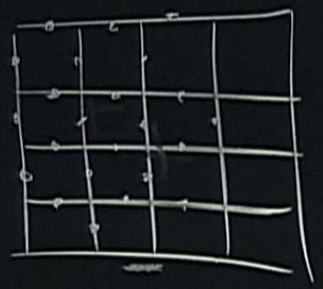
Title: Subsystem Codes

Date: Jul 21, 2016 05:00 PM

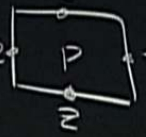
URL: http://pirsa.org/16070027

Abstract:

1. Toric code



$$H = -\sum_p B_p - \sum_v A_v \qquad \pm 1 \qquad \pm 1$$

$B_p =$ 

$A_v =$

$[B_p, A_v] = 0$

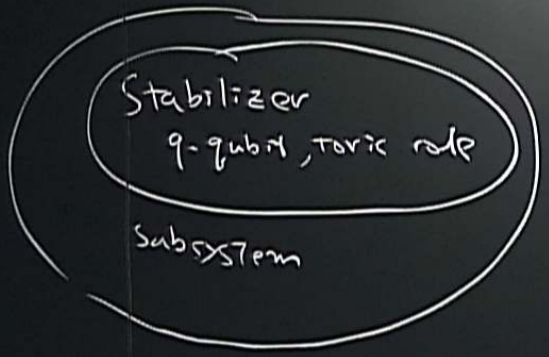
$B_p^2 = A_v^2 = I$

$$C = \{|\psi\rangle : B_p|\psi\rangle = |\psi\rangle,\ A_v|\psi\rangle = |\psi\rangle\}$$

$\prod_p B_p = I \qquad \prod_v A_v = I$

4-fold states

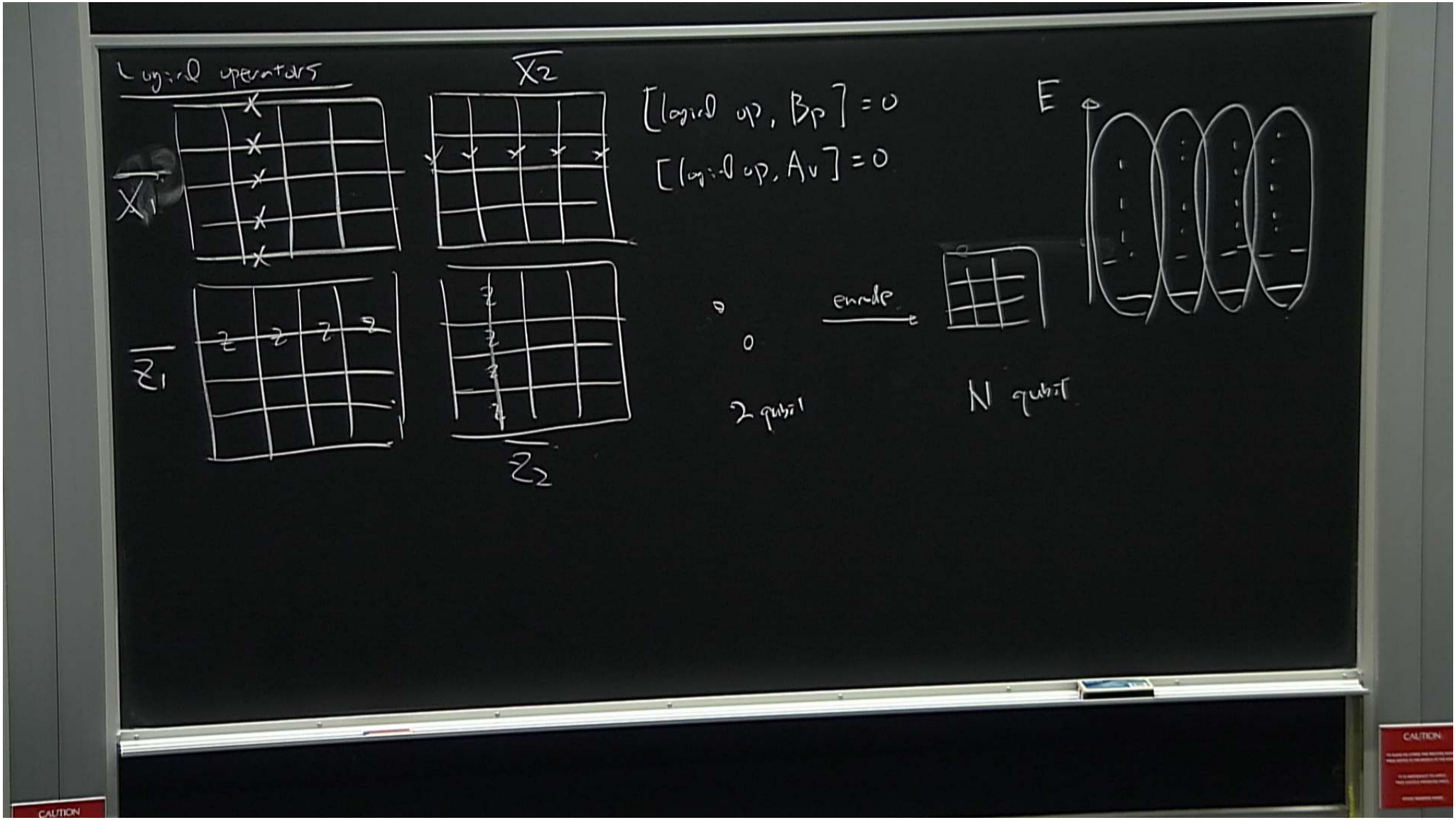
Subsystem Code (?)

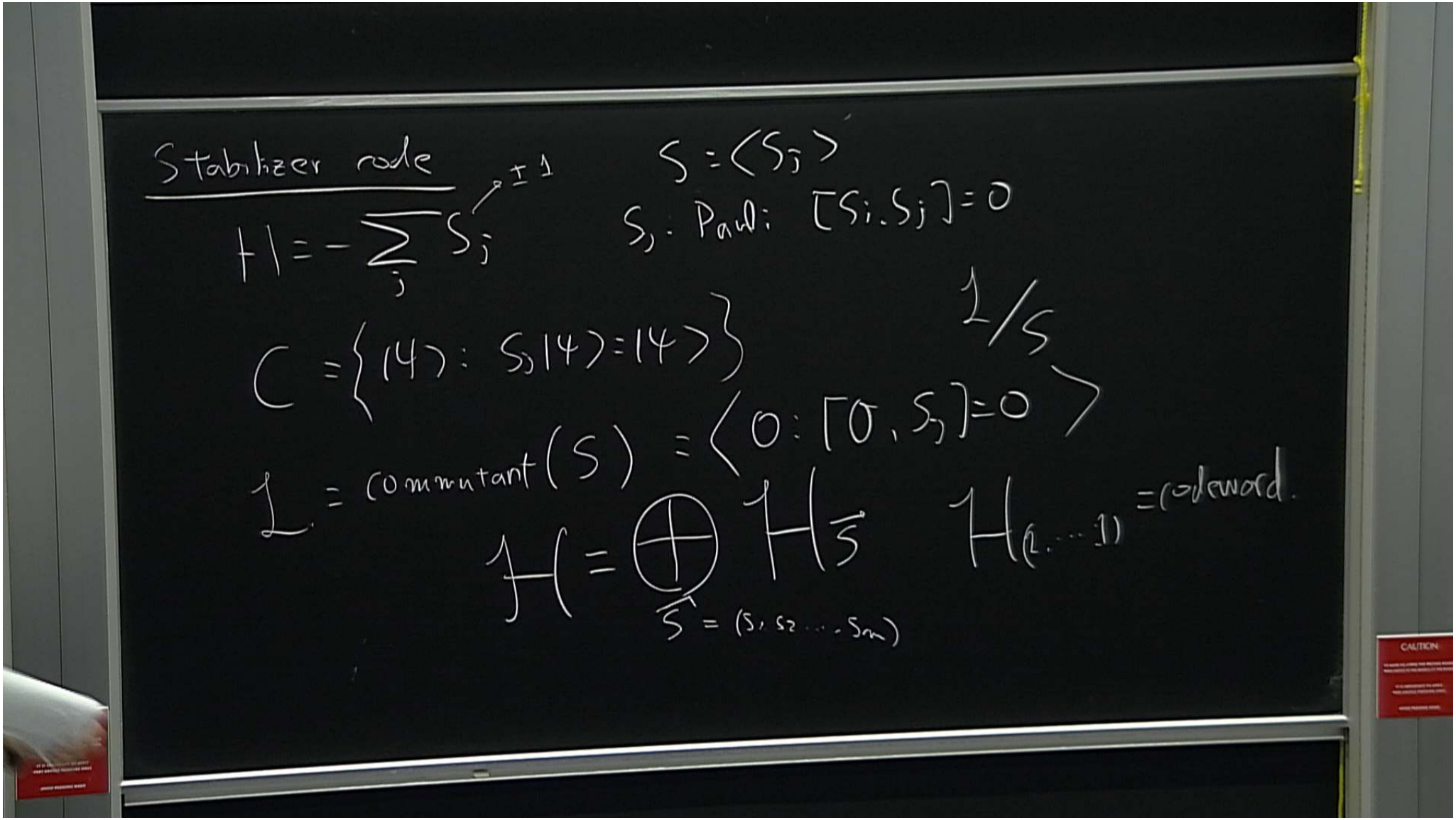


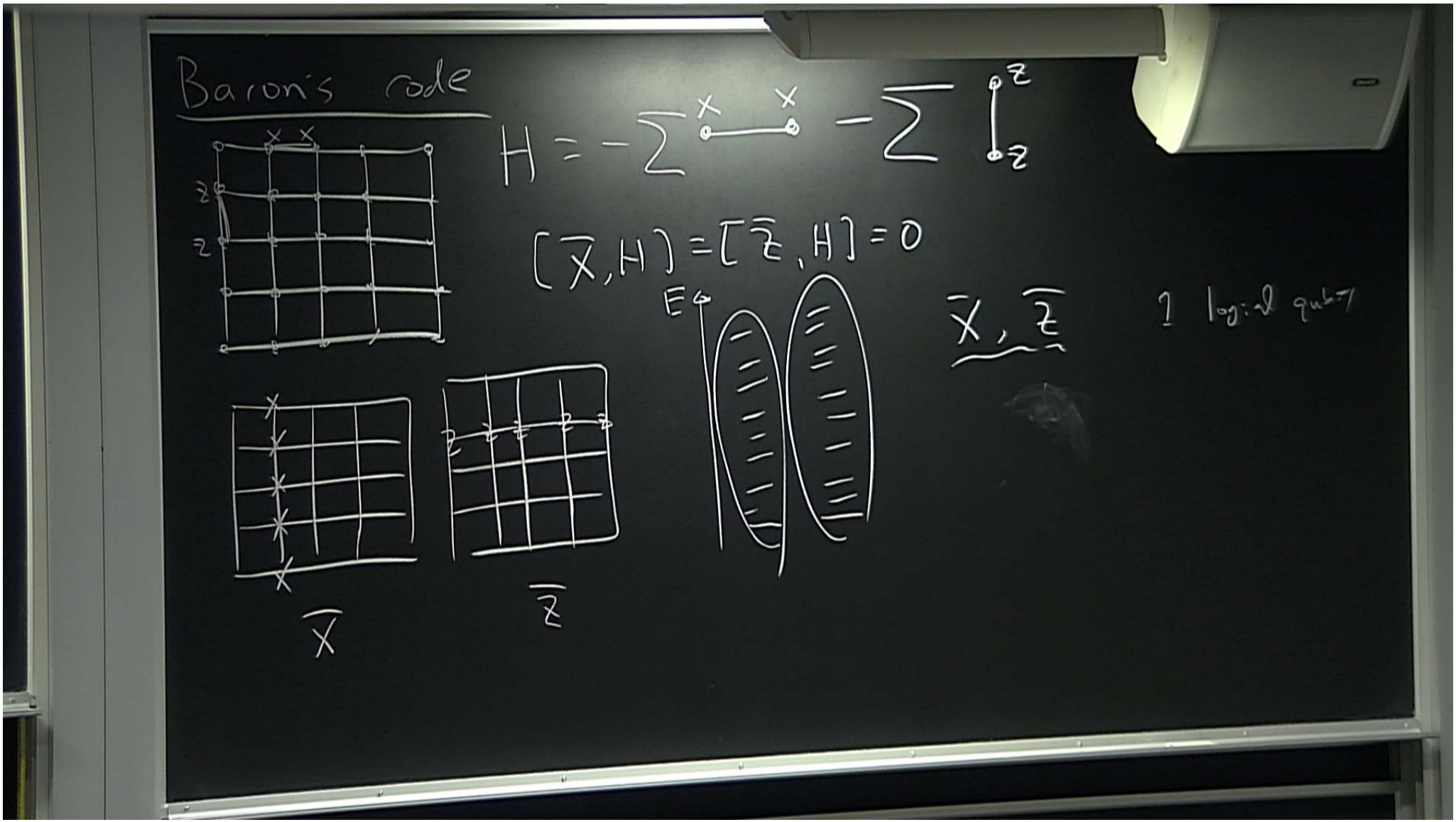
There are some constraints on operators / DOFs.

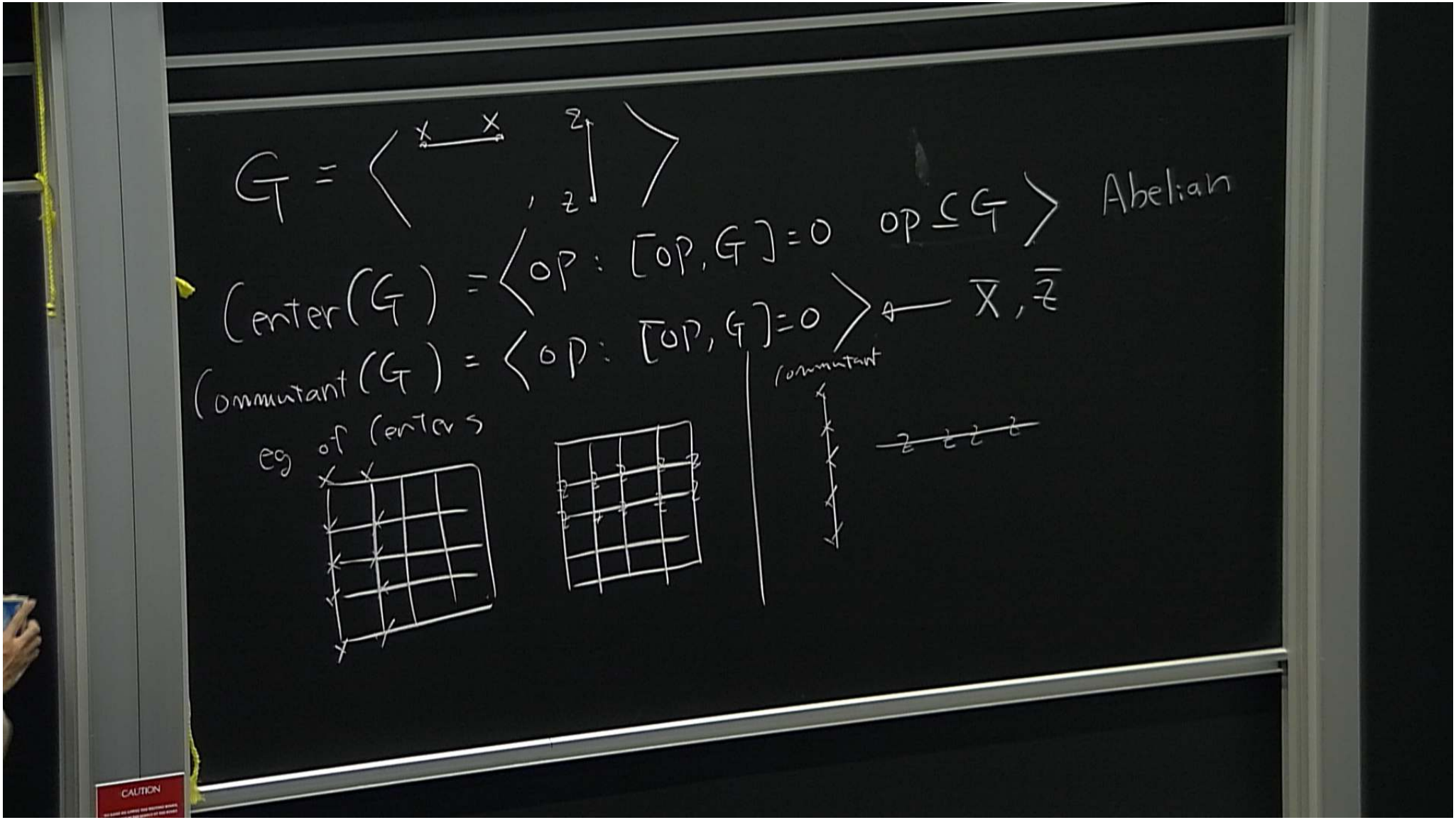
Boran PRA 73. 012340 (2006)

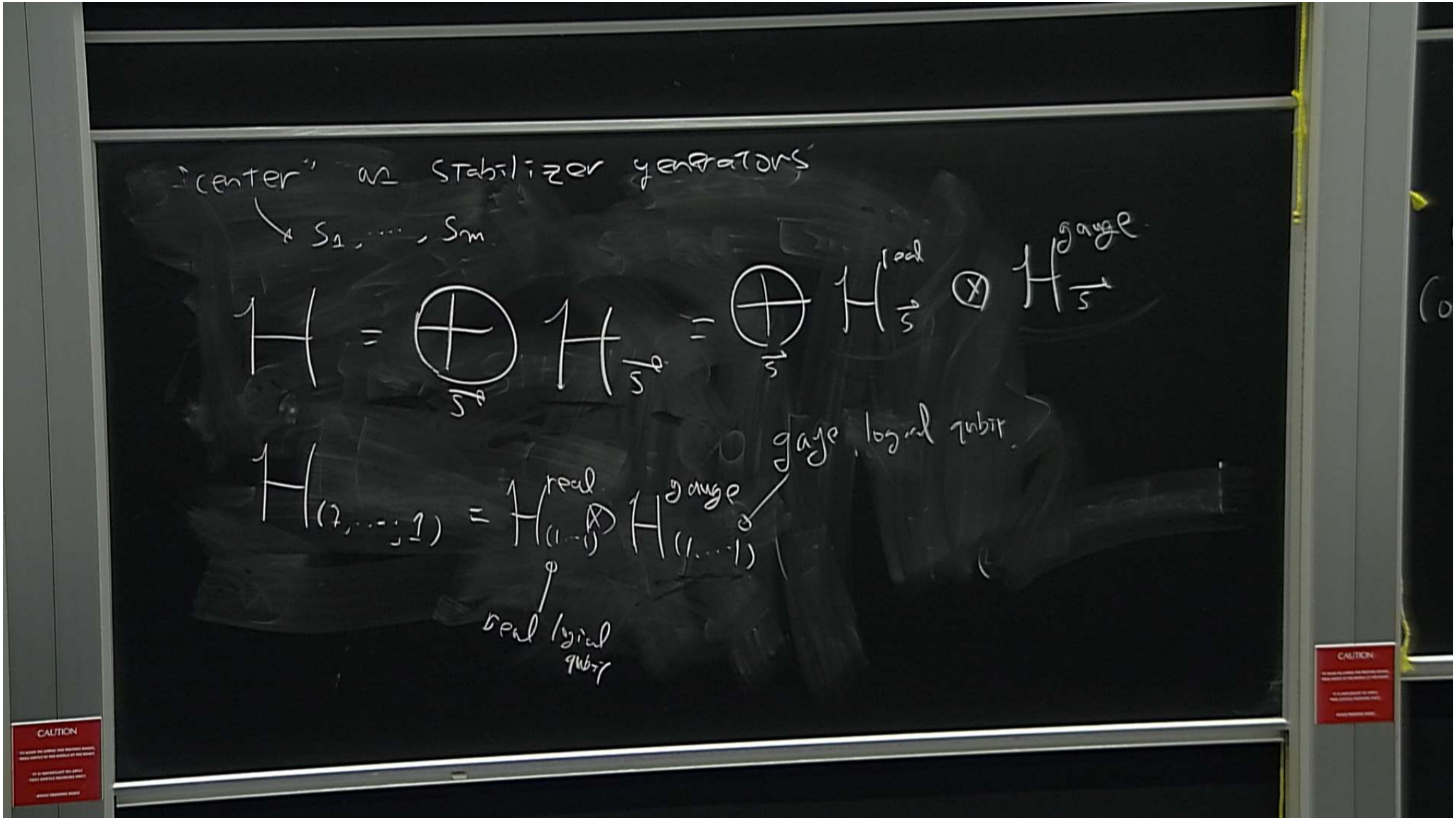
1. Toric code


Logical operators
$\overline{X_2}$
$\overline{X_1}$
$\overline{Z_1}$
$\overline{Z_2}$
[logical op, B_p] = 0
[logical op, A_v] = 0
E
encode
2 qubit
N qubit


Stabilizer code
$H = -\sum_j S_j$ $= 1$
$S = \langle S_j \rangle$
S_j Pauli: $[S_i, S_j] = 0$
$C = \{|\psi\rangle : S_j|\psi\rangle = |\psi\rangle\}$
1/5
$\mathcal{L} = \text{Commutant}(S) = \langle O : [O, S_j] = 0 \rangle$
$\mathcal{H} = \bigoplus_{\vec{s}} \mathcal{H}_{\vec{s}}$
$\mathcal{H}_{(1 \cdots 1)} = \text{codeword}$.
$\vec{s} = (s_1, s_2 \cdots s_m)$


Baron's code
H = − Σ − Σ
[X̄, H] = [Z̄, H] = 0
E
X̄, Z̄
1 logical qubit
X̄
Z̄


G = ⟨ X X , Z Z ⟩
Abelian
Center(G) = ⟨ op : [op, G] = 0 op ⊆ G ⟩
Commutant(G) = ⟨ op : [op, G] = 0 ⟩ ← X̄, Z̄
eg of Centers
Commutant


'center' or stabilizer generators
$s_1, \cdots, s_m$
$H = \bigoplus_{\vec{s}} H_{\vec{s}} = \bigoplus_{\vec{s}} H^{real}_{\vec{s}} \otimes H^{gauge}_{\vec{s}}$
$H_{(1,\cdots,1)} = H^{real}_{(1\cdots1)} \otimes H^{gauge}_{(1\cdots1)}$
gauge logical qubit
real logical qubit