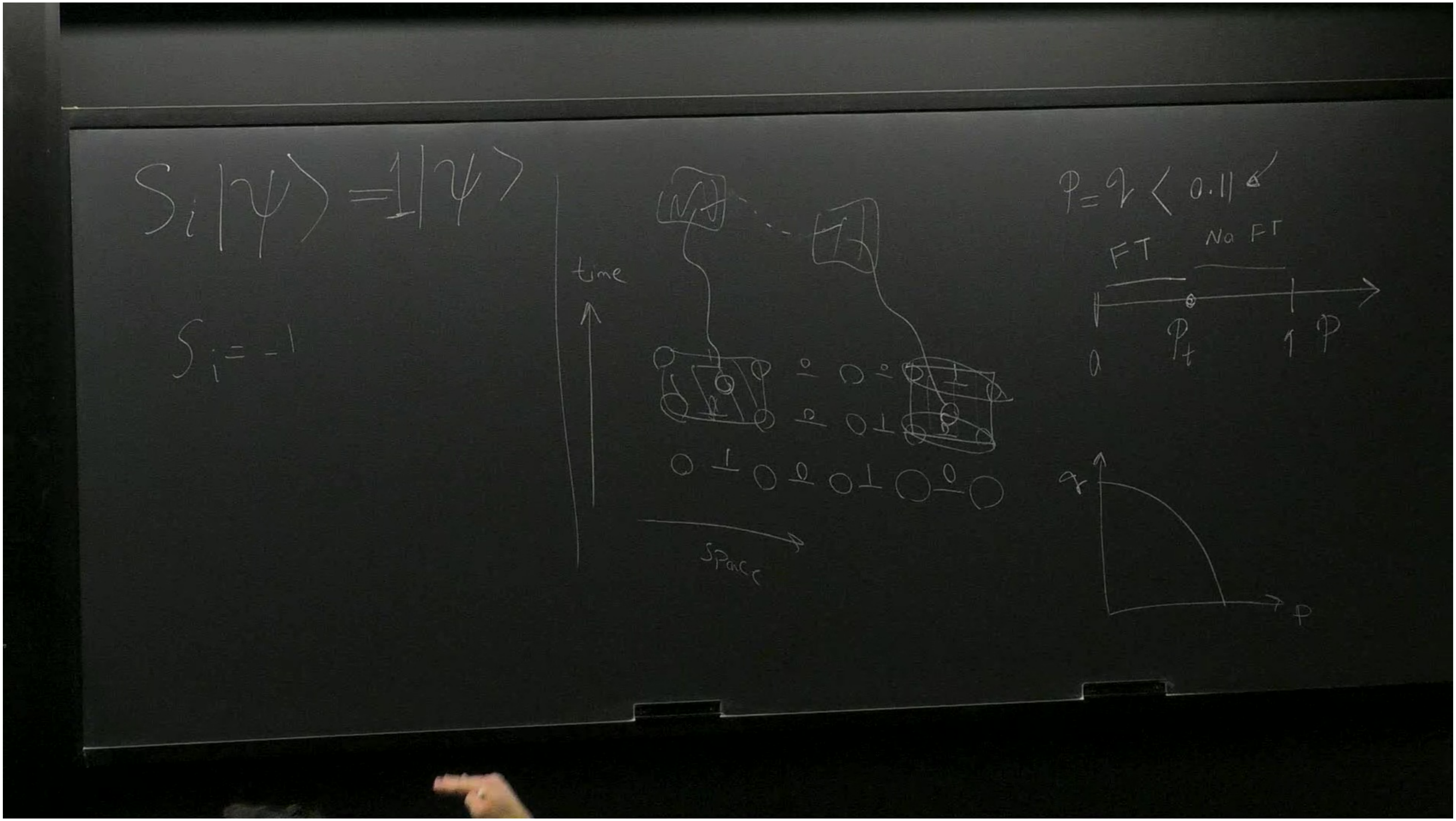
Parity checks = $\hat{S}_i$

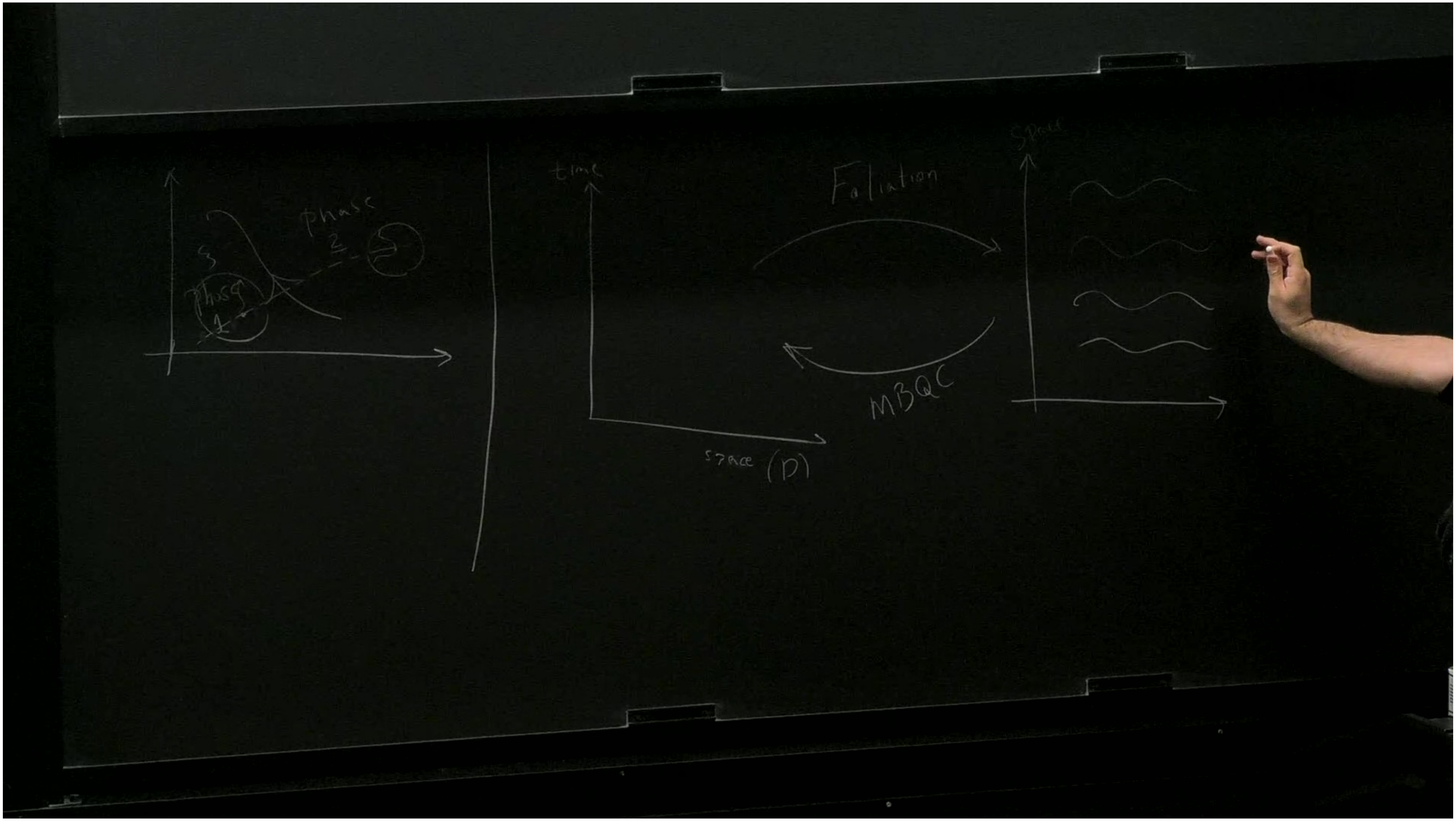
$$\frac{P_1}{P_2} \sim e^{-\alpha N}$$

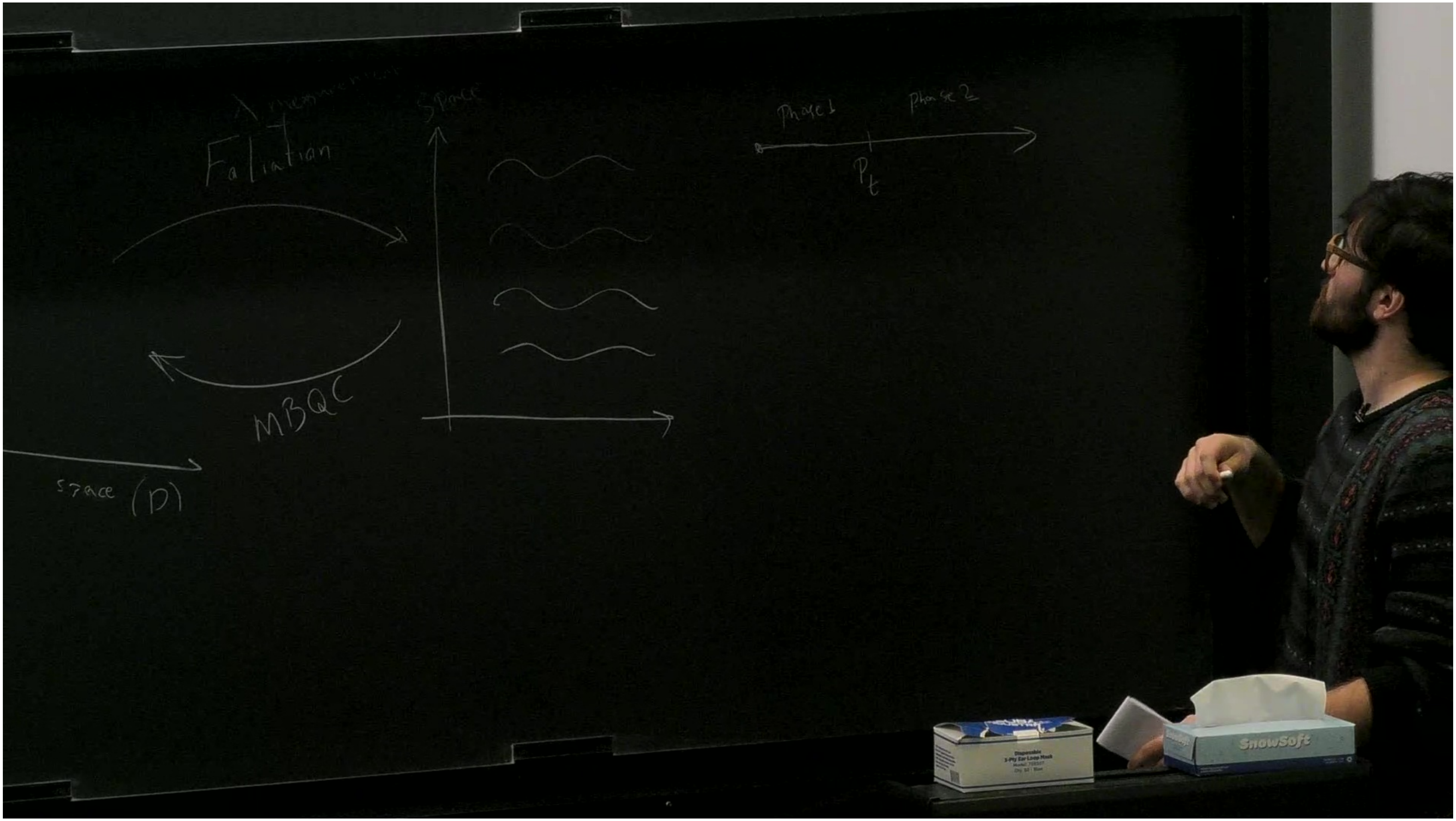
S_i

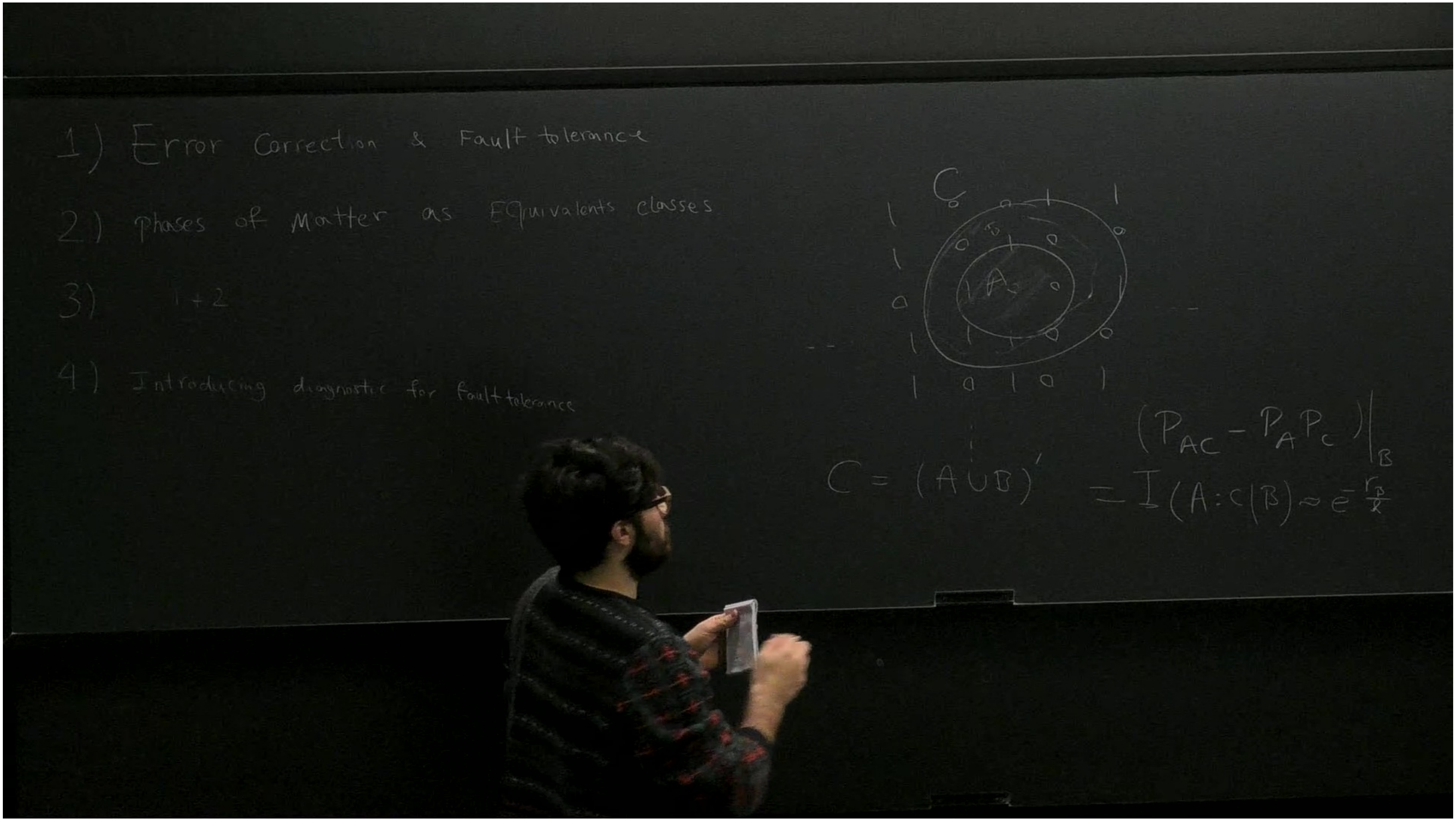

$S_i|\psi\rangle = 1|\psi\rangle$
$S_i = -1$
time
space

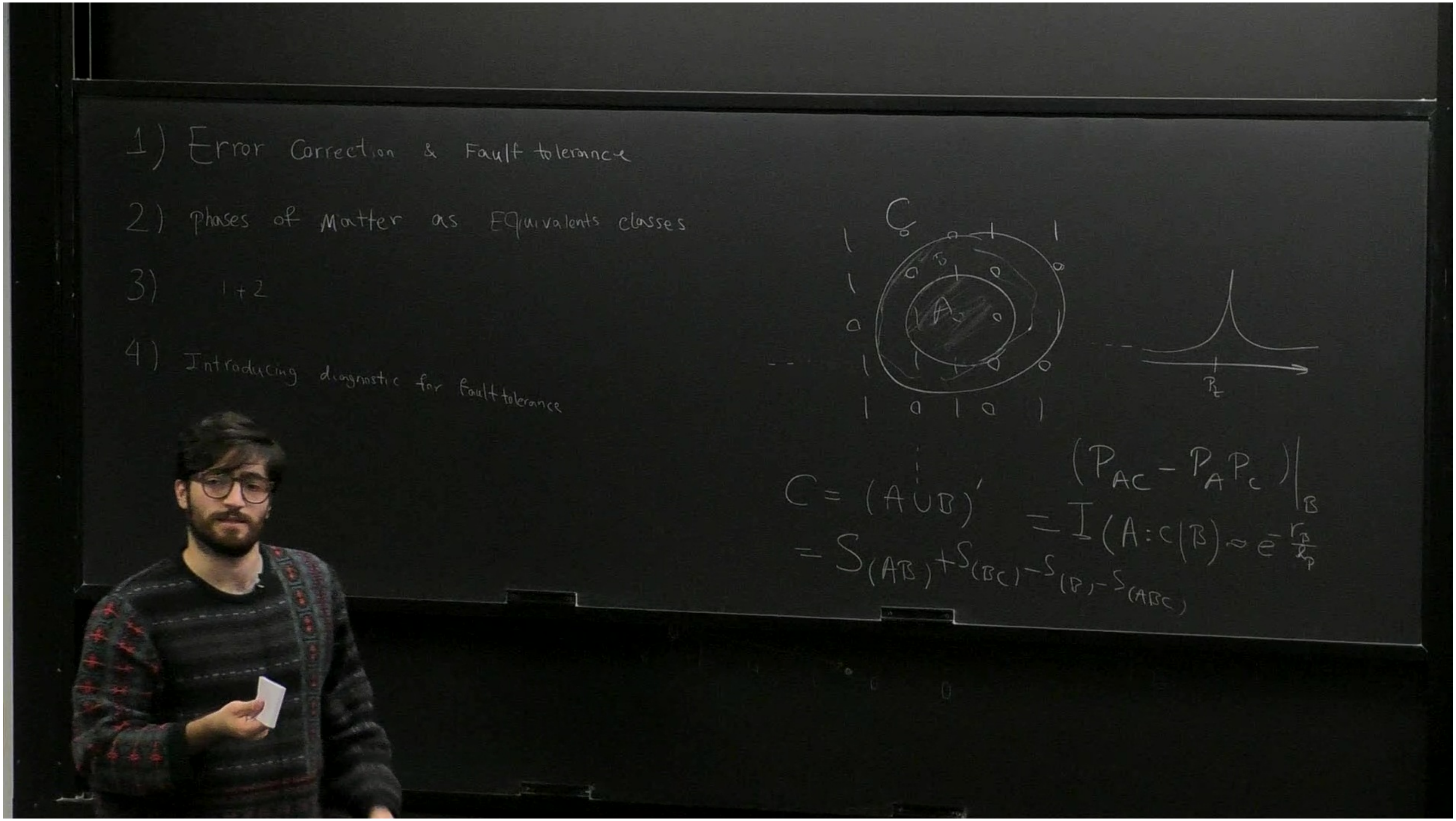

time
space
FT
No FT
0.11
0

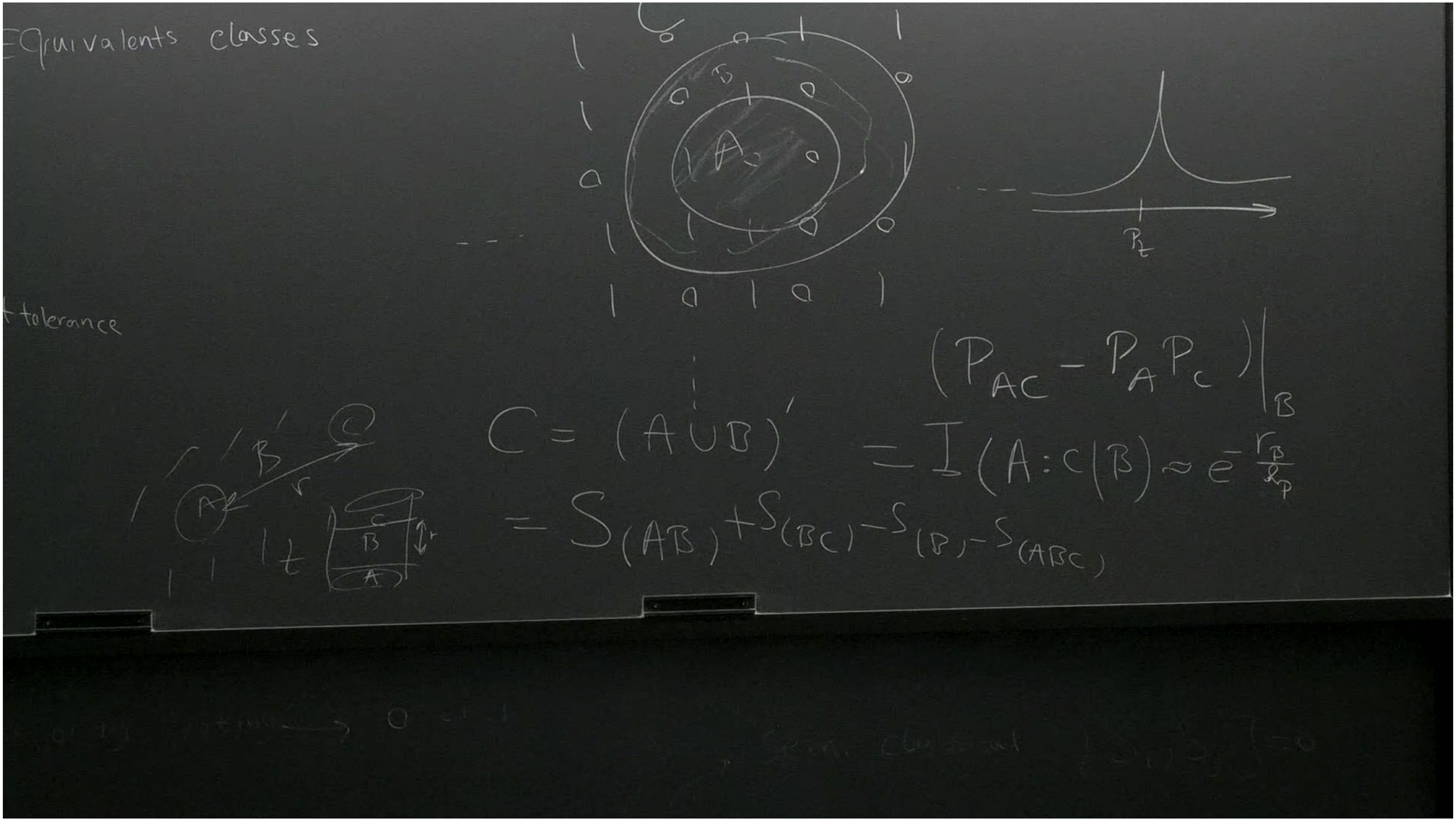

S_i|ψ> = 1|ψ>
S_i = -1
time
Space
p = q < 0.11
FT
No FT
0
p_t
1
p
q
p


phase
2
phase
1
time
space (D)
Foliation
MBQC
Space


Foliation
Space
phase 1
phase 2
P_t
MBQC
space (D)


1) Error Correction & Fault tolerance
2) phases of Matter as Equivalents classes
3) 1+2
4) Introducing diagnostic for fault tolerance
C
A
B
(P_AC - P_A P_C)|_B
= I(A:C|B) ≈ e^(-r_B/ξ)
C = (A∪B)'


1) Error Correction & Fault tolerance
2) phases of Matter as Equivalents classes
3) 1+2
4) Introducing diagnostic for Fault tolerance
C = (A∪B)'
$(P_{AC} - P_A P_C)|_B$
$= I(A:C|B) \sim e^{-\frac{r_B}{\xi_p}}$
$= S_{(AB)} + S_{(BC)} - S_{(B)} - S_{(ABC)}$
p_c


Equivalents classes
tolerance
$(P_{AC} - P_A P_C)|_B$
$C = (A \cup B)' = I(A:C|B) \approx e^{-r_B/\ell_p}$
$= S_{(AB)} + S_{(BC)} - S_{(B)} - S_{(ABC)}$
P_t