Title: Entanglement and DMRG in the Generalised Landau Paradigm

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Collection/Series: Mathematical Physics

Subject: Mathematical physics

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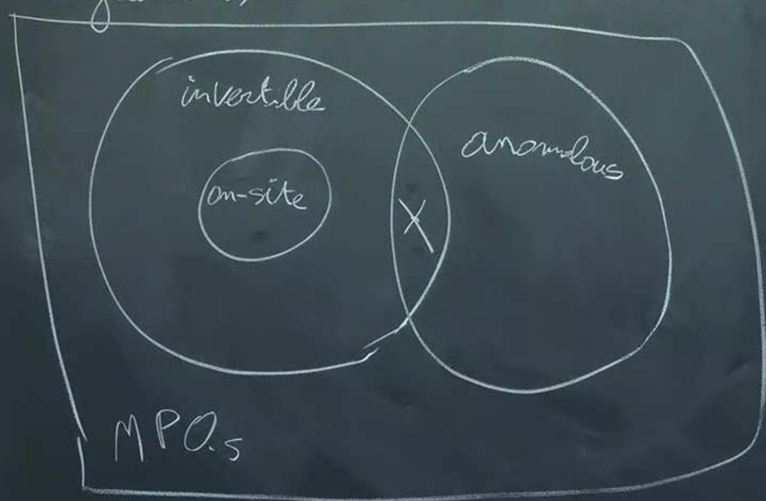
MPO-symmetries

global symm. in 1+1D lattice models

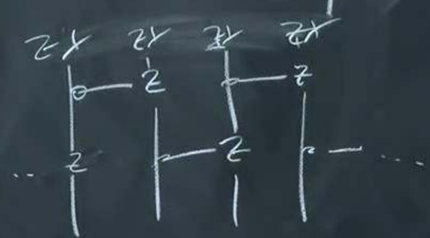


ce models

$$H = \sum_{i=1}^{N} X_i - Z_{i-1} X_i Z_{i+1}$$

$$U_{CZY} = \prod_{i=1}^{N} CZ_{i,i+1} \prod_{i=1}^{N} Z_i X_i$$

$$CZ_{i,i+1} = \begin{pmatrix} 1 & & & \\ & 1 & & \\ & & 1 & \\ & & & -1 \end{pmatrix} =$$

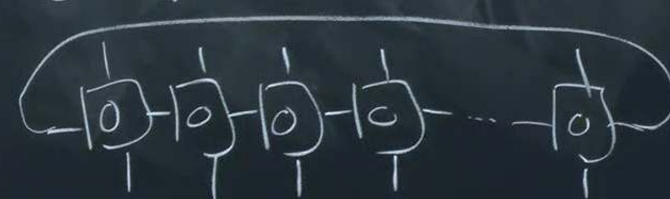


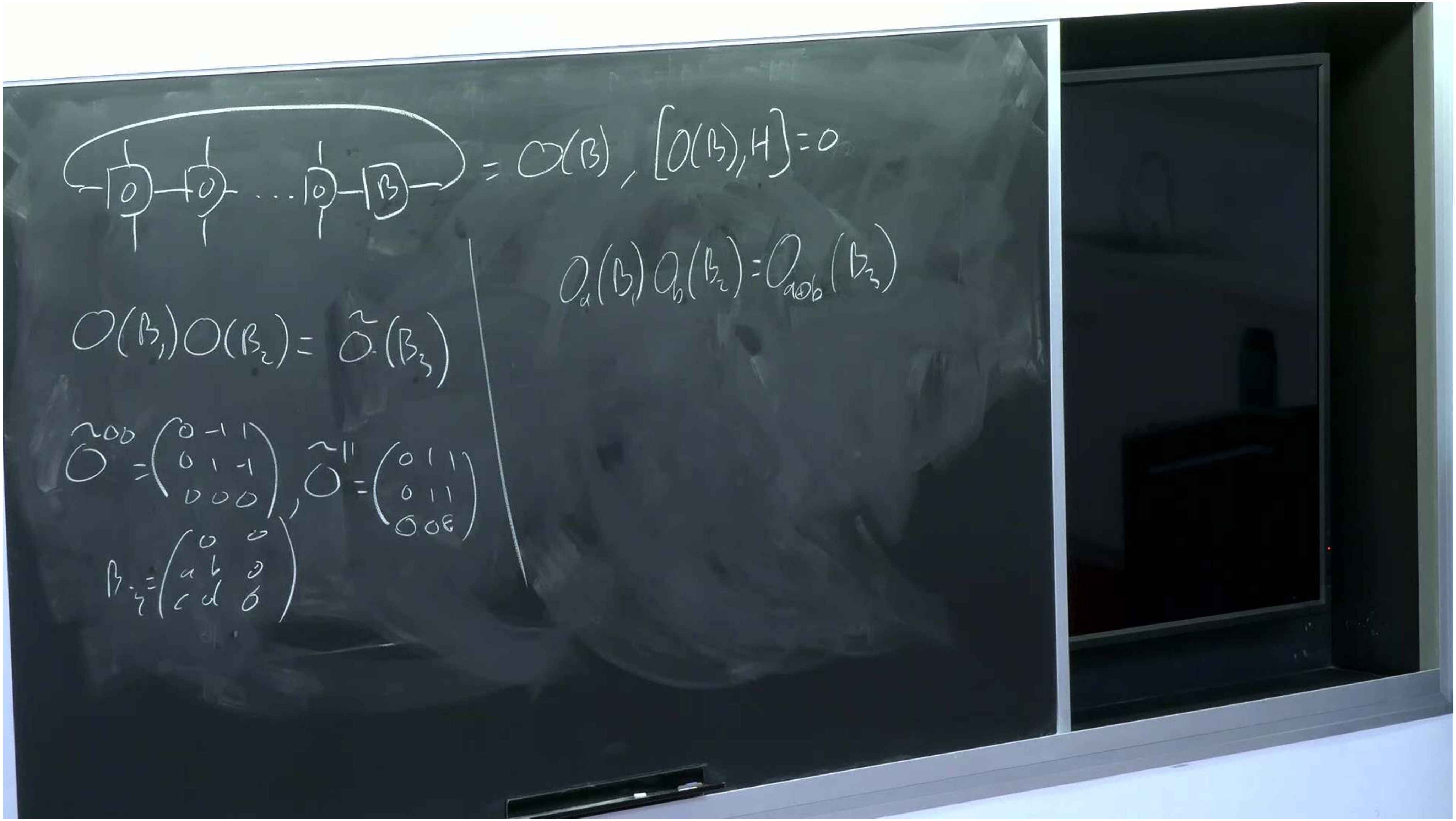
$$[U_{CZY}, H] = 0, \quad U_{CZY}^2 = \mathbb{1}$$

U_{CZY} is an MPO

$$= \sum_{\{i\}\{j\}} \mathrm{Tr}\left(O^{i_1 j_1} O^{i_2 j_2} \cdots O^{i_N j_N}\right) |i_1 \ldots i_N\rangle\langle j_1 \ldots j_N|$$

$$O^{01} = \begin{pmatrix} 1 & 1 \\ 0 & 0 \end{pmatrix}, \quad O^{10} = \begin{pmatrix} 0 & 0 \\ -1 & 1 \end{pmatrix}$$



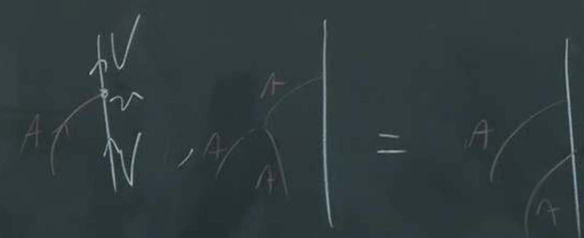

= O(B) , [O(B), H] = 0
O(B₁) O(B₂) = Õ(B₃)
O_a(B₁) O_b(B₂) = O_{a⊕b}(B₃)

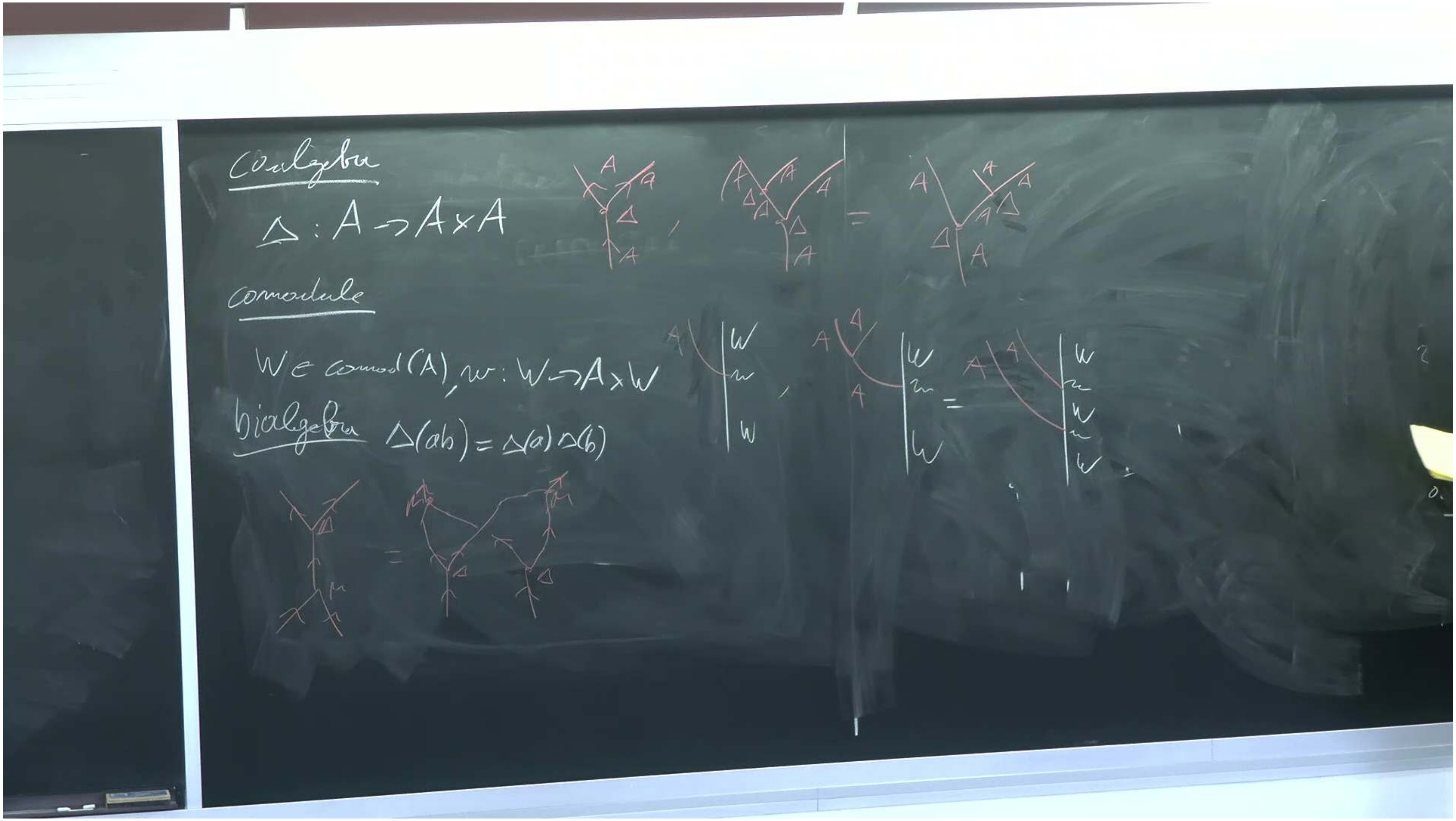
2) bialgebra

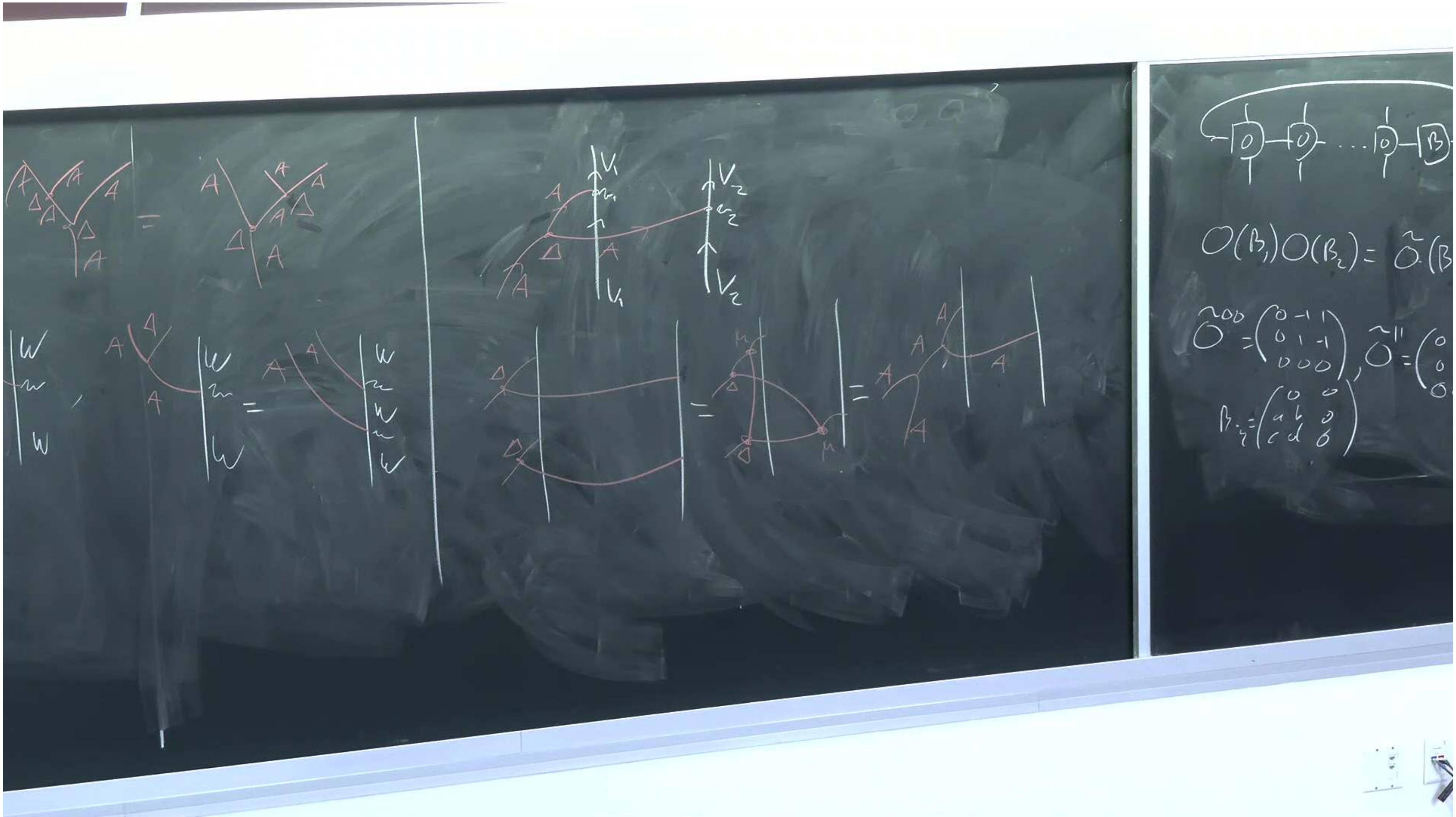
- A, $\mu: A \times A \to A$

- modules over A:

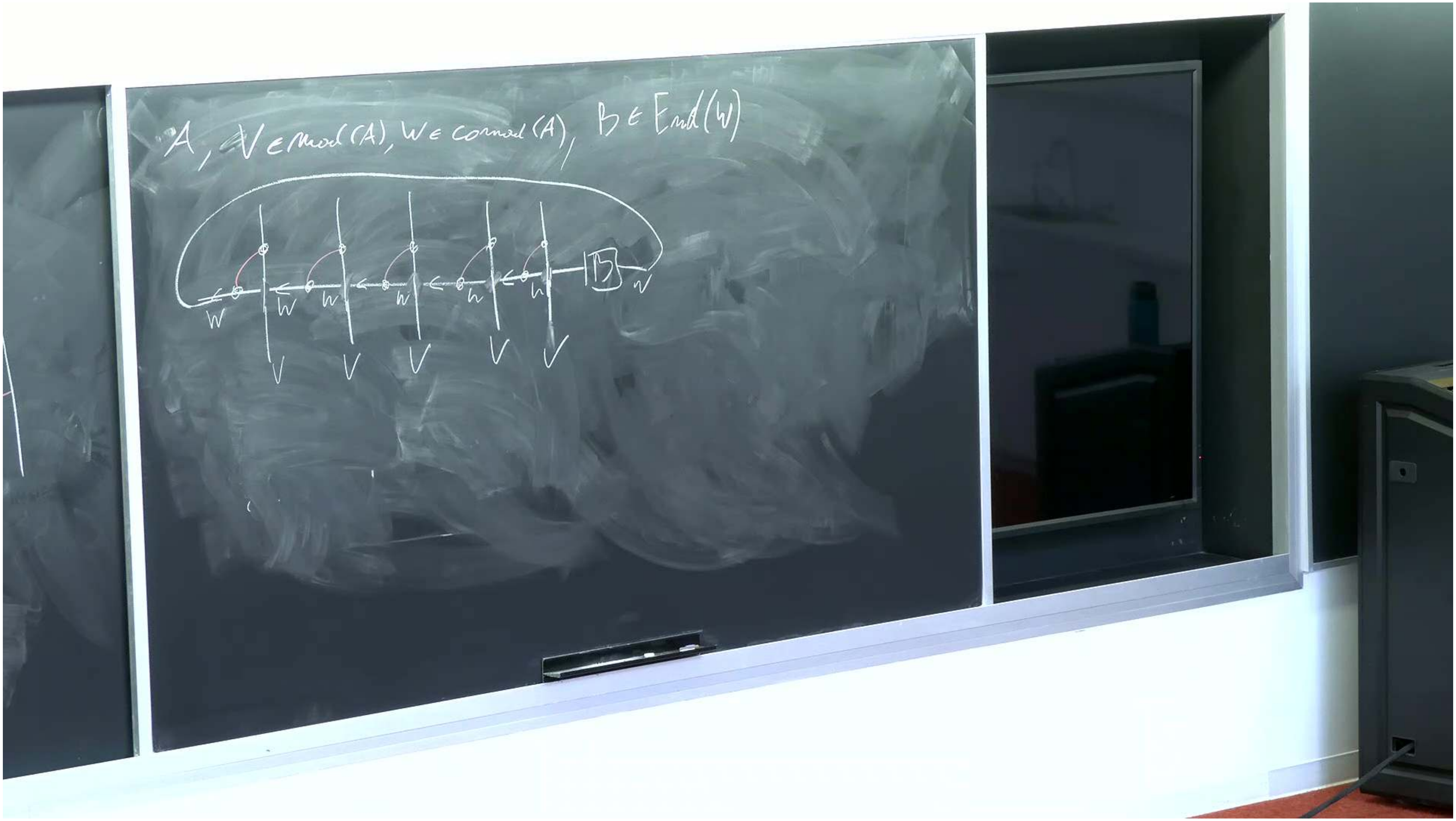
$V \in Mod(A)$, $\nu: A \times V \to V$

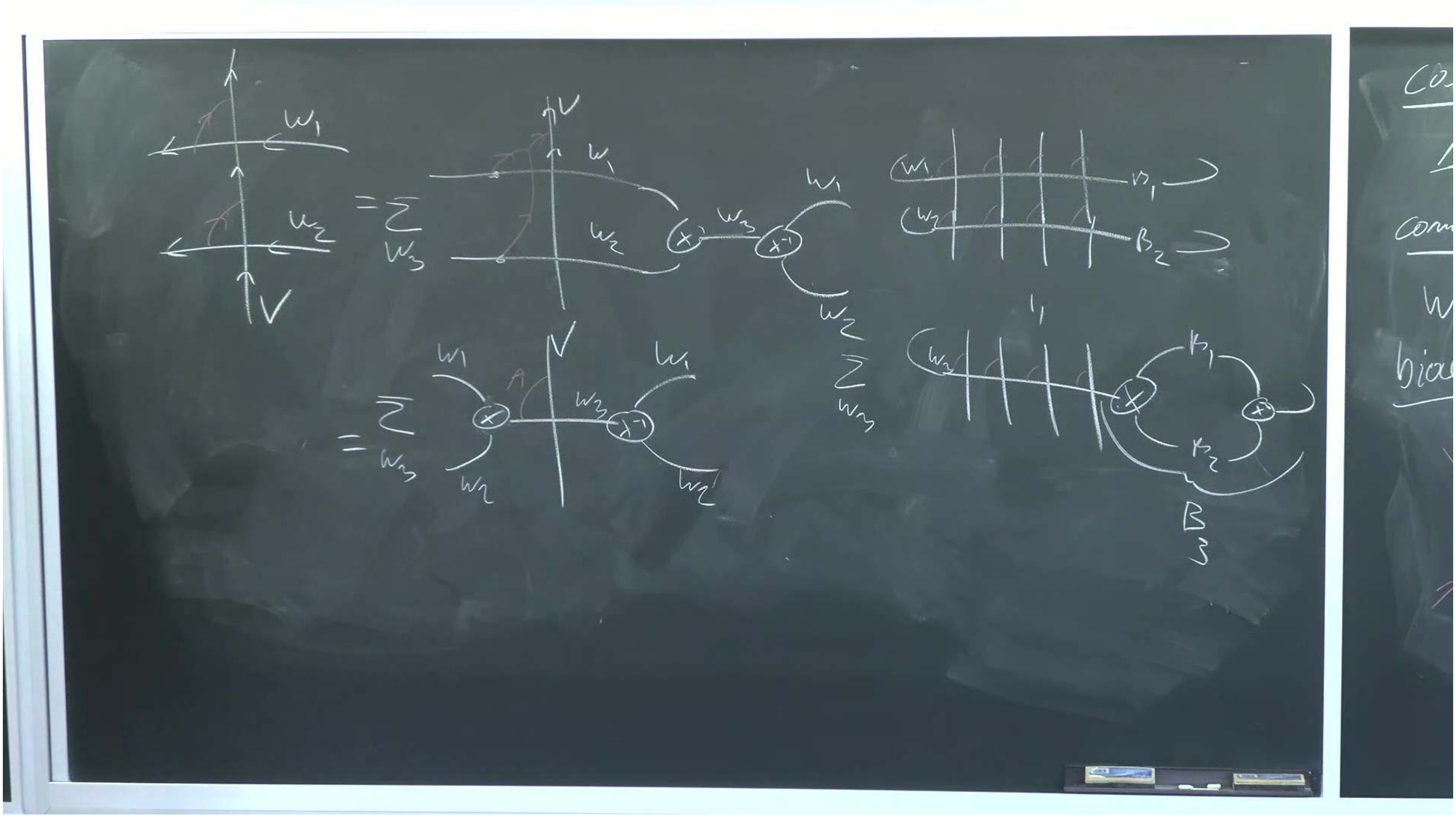



Coalgebra
Δ : A → A × A
comodule
W ∈ comod(A), w : W → A × W
bialgebra Δ(ab) = Δ(a)Δ(b)



O(B1)O(B2) = Õ(B
B =(a b 0 / c d 0)


A, V ∈ Mod(A), W ∈ comod(A), B ∈ End(W)



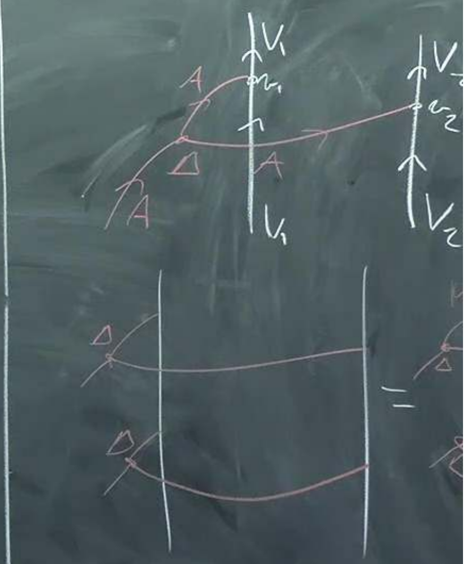
w_1
w_2
V
$= \sum_{w_3}$
w_3
x
x^{-1}
B_1
B_2
B_3
A

CZY: - A is 8-dim.

- mod(A) is ss. pre-monoidal cat
- comod(A) is non ss, monoidal cat

$\mathrm{Vec}^{\omega}_{\mathbb{Z}_2}$ is semi-simpl. of comod(A)

$\omega \in H^3(\mathbb{Z}_2, U(1))$



-dim.

is ss pre-monoidal cat

is non ss, monoidal cat

simpl. of comod(A)

$U(sl(2))$

$[E,F] = \dots$

$\Delta(X) = X \otimes 1 + 1 \otimes X$

$U_q(sl(2))$

$A,$

W