Title: Quantum Foundations Lecture

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Collection: Quantum Foundations

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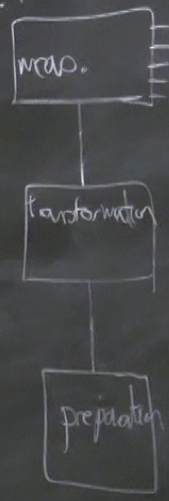
Operational reconstruction of QT

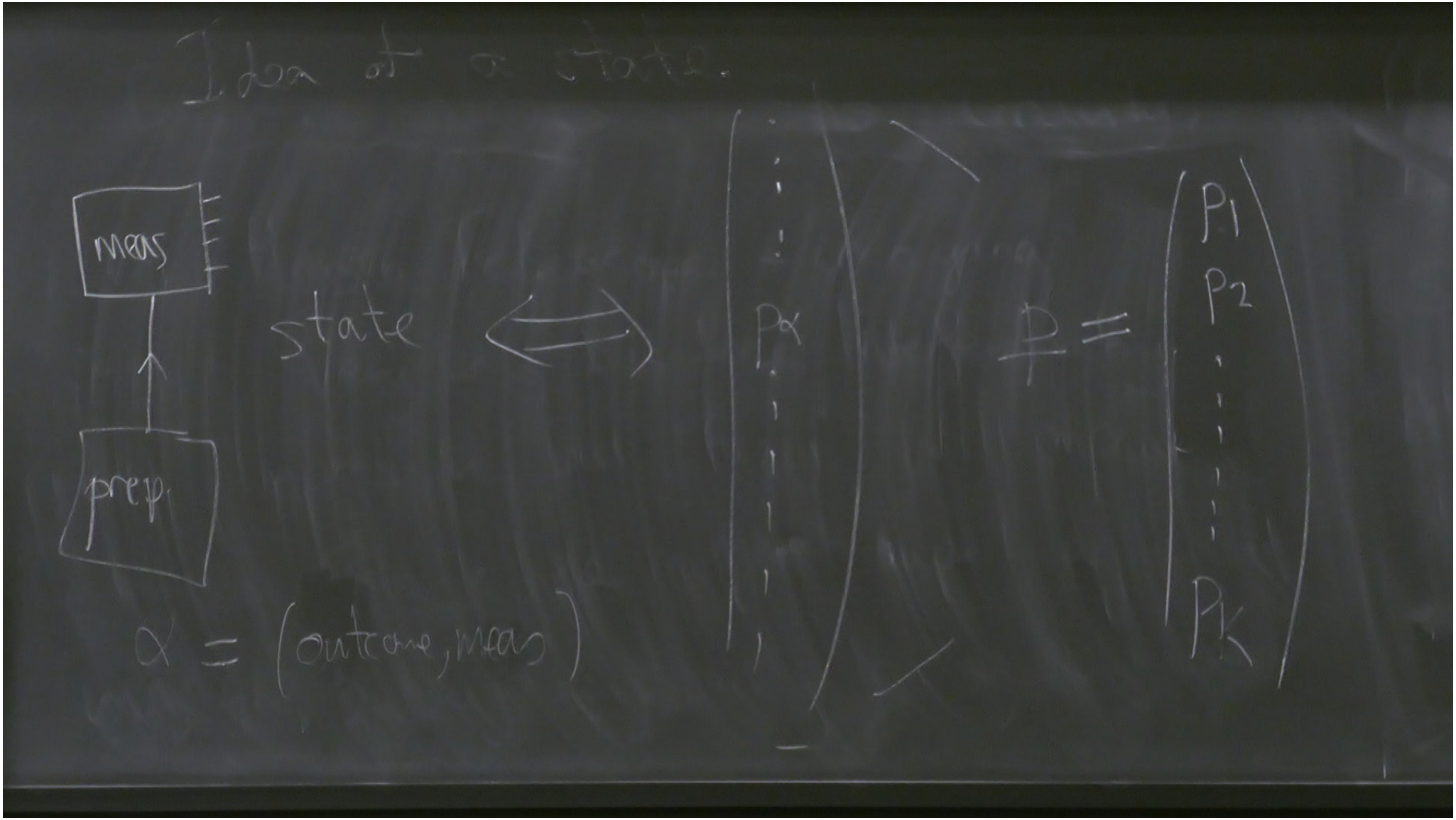
quant-ph/0101012

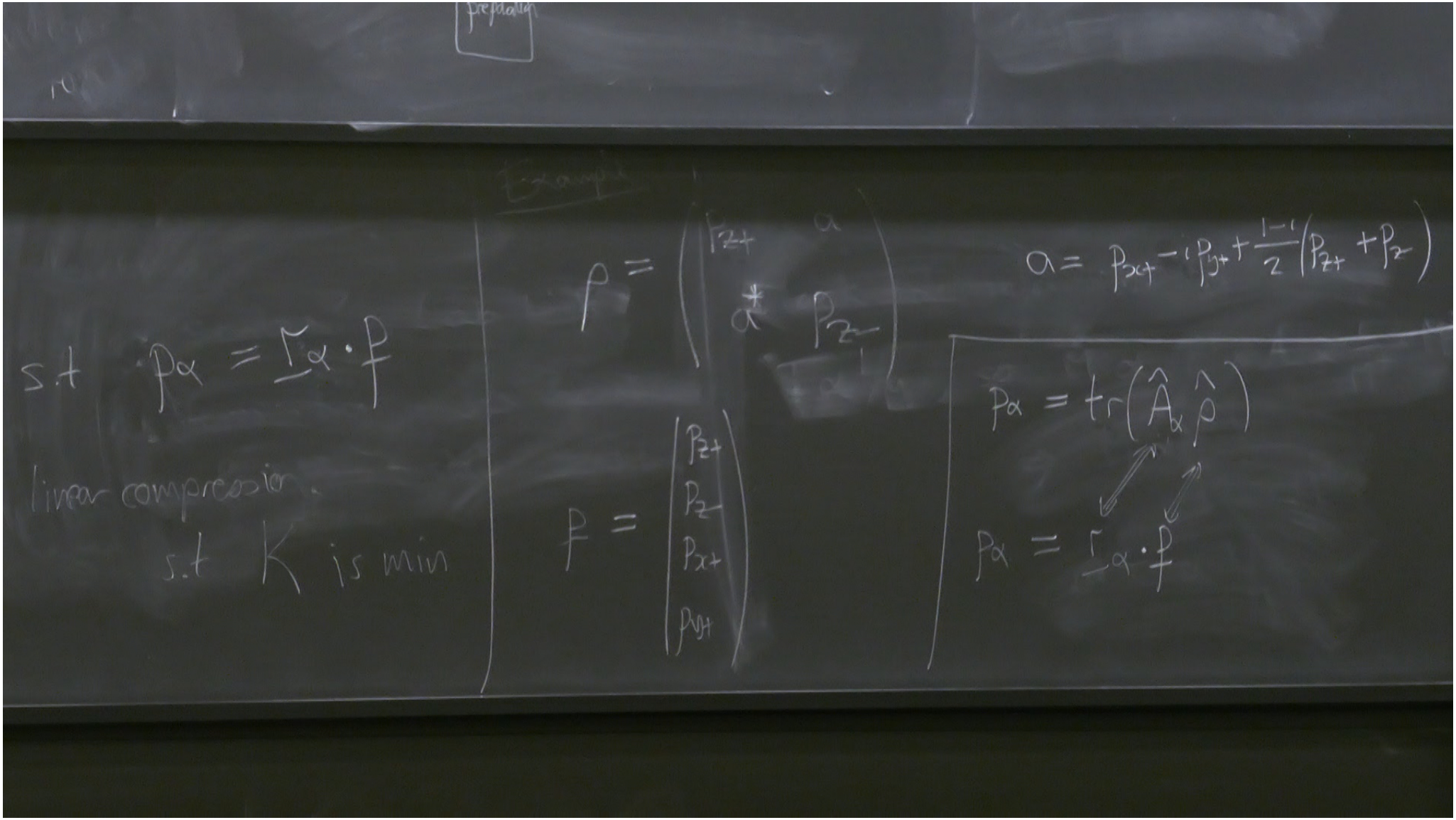
Motivation usual axioms of QT abstract.

		Beyond.
Maxwell's eqns.	SR	→ GR
Kepler laws	Newton's	
QT	?	→ QG

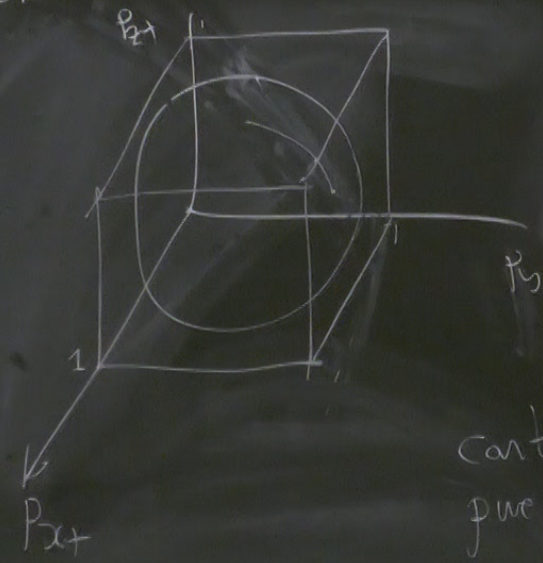
Operational?




Idea of a state.
meas
prep
state
$\alpha = (\text{outcome}, \text{meas})$
p_α
$\underline{p} =$
p_1
p_2
p_K


Preparation
Example
$p_\alpha = \underline{\Gamma}_\alpha \cdot \underline{p}$
s.t
linear compression
s.t K is min
$\rho = \begin{pmatrix} \Gamma_{z+} & a \\ a^* & p_{z-} \end{pmatrix}$
$\underline{p} = \begin{pmatrix} p_{z+} \\ p_{z-} \\ p_{x+} \\ p_{y+} \end{pmatrix}$
$a = p_{x+} - i p_{y+} + \frac{1-\gamma}{2}(p_{z+} + p_{z-})$
$p_\alpha = \mathrm{tr}(\hat{A}_\alpha \hat{\rho})$
$p_\alpha = \underline{\Gamma}_\alpha \cdot \underline{p}$

impose $P_{z+} + P_{z-} = 1$



$N=2$

continuous set of pure states.

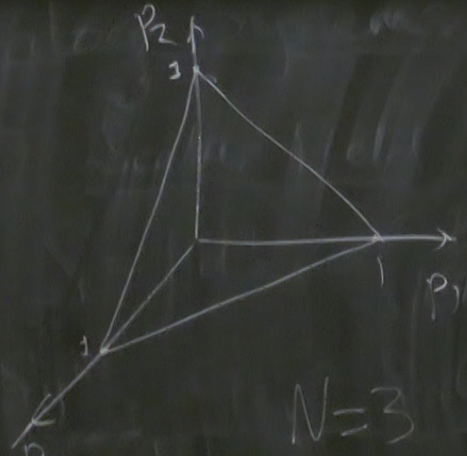
mixed state

$$\hat{\rho} = \lambda \hat{\rho}_A + (1-\lambda)\hat{\rho}_B$$

$\hat{\rho}_A \neq \hat{\rho}_B \quad 0 < \lambda < 1$

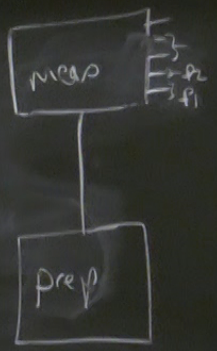
pure states $\Rightarrow$ not mixed.

Classical prob. (0, 1, 2)



$N = 3$

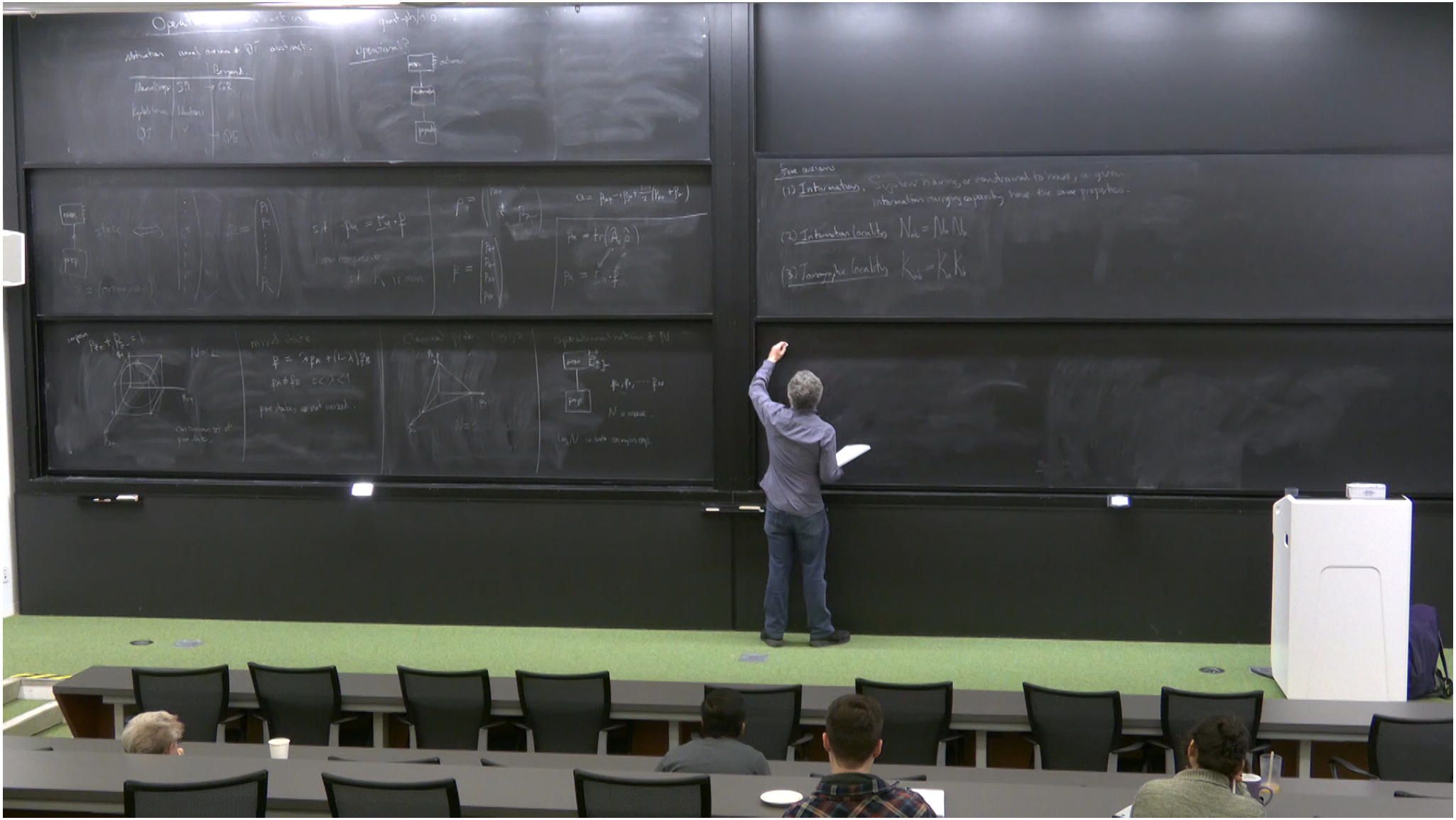
operational notion of N

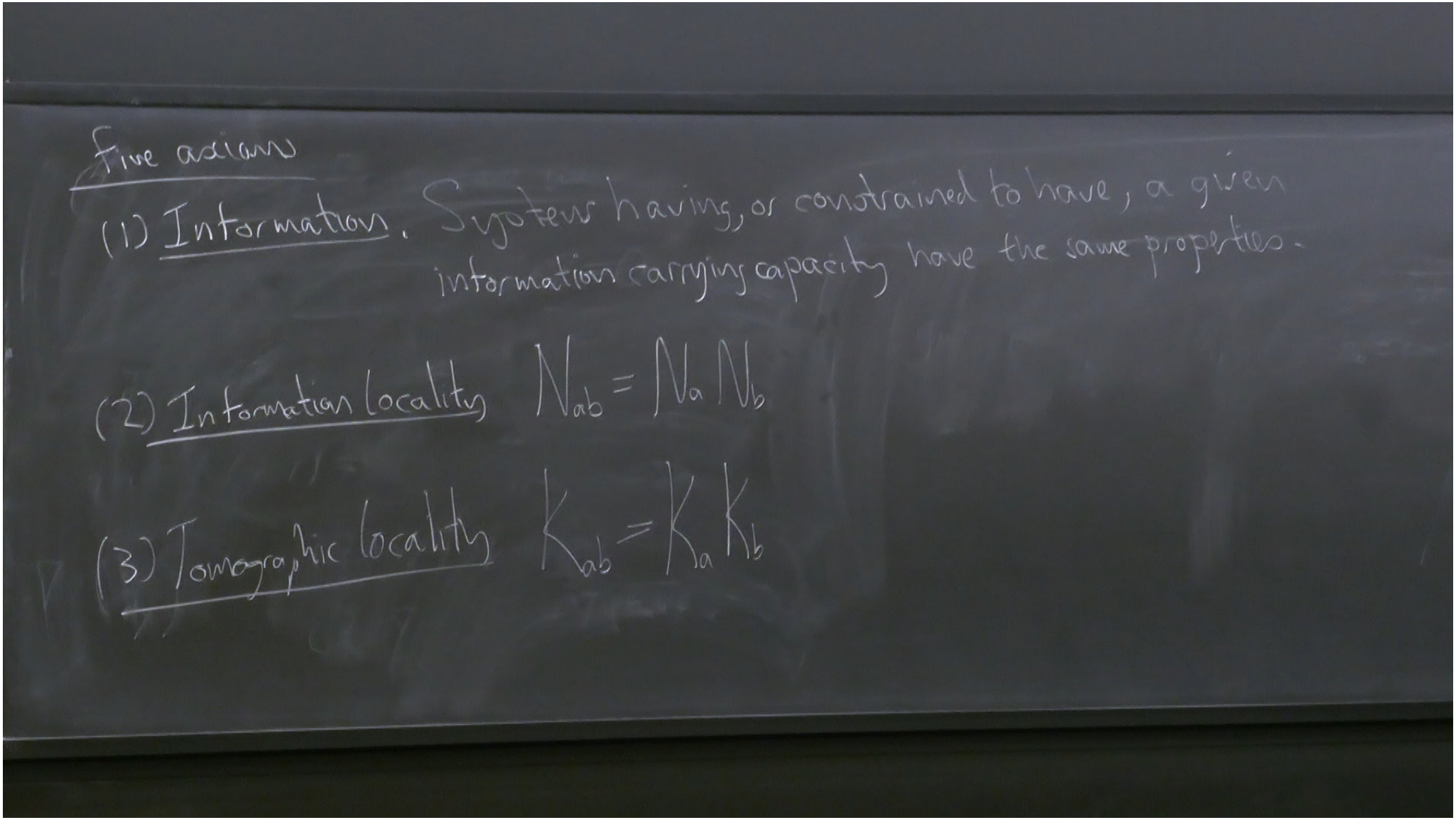


$p_1, p_2, \cdots p_N$

N is max.

$\log_2 N$ is info carrying cap.

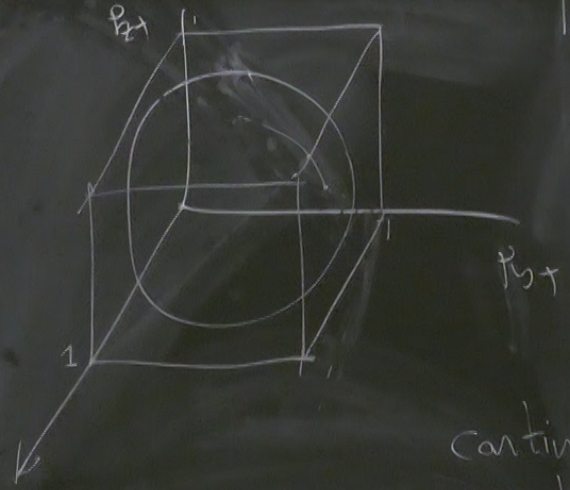

(1) Information.
(2) Information Locality
(3) Tomography locality


Five axioms
(1) Information. Systems having, or constrained to have, a given information carrying capacity have the same properties.
(2) Information locality $N_{ab} = N_a N_b$
(3) Tomographic locality $K_{ab} = K_a K_b$

(4) Continuity There exists a continuous reversible transformation between any pair of pure states.

(5) Simplicity. Systems are described by the smallest number of probabilities (K) consistent with the other axioms.

impose $P_{z+} + P_{z-} = 1$



$N = 2$

$|\psi\rangle\langle\psi|$

$K = N^2$

continuous set of pure states.

mixed state

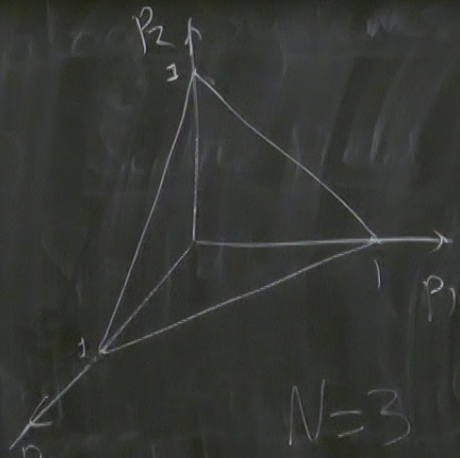
$$\hat{\rho} = \lambda \hat{\rho}_A + (1-\lambda)\hat{\rho}_B$$

$\hat{\rho}_A \neq \hat{\rho}_B \quad 0 < \lambda < 1$

pure states $\Rightarrow$ not mixed.

$$\hat{\rho} = \sum_k |\psi_k\rangle\langle\psi_k|$$

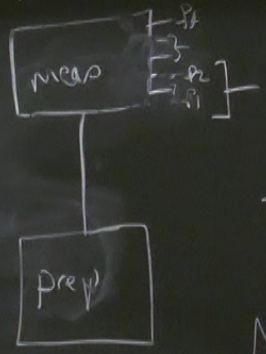
Classical prob. (0,1,2)



$N=3$

$K = N \quad (r=1)$

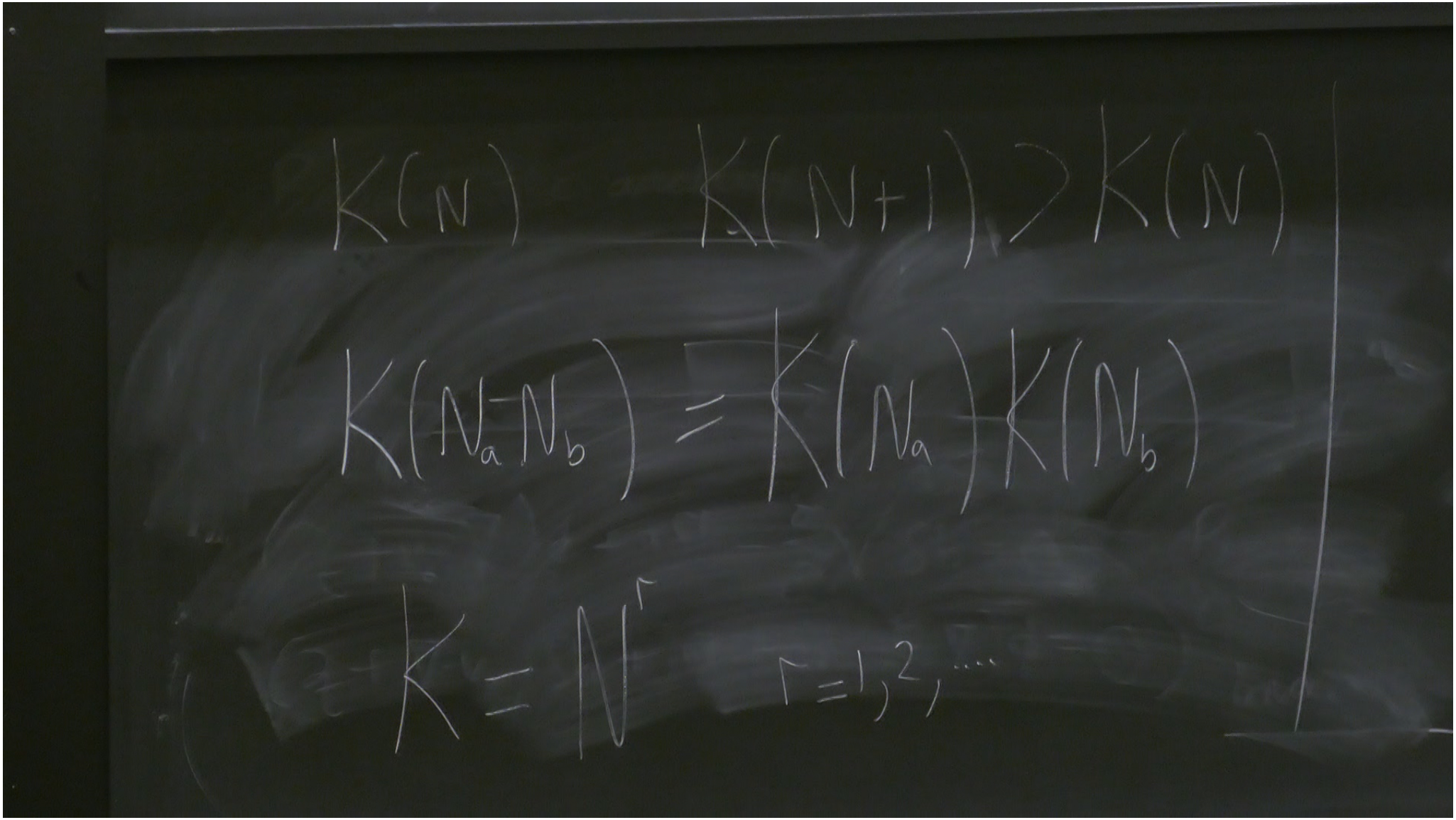
operational notion of N

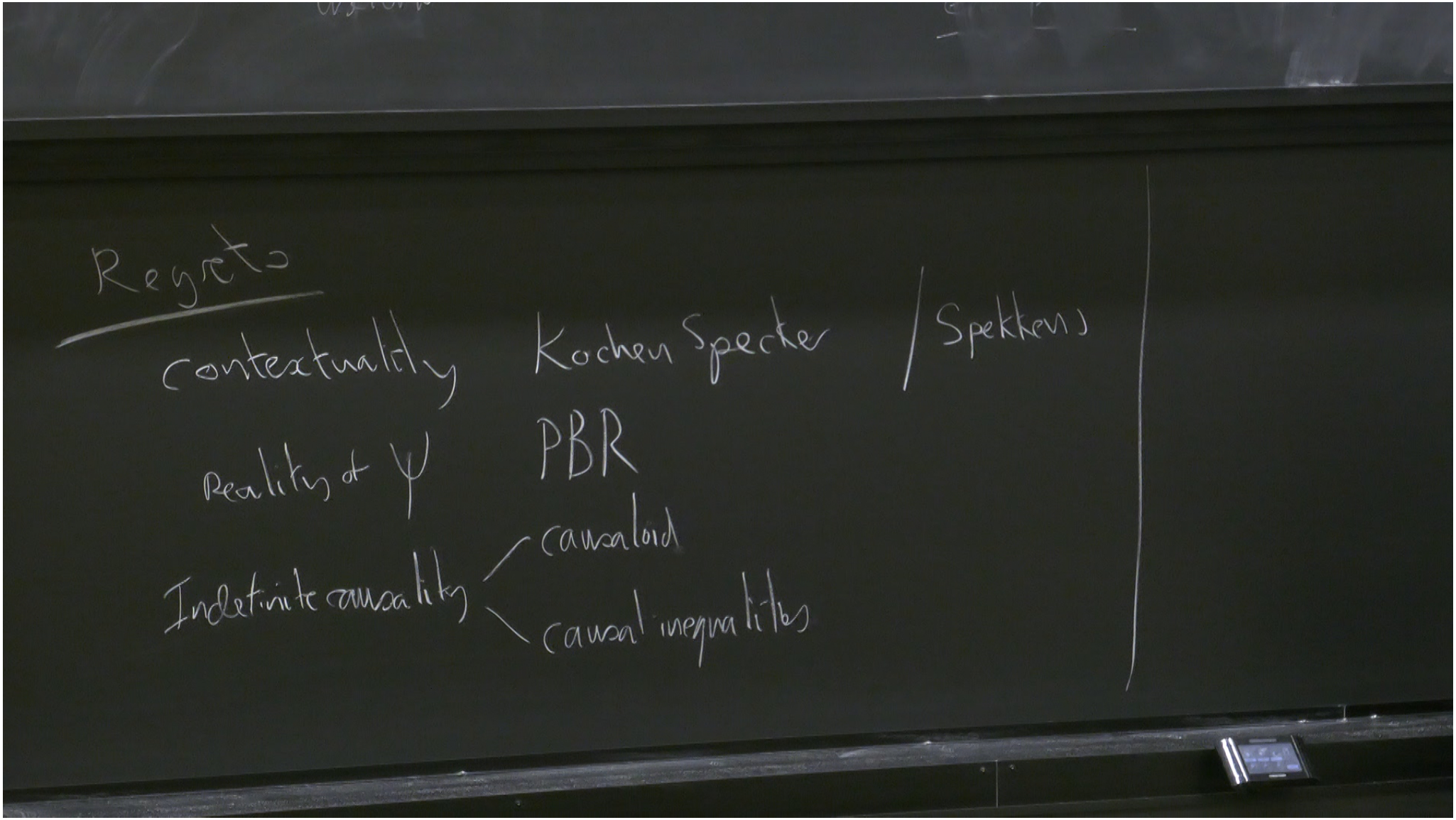


$f_1, f_2, \cdots f_N$

N is maximal.

$\log_2 N$ is info carrying cap.


K(N) K(N+1) > K(N)
K(N_a N_b) = K(N_a) K(N_b)
K = N^Γ Γ = 1, 2, ...


Regrets
contextuality
Kochen Specker
/ Spekkens
Reality of ψ
PBR
Indefinite causality
causaloid
causal inequalities