Title: PSI 2015/2016 Foundations of Quantum Mechanics - Lecture 11

Date: Jan 18, 2016 11:30 AM

URL: http://pirsa.org/16010065

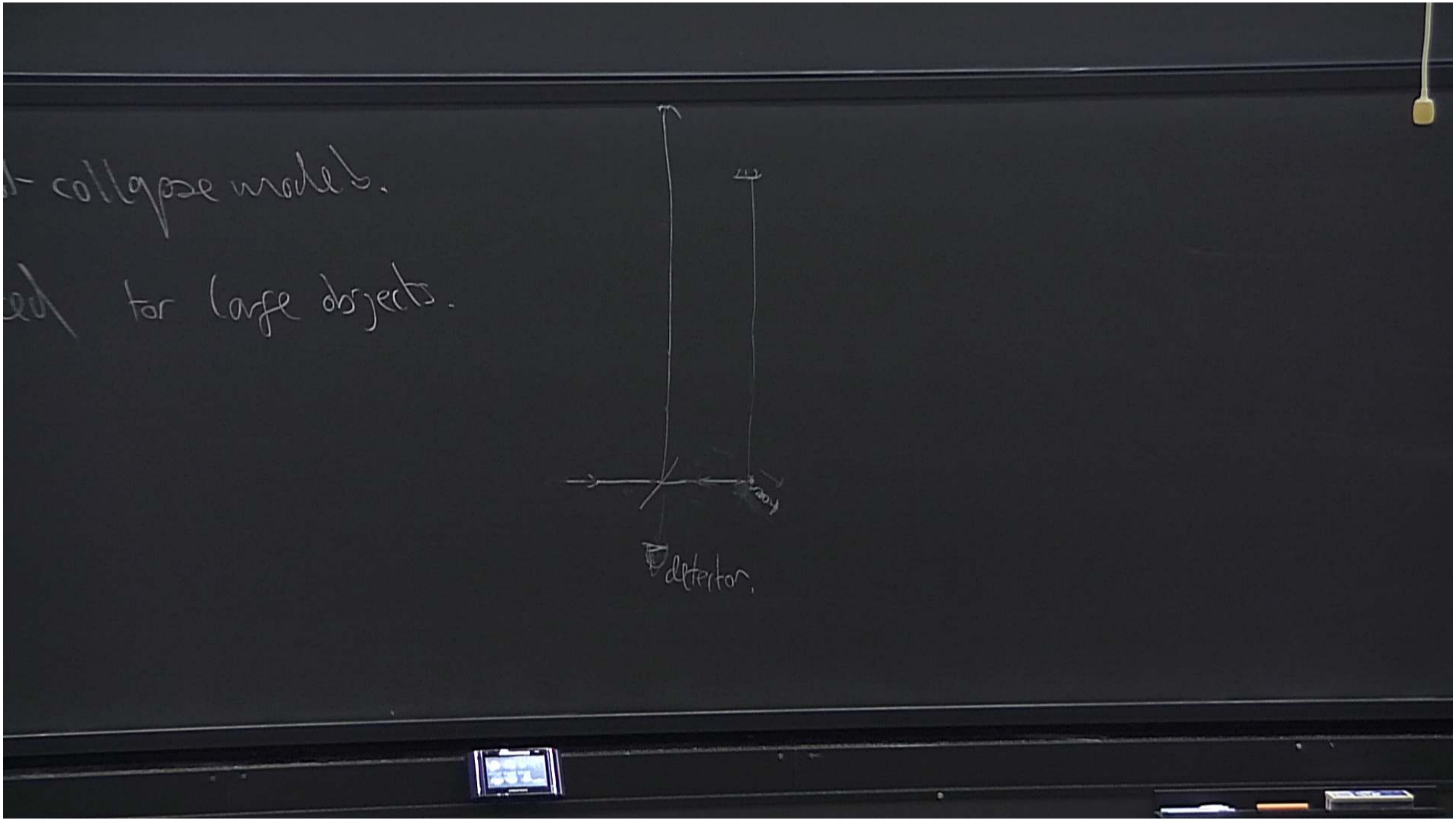
Abstract:

PERIMETER INSTITUTE FOR THEORETICAL PHYSICS

Empirical predictions of collapse models.

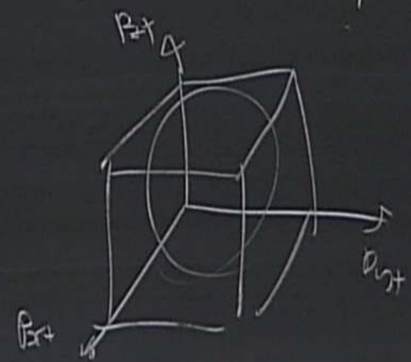
(1) Interference is reduced for large objects.

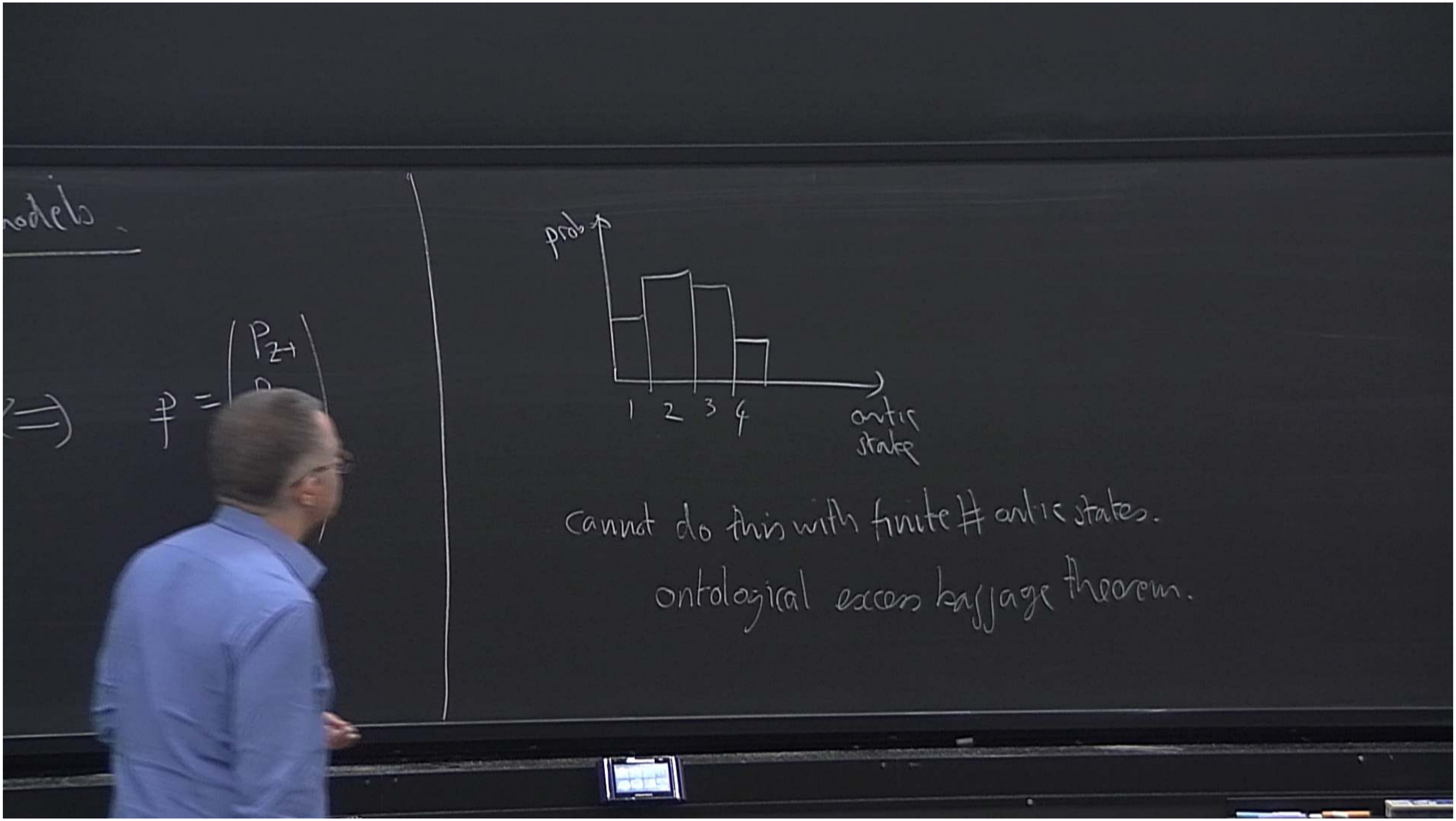
Penrose proposal.

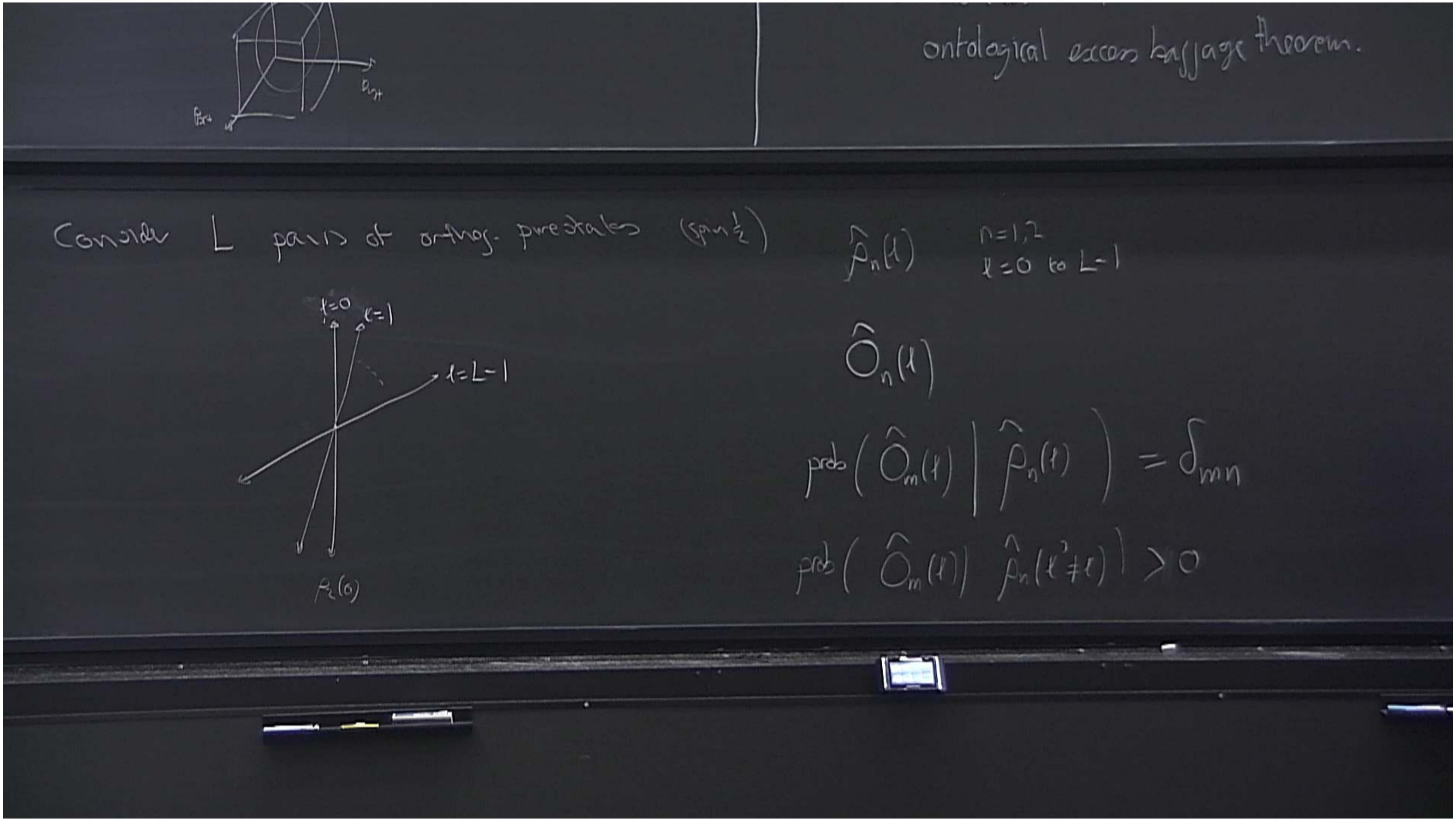

collapse models.
for large objects.
detector.

Topics on ontological models

$$\rho = \begin{pmatrix} p_{z+} & a \\ a^* & p_{z-} \end{pmatrix} \iff \vec{p} = \begin{pmatrix} p_{z+} \\ p_{z-} \\ p_{x+} \\ p_{x-} \end{pmatrix}$$




models
prob
1 2 3 4
ontic state
cannot do this with finite # ontic states.
ontological excess baggage theorem.


ontological excess baggage theorem.
Consider L pairs of orthog. pure states (spin $\frac{1}{2}$)
$\hat{\rho}_n(l)$ $n=1,2$ $l=0$ to $L-1$
$\hat{O}_n(l)$
$\text{prob}(\hat{O}_m(l) \mid \hat{\rho}_n(l)) = \delta_{mn}$
$\text{prob}(\hat{O}_m(l) \; \hat{\rho}_n(l' \neq l)) > 0$
$l=0$
$l=1$
$l=L-1$

ontological excess baggage theorem.

$\hat{\rho}_n(l)$ $n = 1, 2$

$l = 0$ to $L-1$

$\hat{O}_n(l)$

$$\text{prob}\left(\hat{O}_m(l) \,\middle|\, \hat{\rho}_n(l)\right) = \delta_{mn}$$

$$\text{prob}\left(\hat{O}_m(l) \,\middle|\, \hat{\rho}_n(l' \neq l)\right) > 0$$

let $\Lambda(O_n(l))$ be the set of ontic states that can excite the $O_n(l)$ outcome.

l — $n=1$, $n=2$; $\uparrow \lambda$

let $\Lambda(\rho_n(l))$ be the set of ontic states in the support of $\rho_n(l)$

$\uparrow \lambda$; $\rho_n(l)$

$$\Lambda\left(\rho_n(\ell)\right) \subseteq \Lambda\left(O_n(\ell)\right)$$

$$\Lambda\left(O_m(\ell)\right) \cap \Lambda\left(\rho_{n \neq m}(\ell)\right) = \emptyset$$

$$\Rightarrow \quad \Lambda\left(\rho_1(\ell)\right) \cap \Lambda\left(\rho_2(\ell)\right) = \emptyset$$

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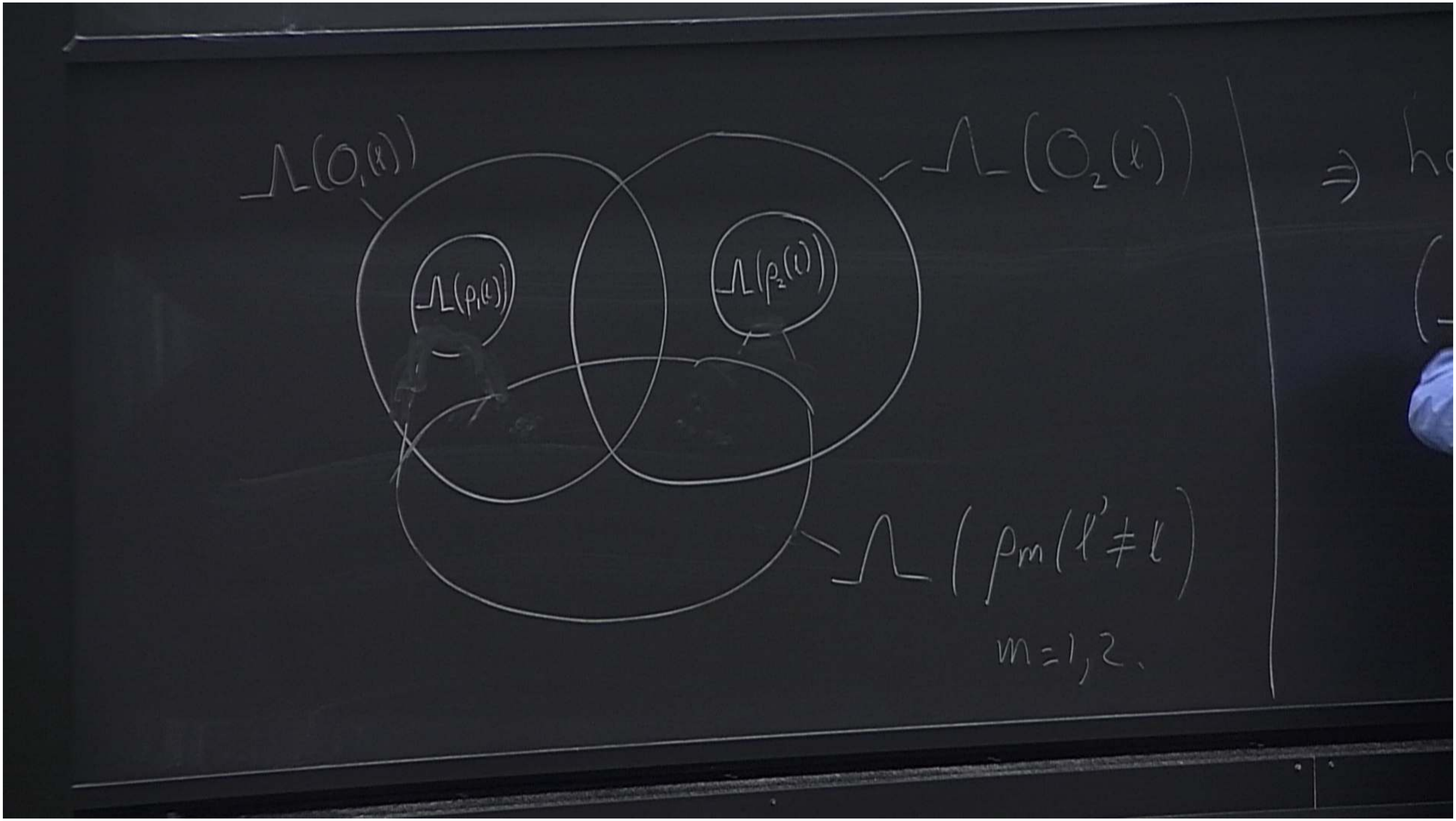
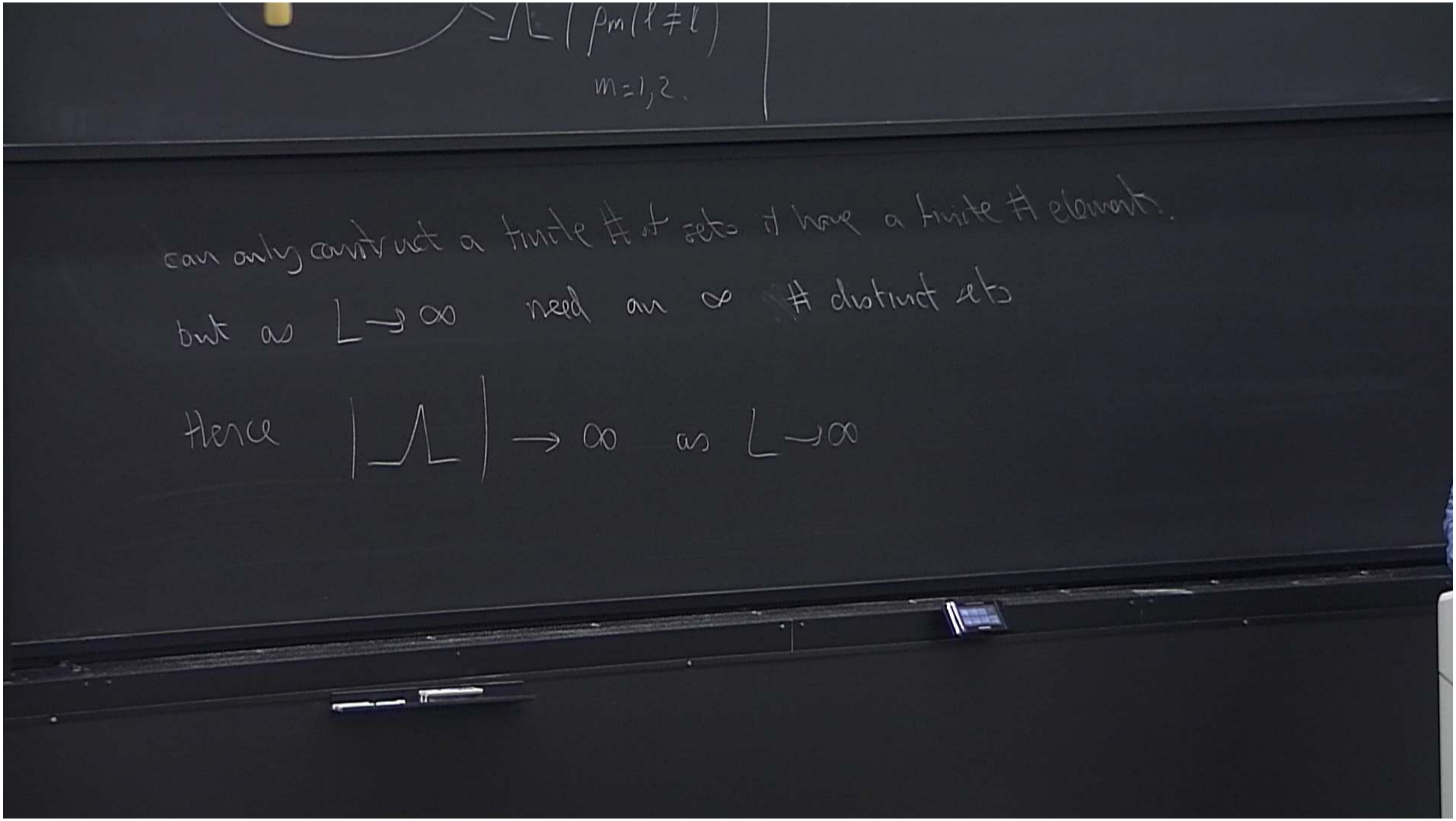
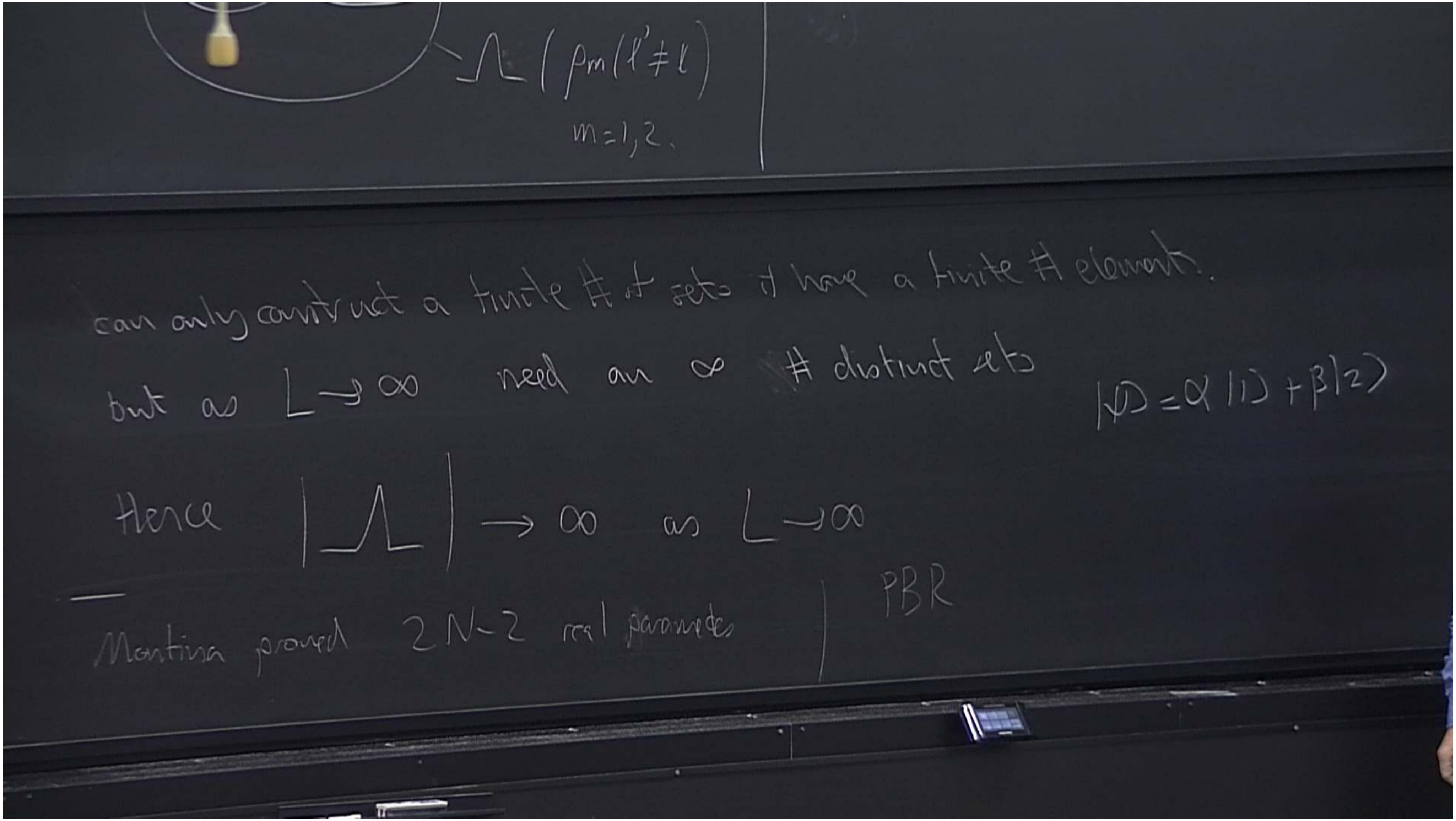
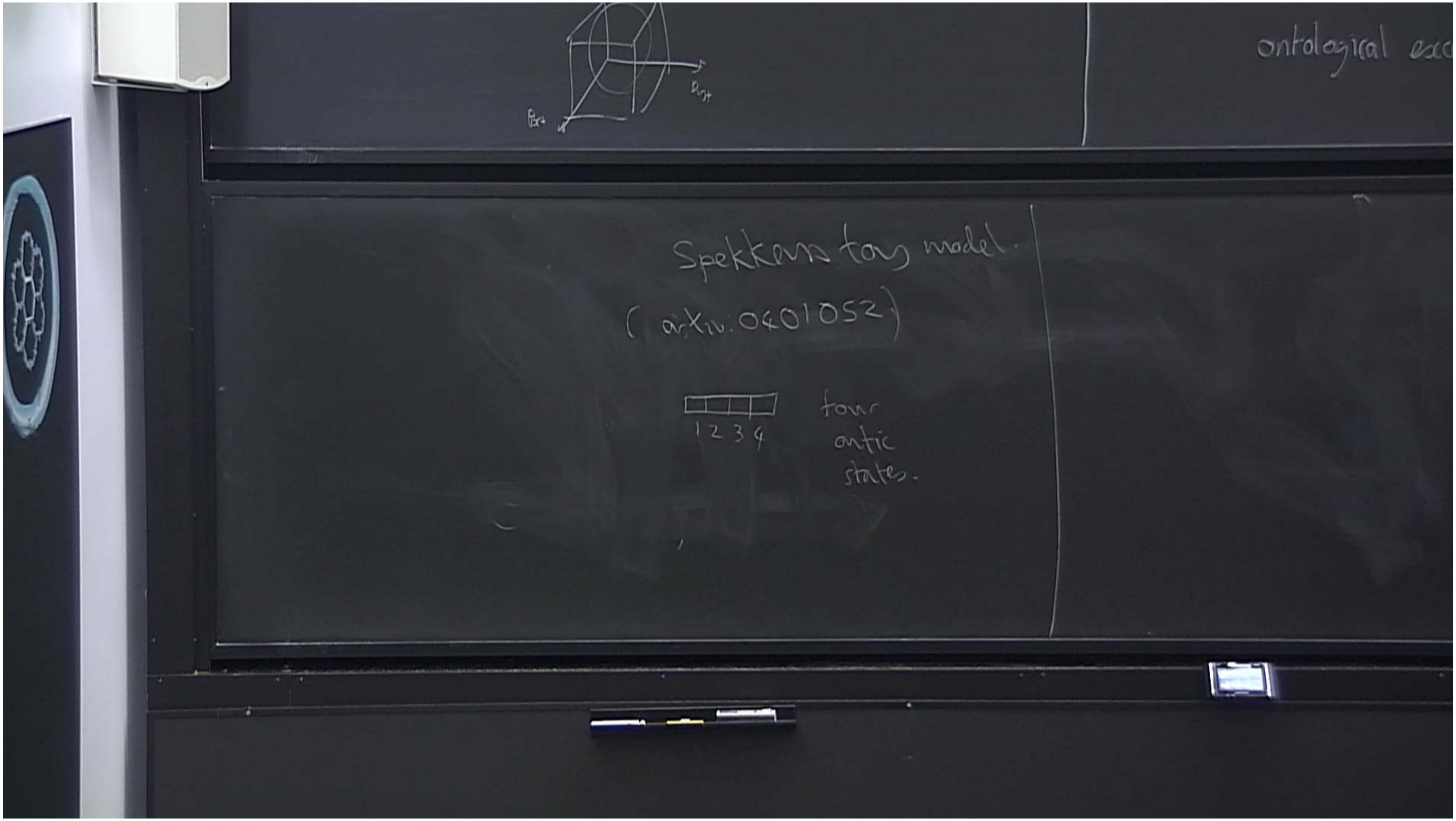
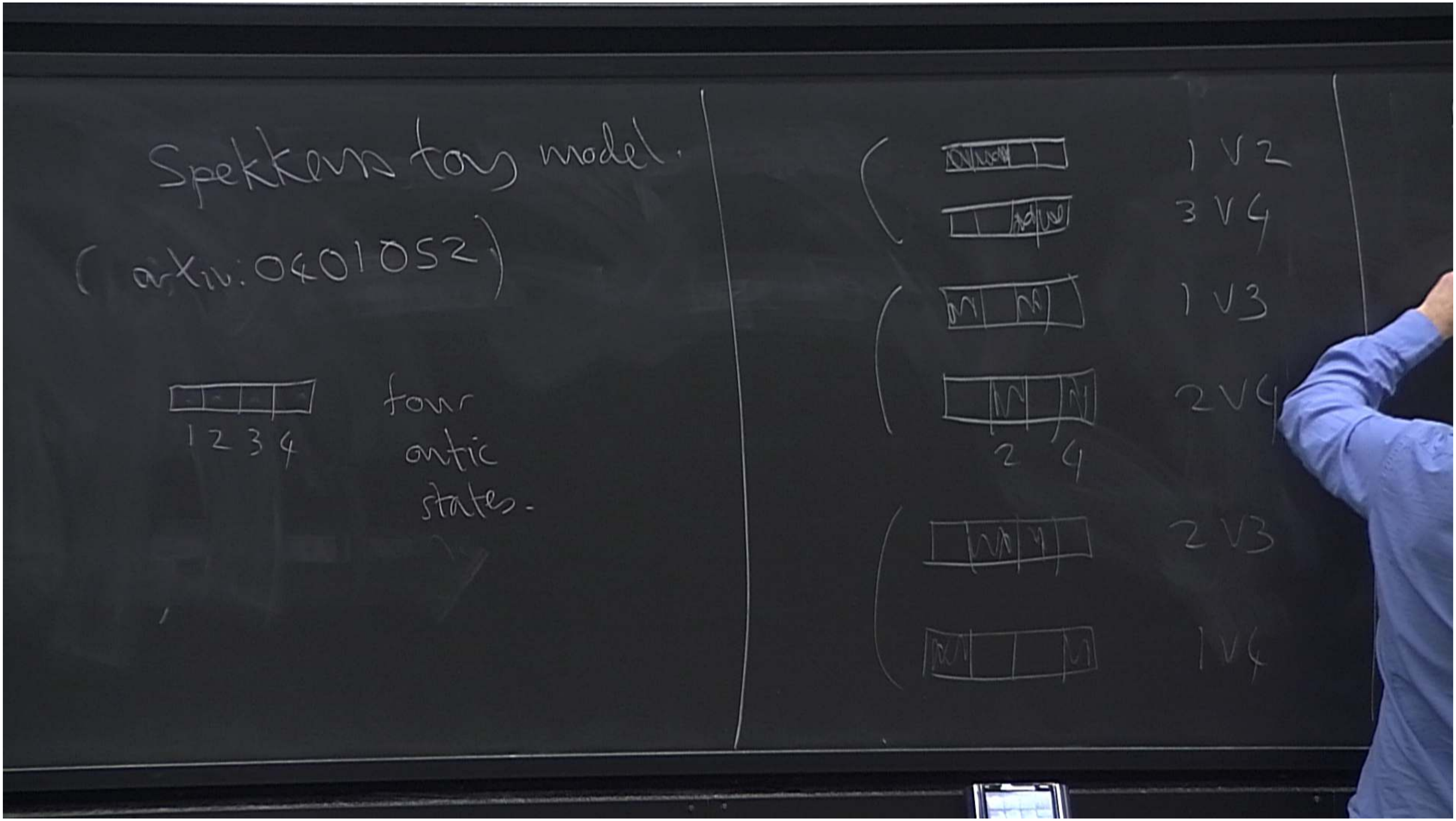
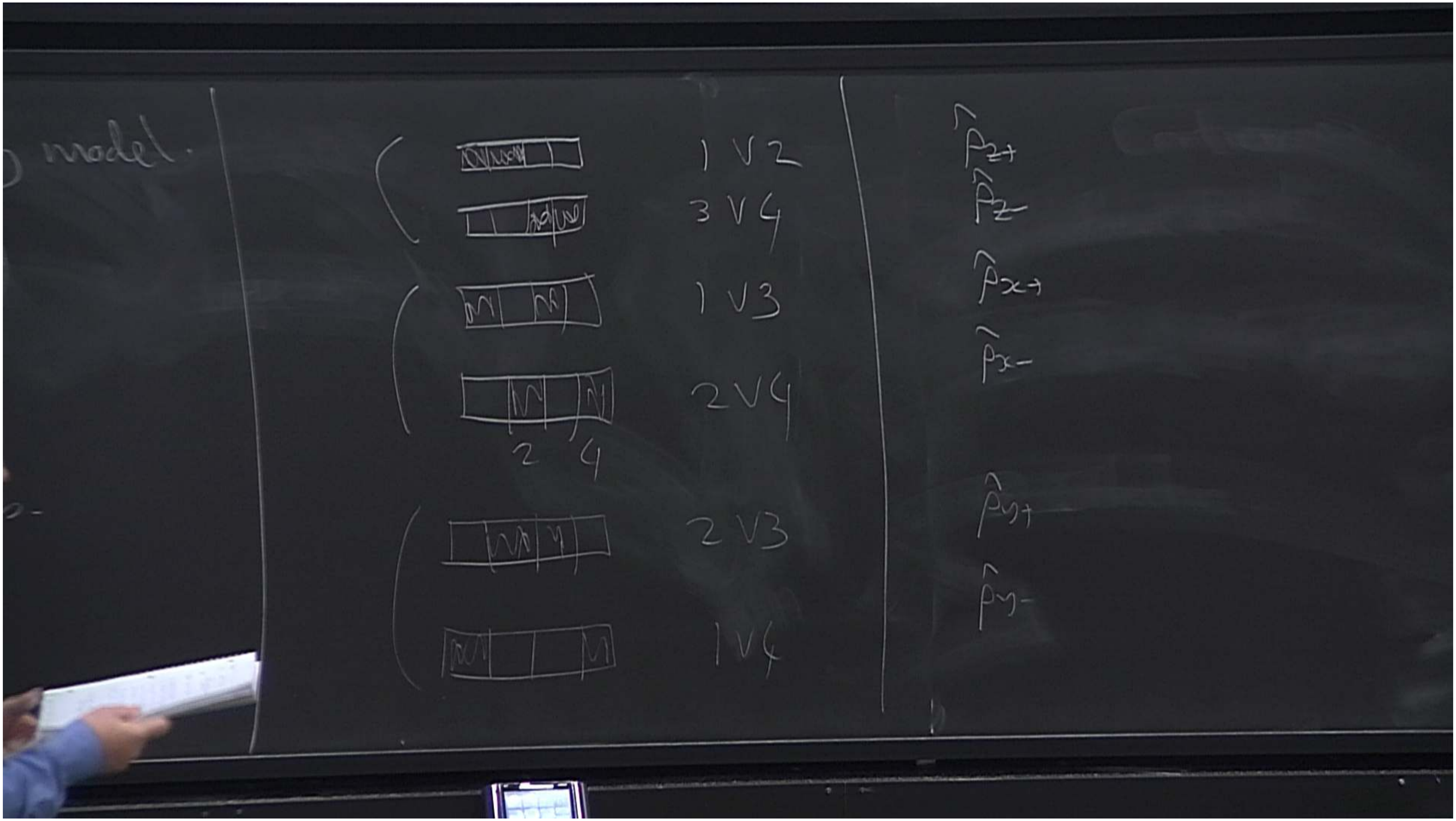

Λ(O₁(ℓ))
Λ(O₂(ℓ))
Λ(ρ₁(ℓ))
Λ(ρ₂(ℓ))
Λ(ρm(ℓ' ≠ ℓ)
m = 1, 2.

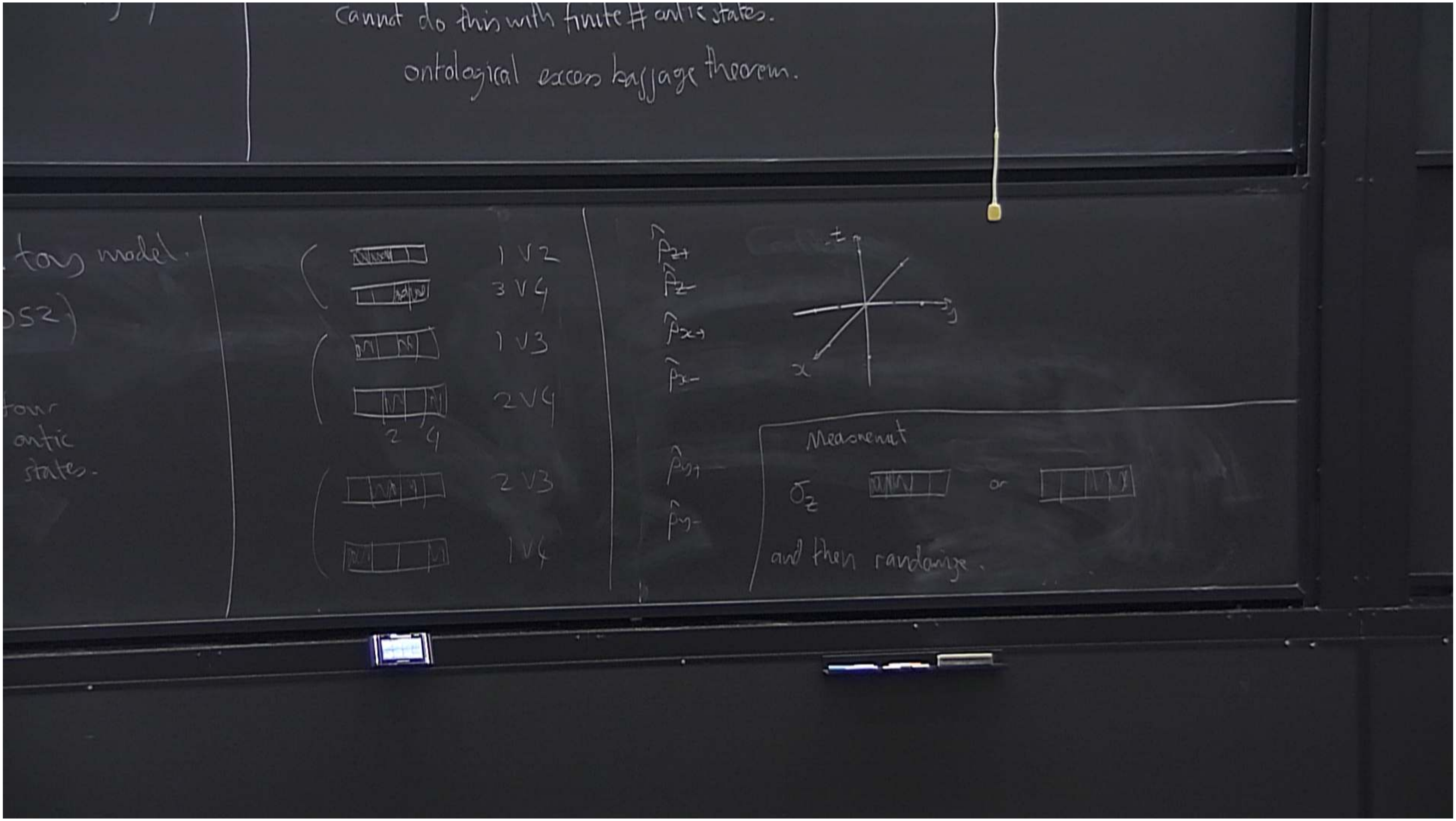

m=1,2.
can only construct a finite # of sets if have a finite # elements.
but as L → ∞ need an ∞ # distinct sets
Hence |Λ| → ∞ as L → ∞

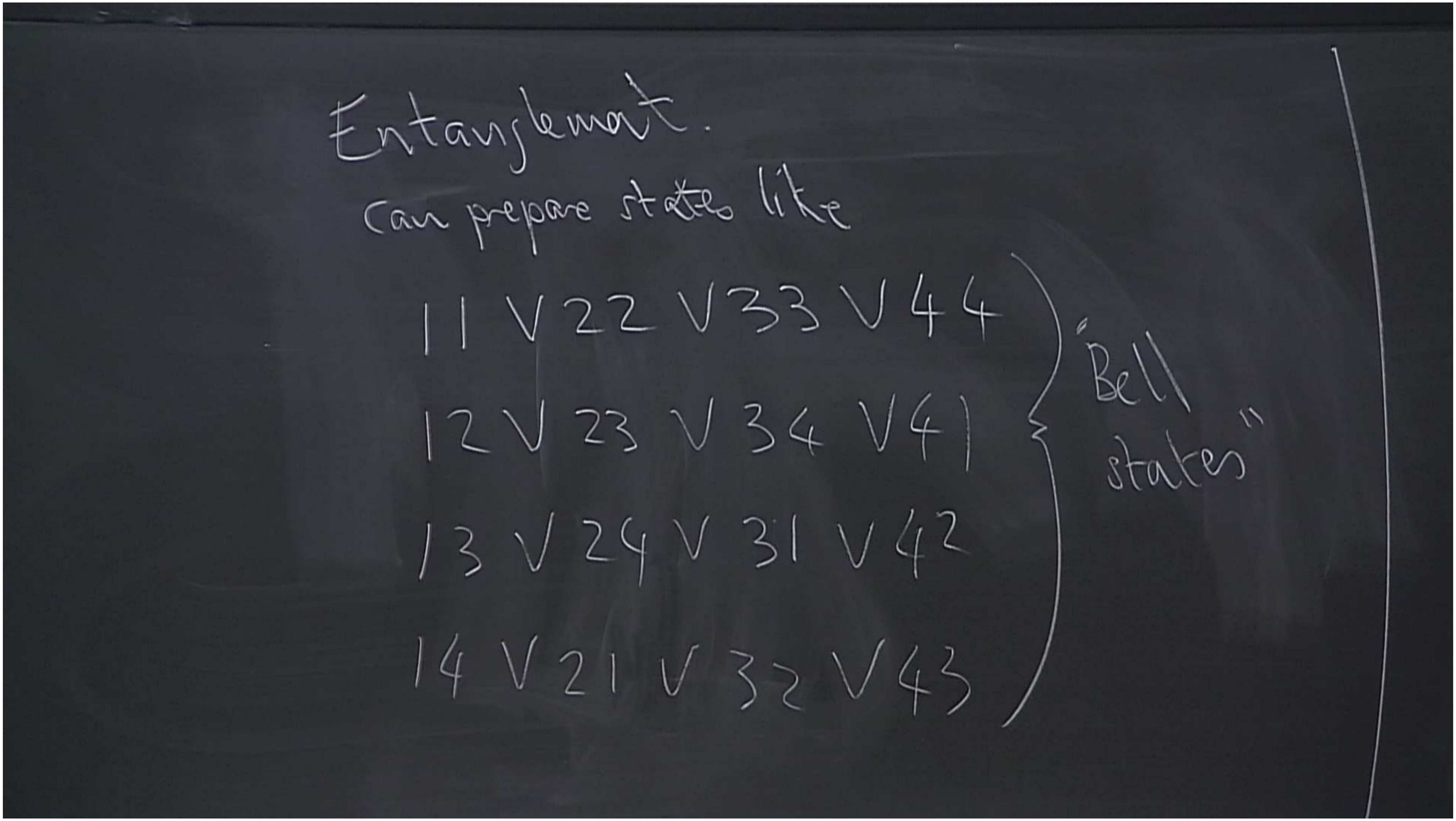

$\Lambda \left(\rho_m (l' \neq l) \right)$
$m = 1, 2$.
can only construct a finite # of sets if have a finite # elements.
but as $L \to \infty$ need an ∞ # distinct sets
$|\psi\rangle = \alpha |1\rangle + \beta |2\rangle$
Hence $|\Lambda| \to \infty$ as $L \to \infty$
Montina proved $2N-2$ real parameters
PBR

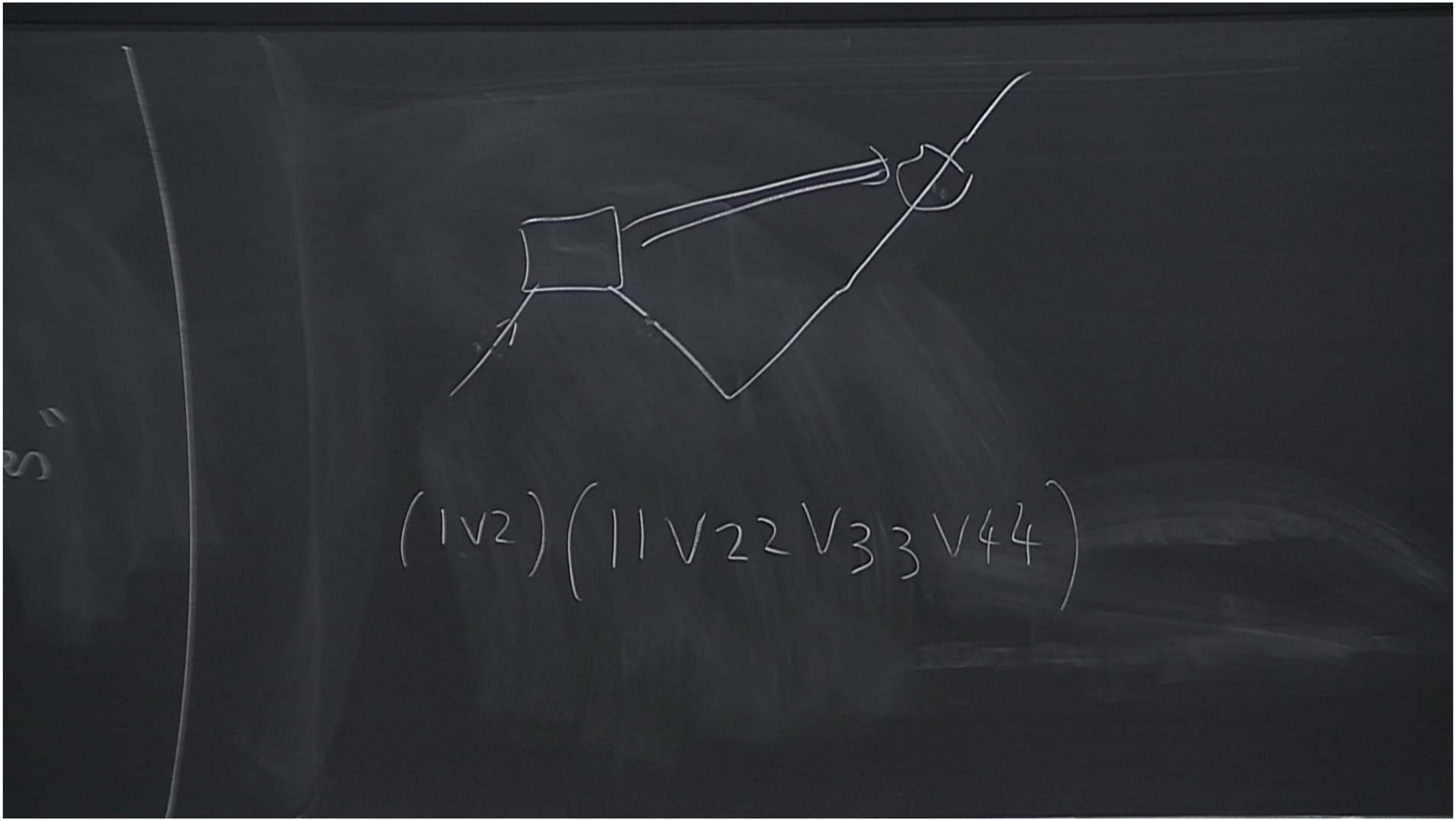

ontological
Spekkens toy model.
(arXiv:0401052)
1 2 3 4
four
ontic
states.

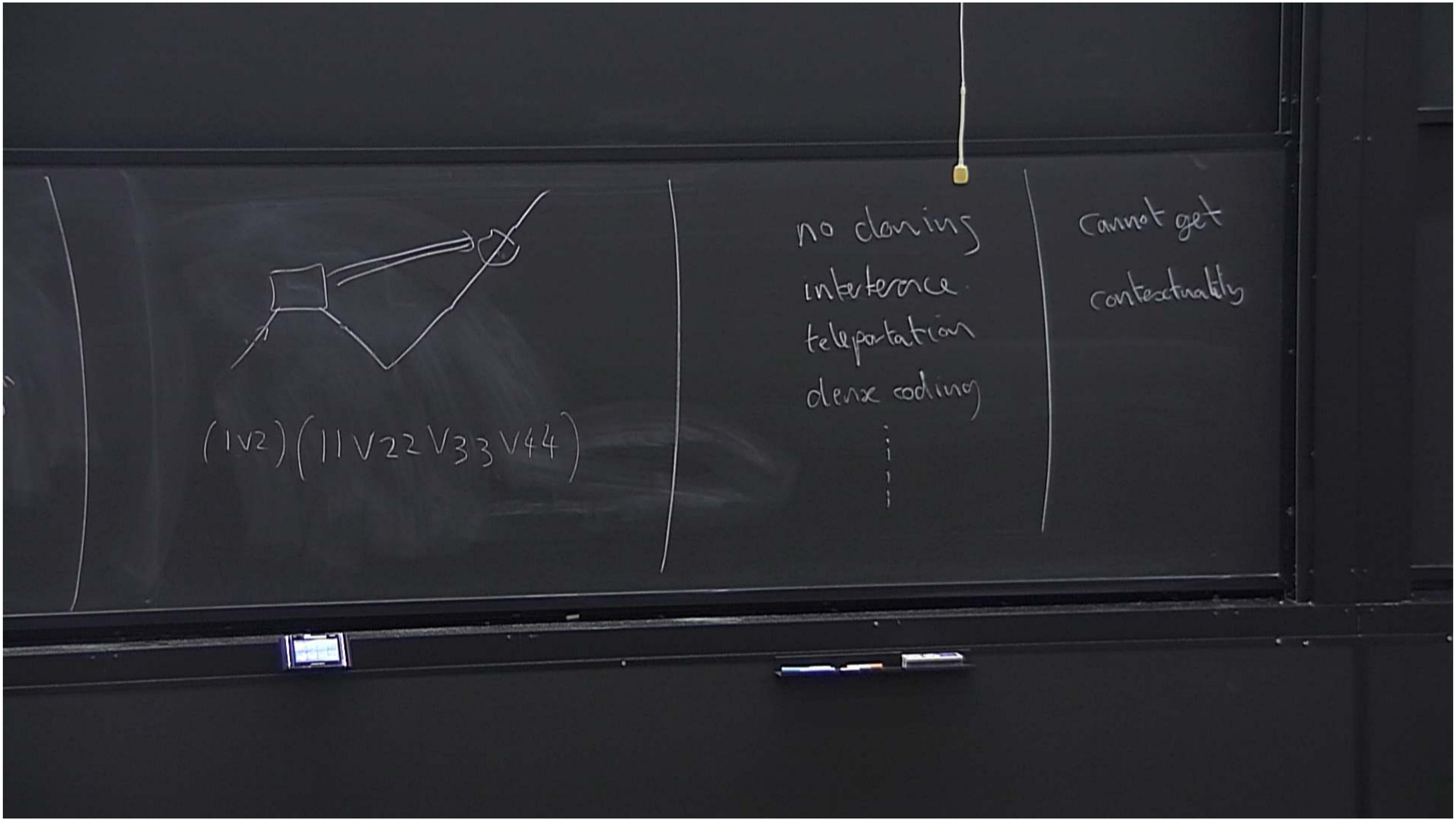

Spekkens toy model.
(arXiv:0401052)
1 2 3 4
four ontic states.
1 V 2
3 V 4
1 V 3
2 V 4
2 4
2 V 3
1 V 4


model.
1 V 2
3 V 4
1 V 3
2 V 4
2 4
2 V 3
1 V 4
p̂z+
p̂z−
p̂x+
p̂x−
p̂y+
p̂y−


cannot do this with finite # ontic states.
ontological excess baggage theorem.
toy model.
four
ontic
states.
1 V 2
3 V 4
1 V 3
2 V 4
2 V 3
1 V 4
Measurement
or
and then randomize.


Entanglement.
Can prepare states like
11 ∨ 22 ∨ 33 ∨ 44
12 ∨ 23 ∨ 34 ∨ 41
13 ∨ 24 ∨ 31 ∨ 42
14 ∨ 21 ∨ 32 ∨ 43
"Bell states"


(1V2)(11V22V33V44)


no cloning
interference
teleportation
dense coding
cannot get
contextuality
(1V2)(11V22V33V44)