Title: The Holographic Entropy Cone

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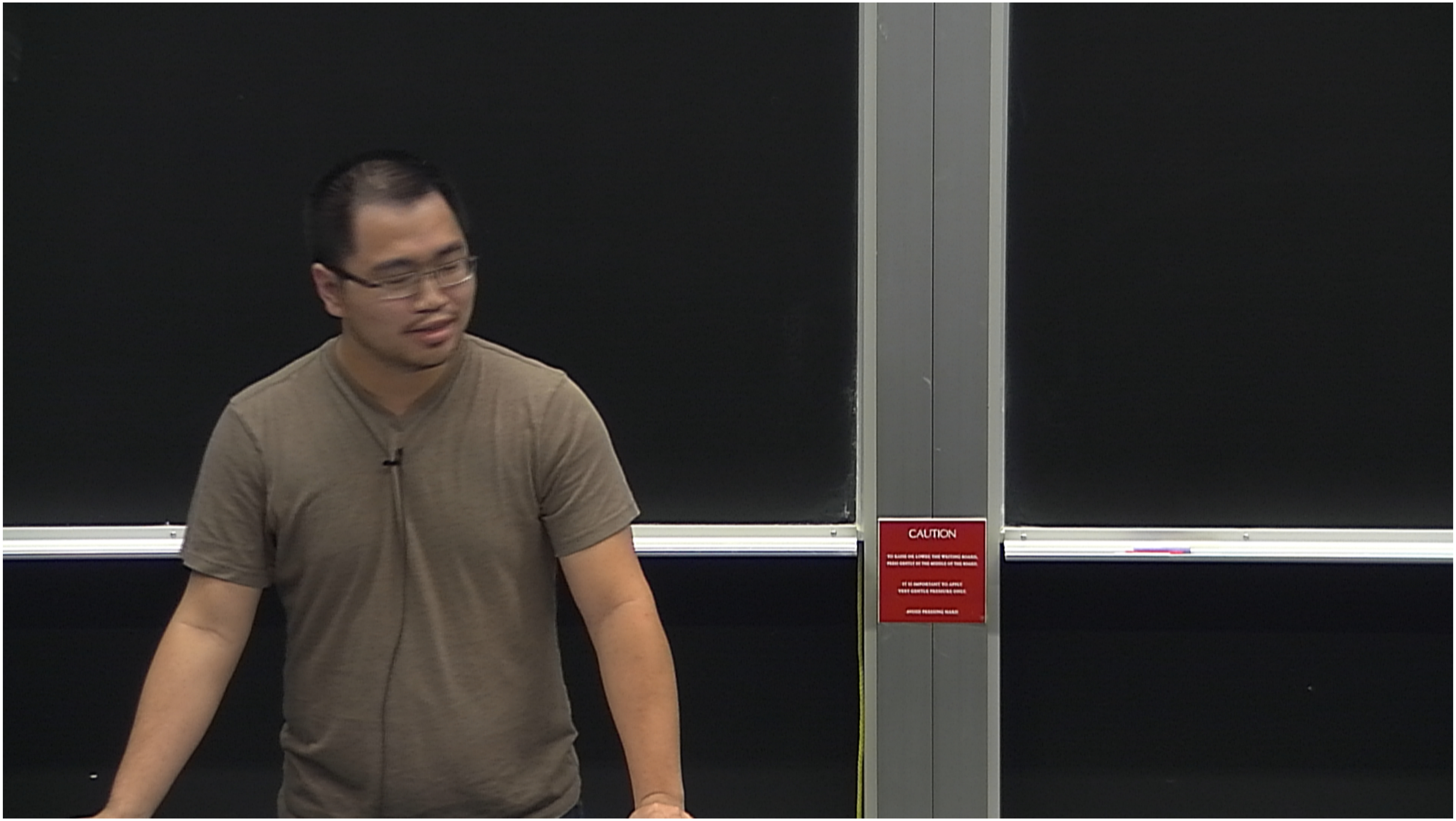
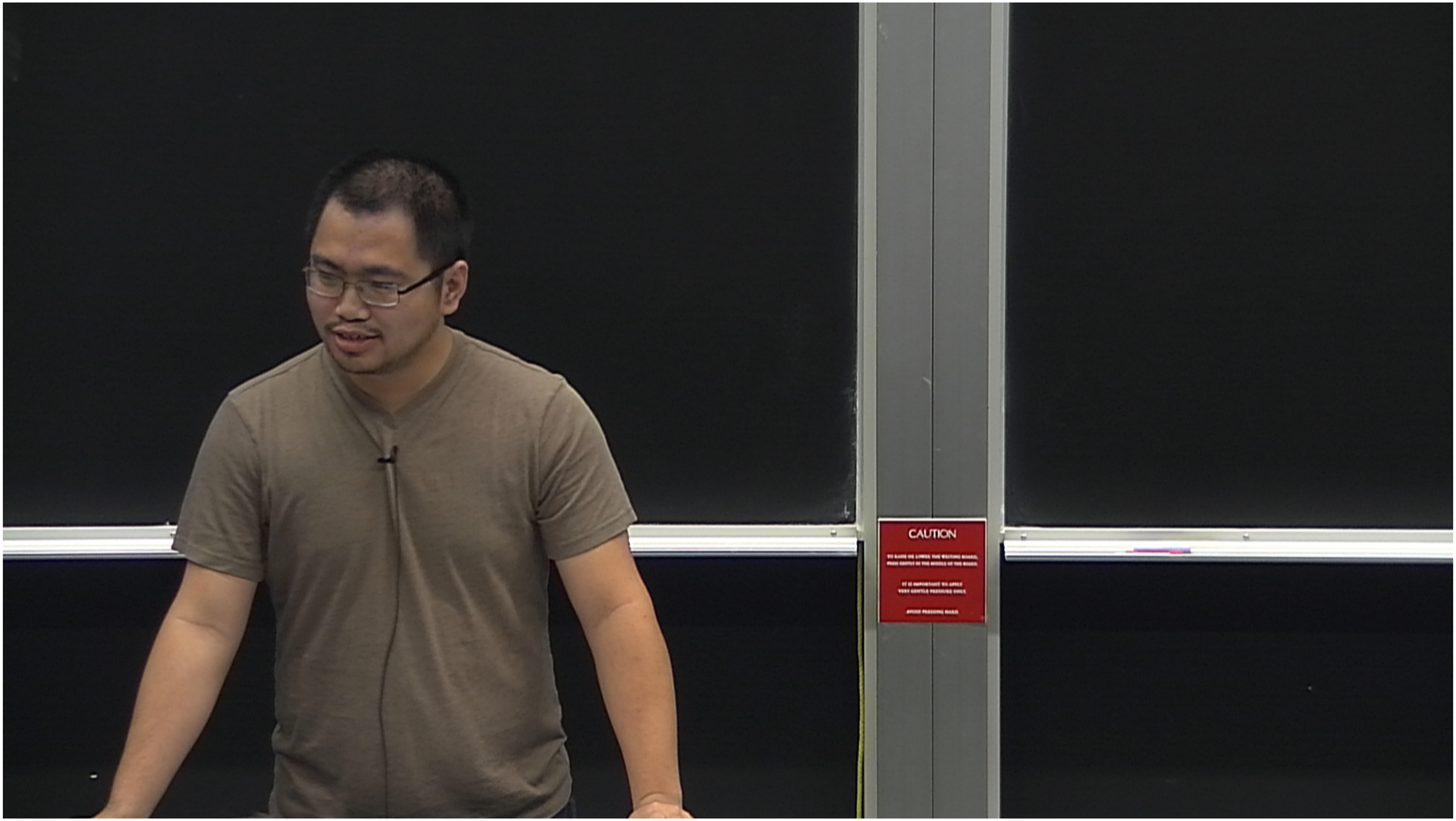
Abstract: We initiate a systematic enumeration and classification of entropy inequalities satisfied by the Ryu-Takayanagi formula for conformal field theory states with smooth holographic dual geometries. For 2, 3, and 4 regions, we prove that the strong subadditivity and the monogamy of mutual information give the complete set of inequalities. This is in contrast to the situation for generic quantum systems, where a complete set of entropy inequalities is not known for 4 or more regions. We also find an infinite new family of inequalities applicable to 5 or more regions. The set of all holographic entropy inequalities bounds the phase space of Ryu-Takayanagi entropies, defining the holographic entropy cone. We characterize this entropy cone by reducing geometries to minimal graph models that encode the possible cutting and gluing relations of minimal surfaces. We find that, for a fixed number of regions, there are only finitely many independent entropy inequalities. To establish new holographic entropy inequalities, we introduce a combinatorial proof technique that may also be of independent interest in Riemannian geometry and graph theory.


CAUTION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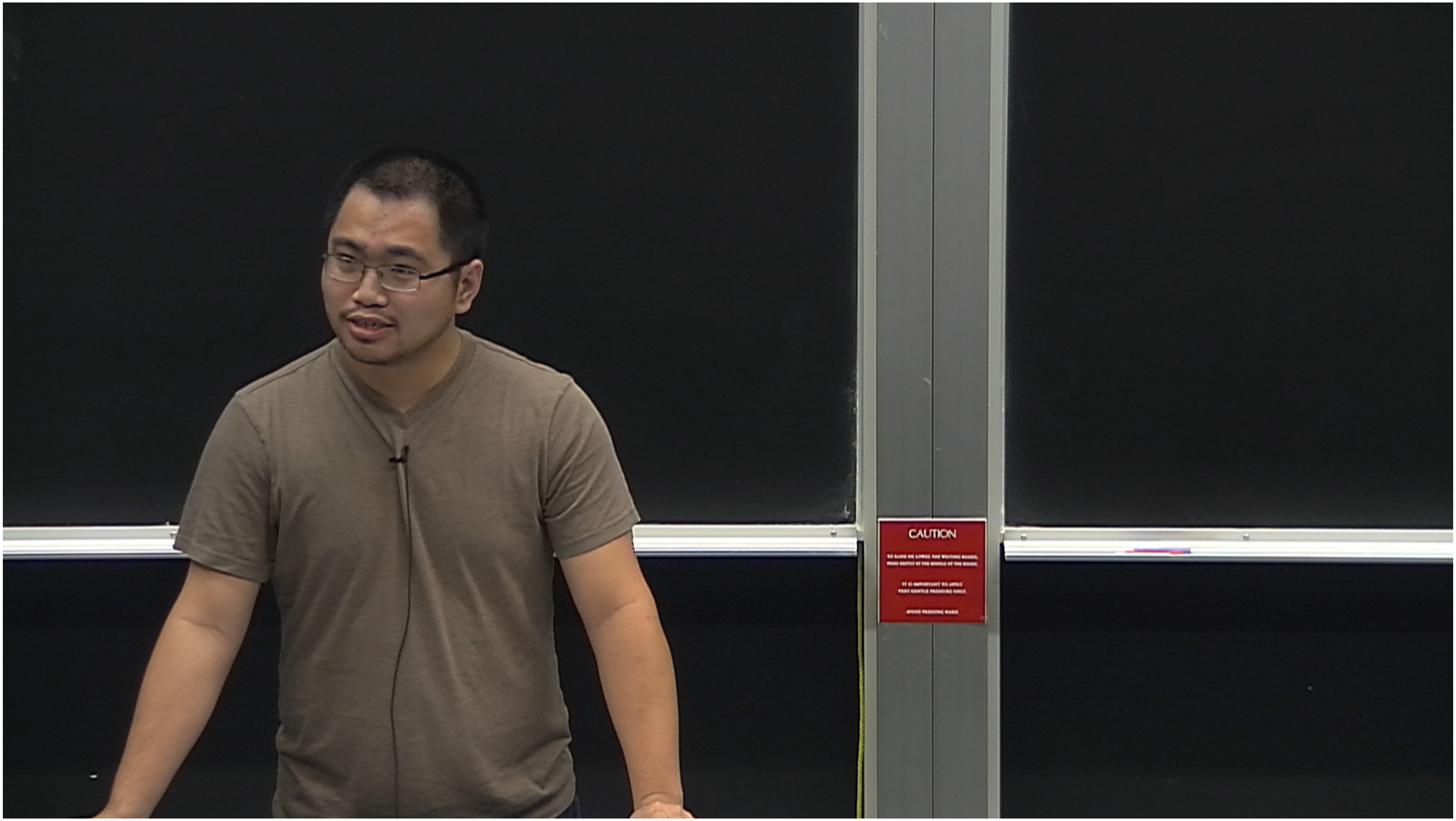
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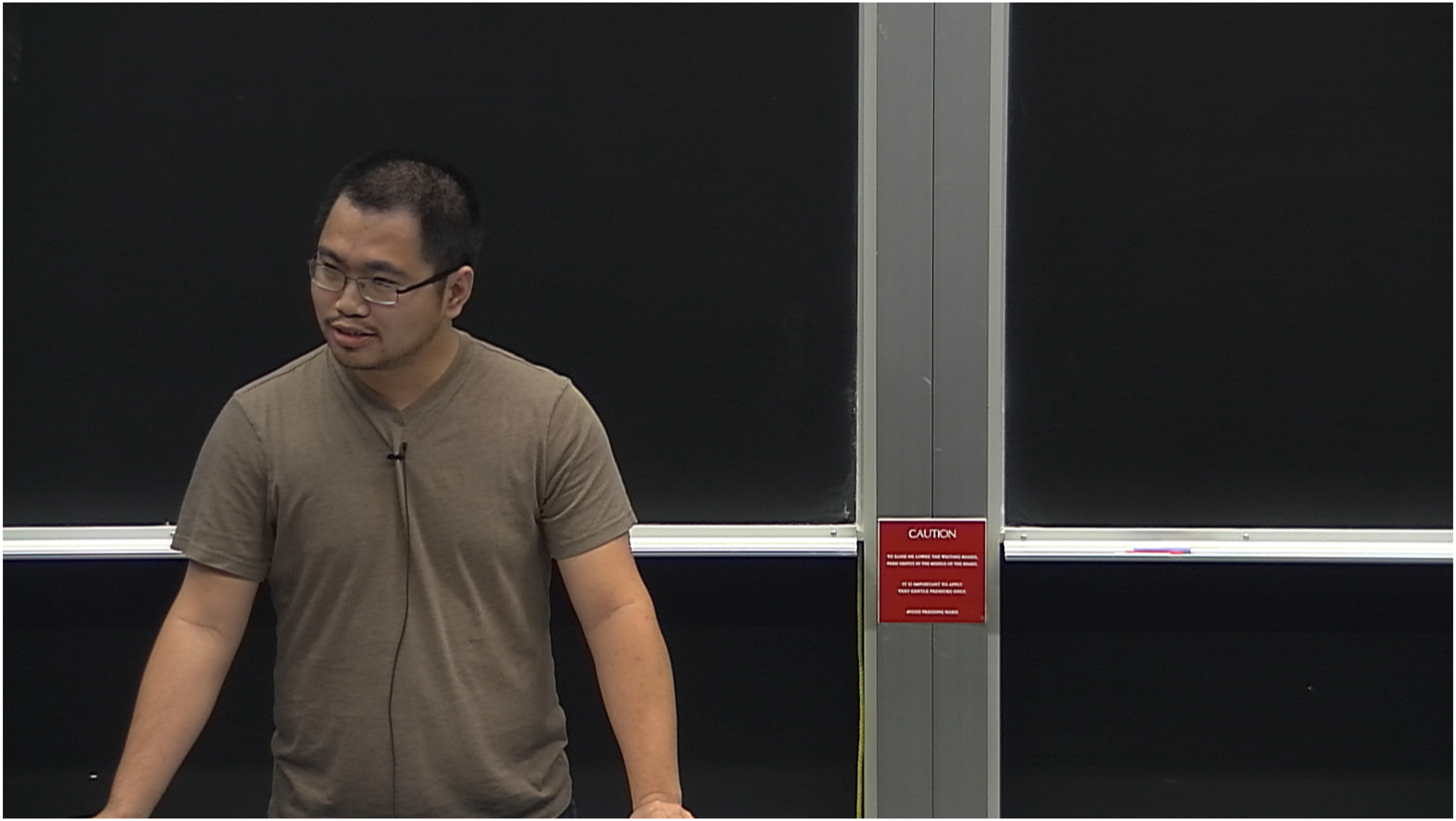
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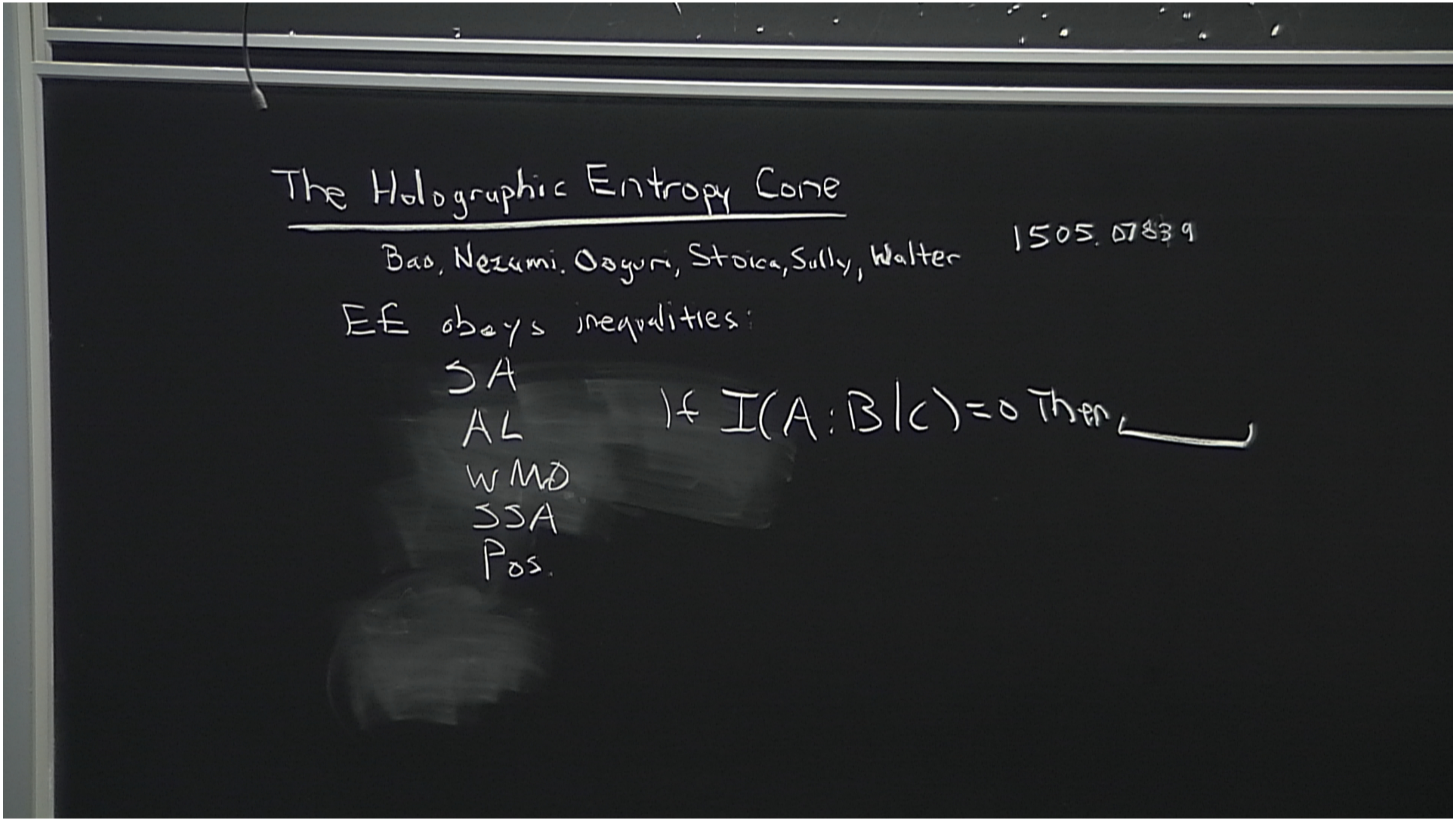
The Holographic Entropy Cone
Bao, Nezami, Ooguri, Stoica, Sully, Walter
1505.07839
EE obeys inequalities:
SA
AL
WMO
SSA
Pos.
If I(A:B|C)=0 Then ___

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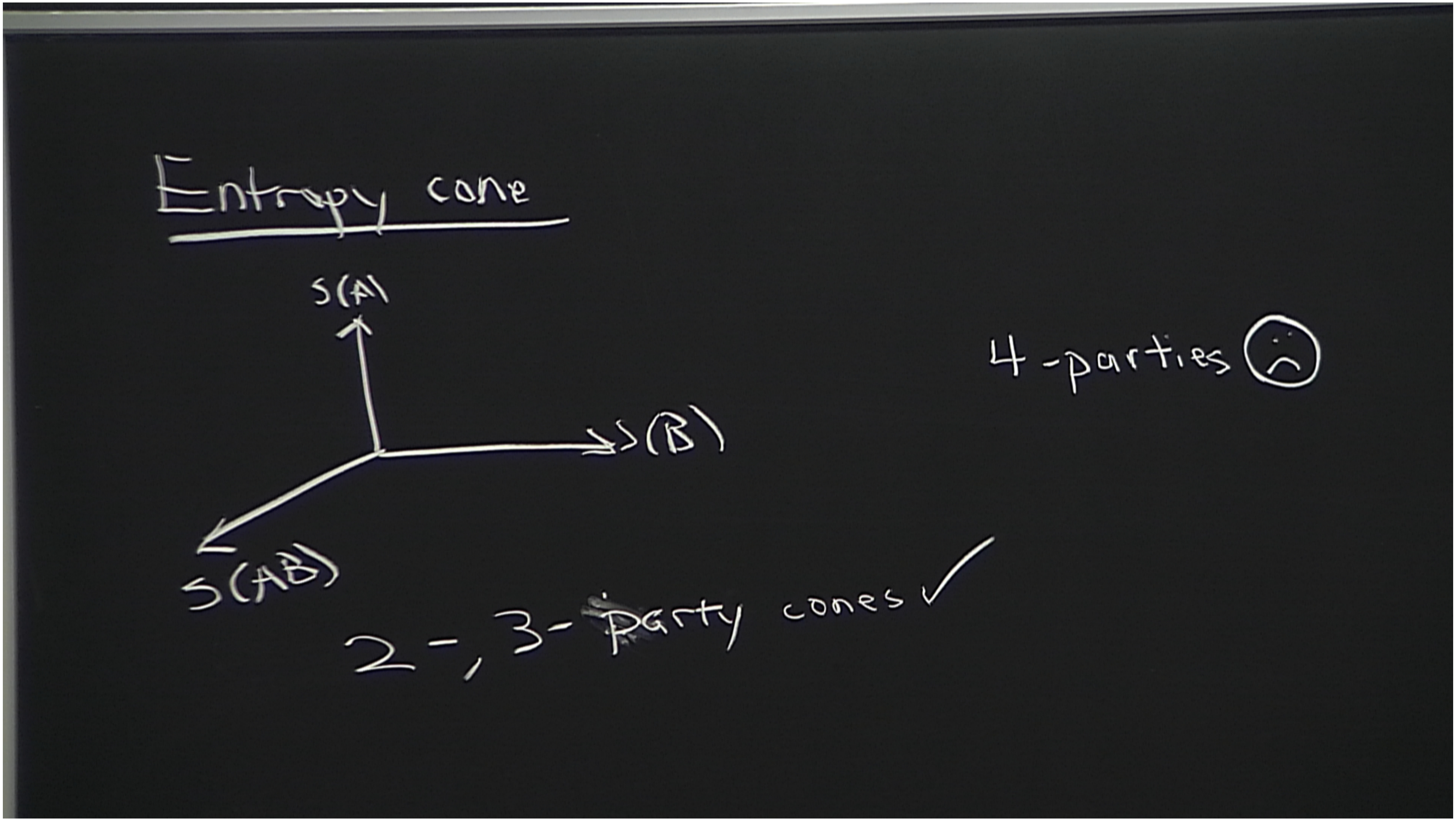
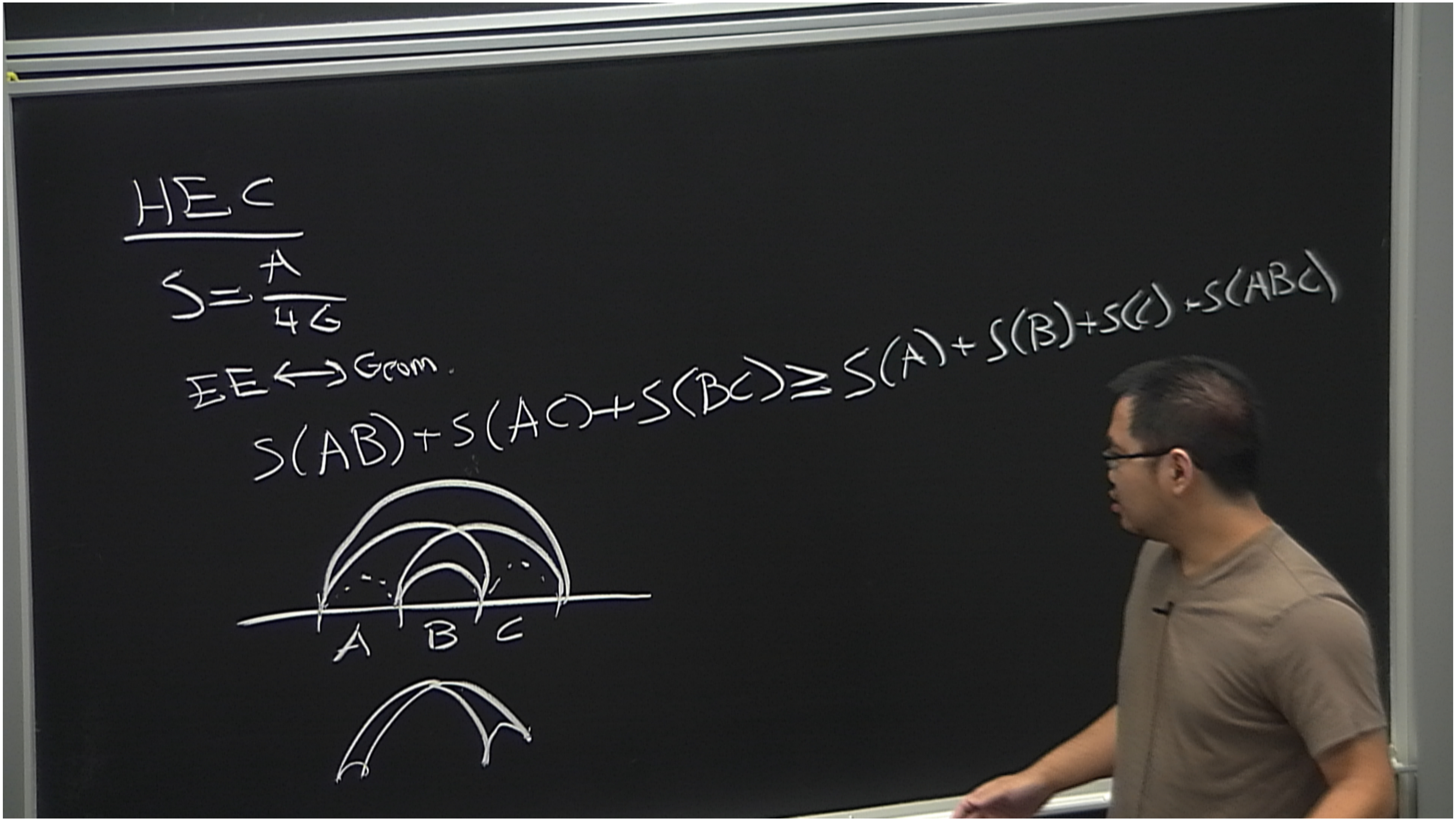
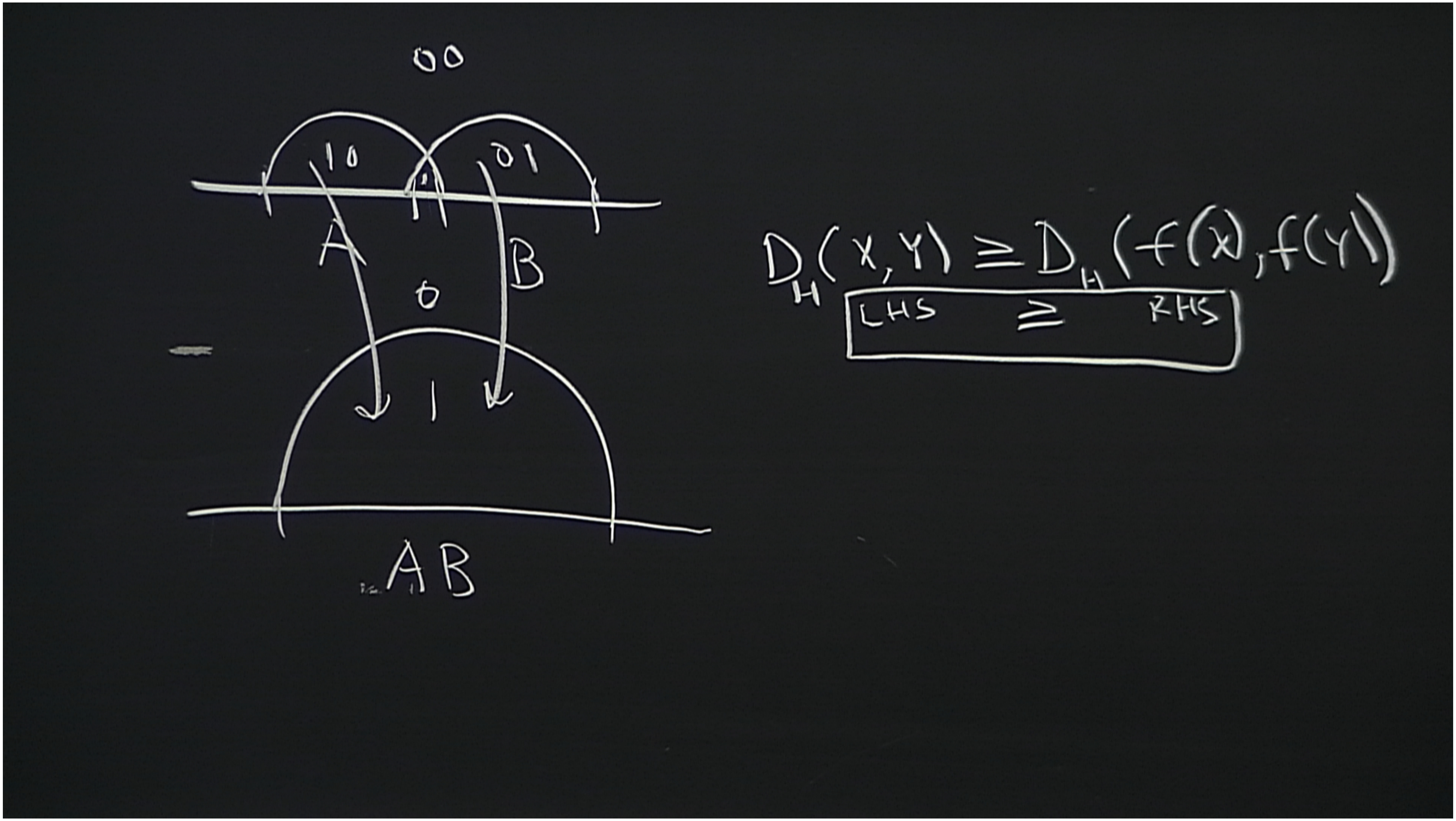
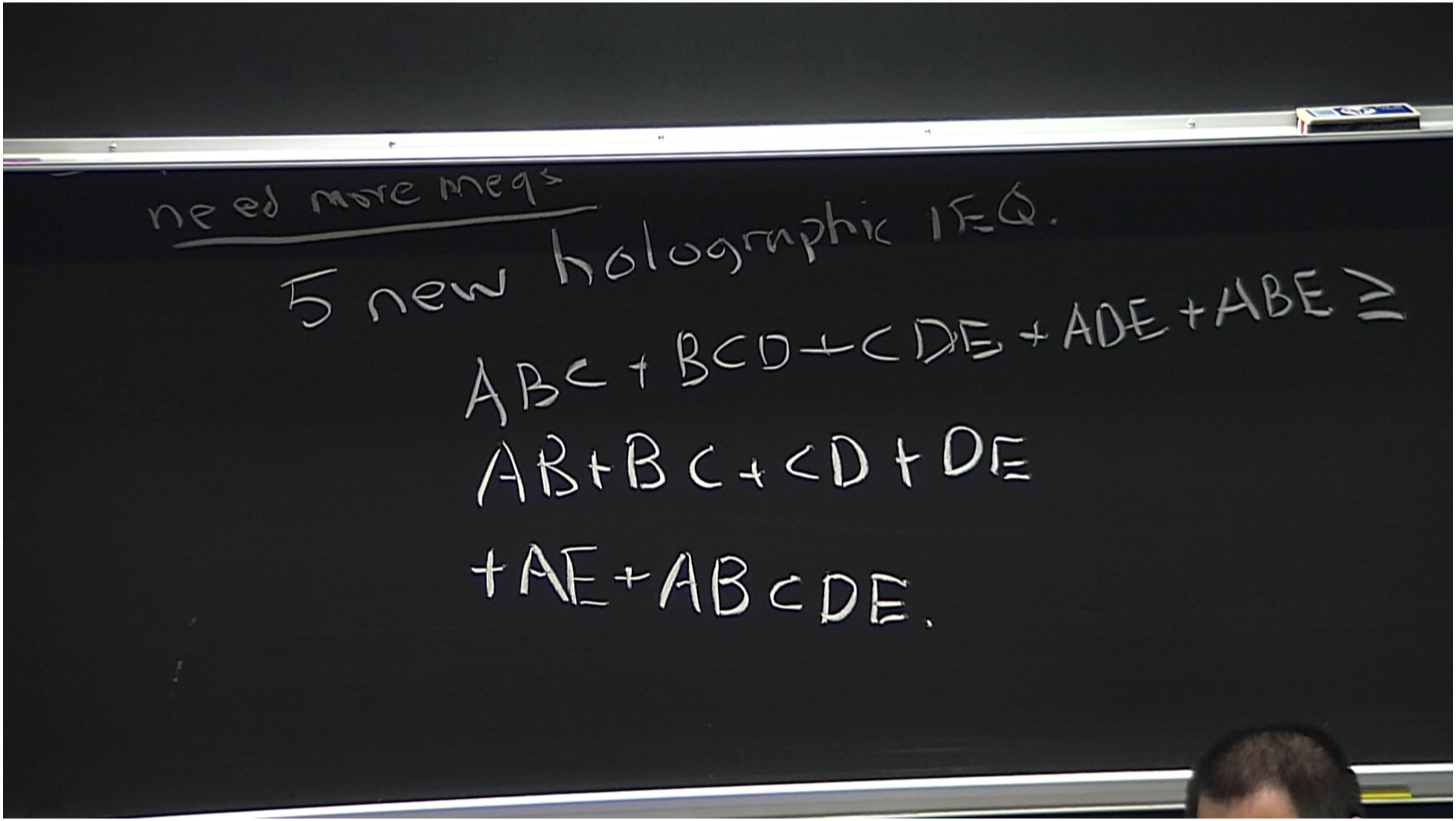
If $I(A:B|C)=0$ Then ___

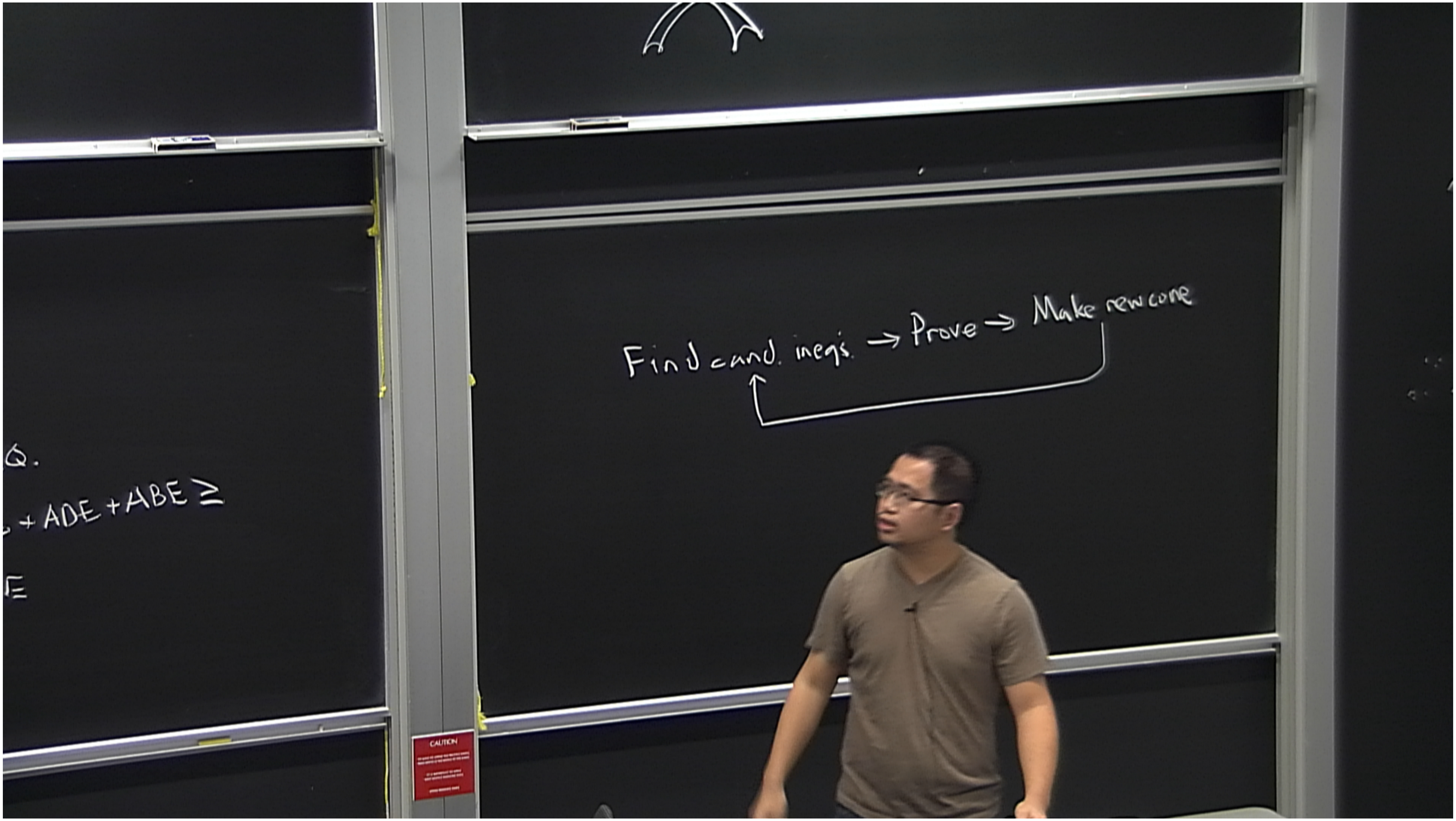
$$AB + AC \geq B + C$$


Entropy cone
S(A)
S(B)
S(AB)
4-parties
2-, 3-party cones ✓


HEC
S = A/4G
EE ⟷ Geom.
S(AB)+S(AC)+S(BC) ≥ S(A)+S(B)+S(C)+S(ABC)
A B C


00
10
01
A
B
0
1
AB
D_H(X,Y) ≥ D_H(f(X),f(Y))
LHS ≥ RHS


need more meqs
5 new holographic IEQ.
ABC + BCD + CDE + ADE + ABE ≥
AB + BC + CD + DE
+ AE + ABCDE.


Find cand. ineqs. → Prove → Make new cone
+ ADE + ABE ≥
CAUTION