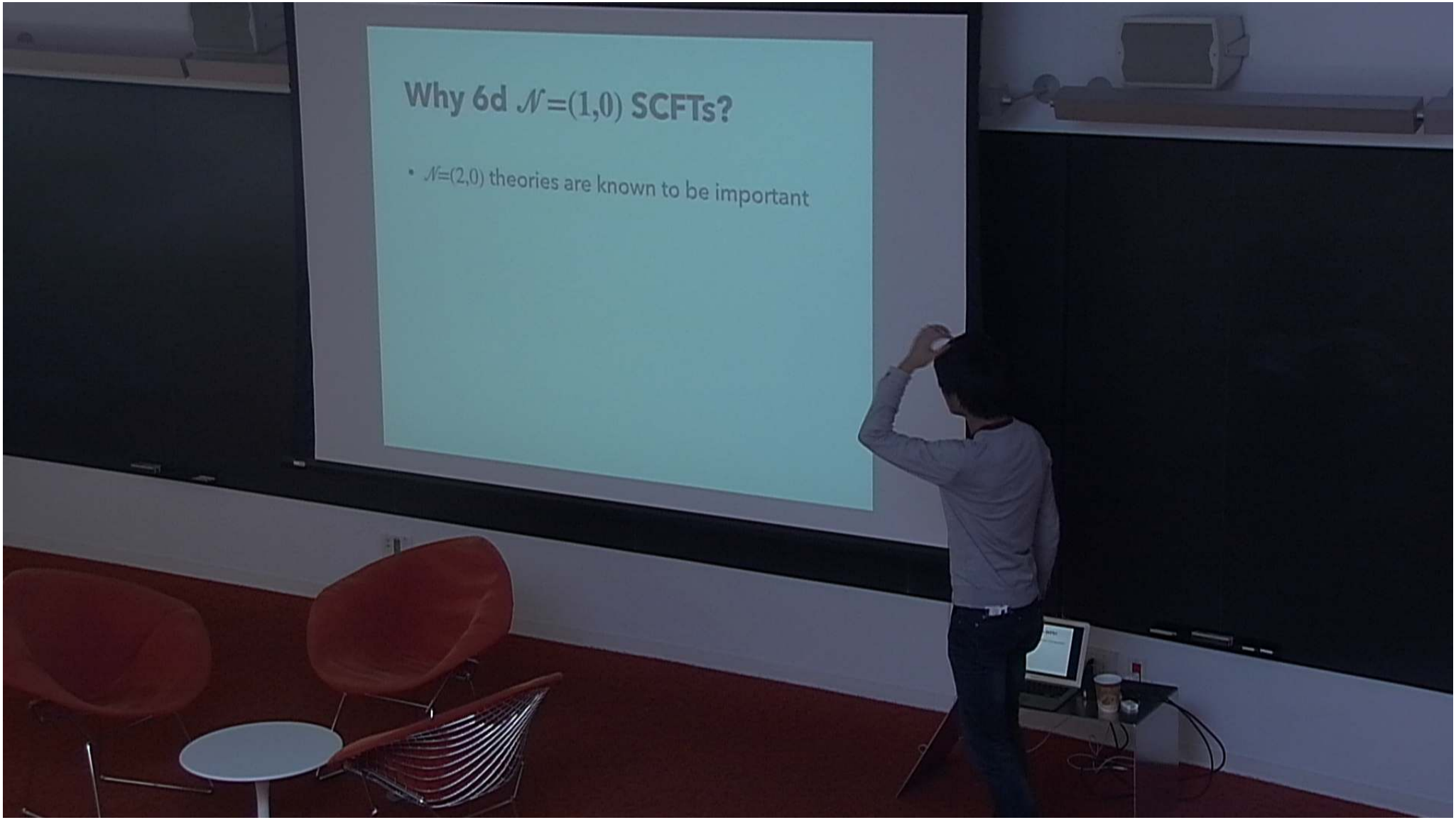
Title: 6d N=(1,0) theories on T^2 and class S theories

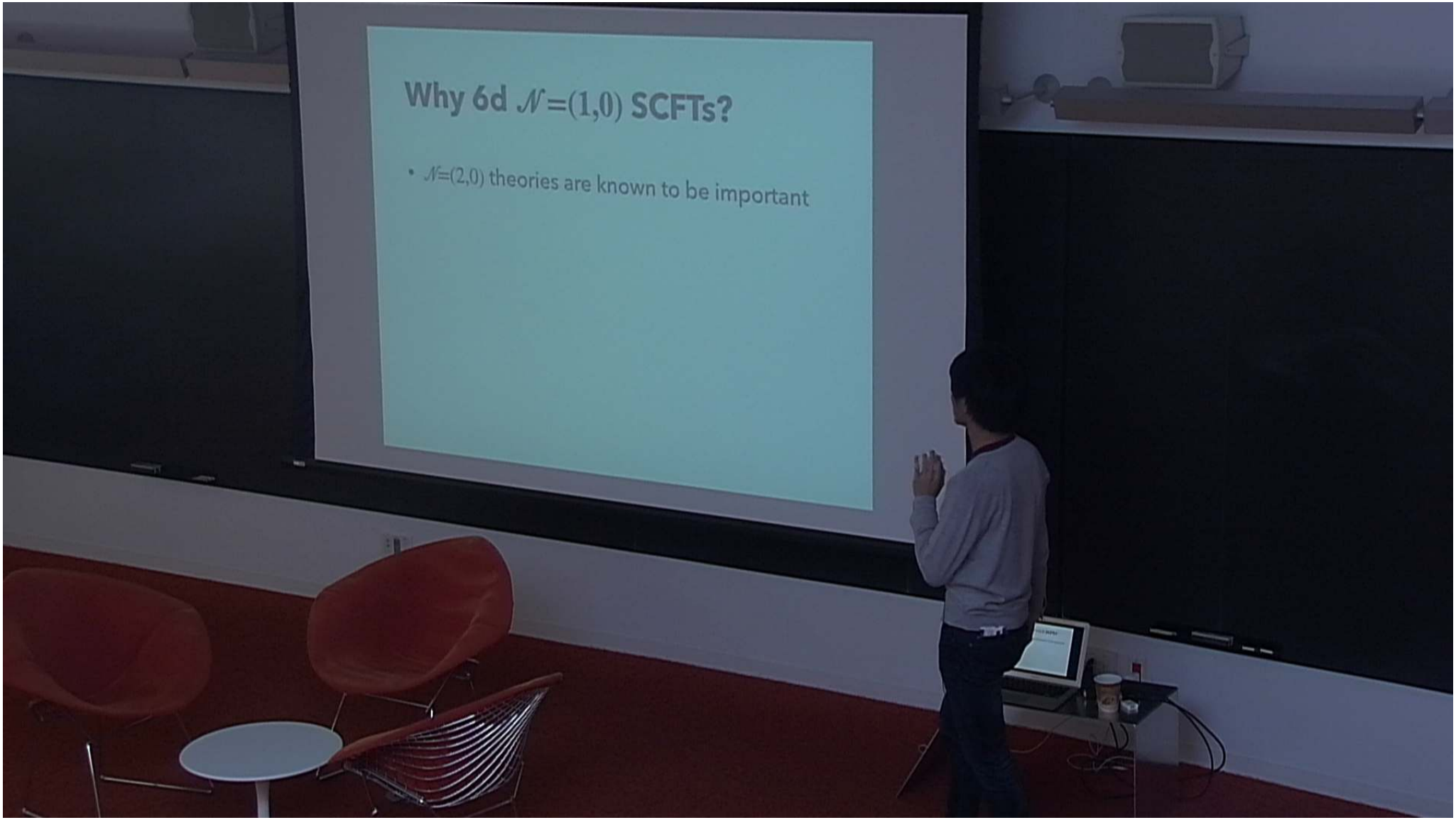
Date: Oct 19, 2015 11:00 AM

URL: http://pirsa.org/15100083

Abstract: In this talk I will discuss the most singular point and T^2 compactifications of a 6d N=(1,0) supersymmetric conformal field theory (SCFT) which arises as the worldvolume theory on coincident N of M5 branes probing the singular locus of the ALE orbifold. When N=1, the compactified theory can be describe by a class S theory of three punctured sphere. Generalization to multiple M5s case results in a pair of 4d N=2 SCFTs which are connected by a IR free gauge multiplet. Along the line, we see that the â€œdynamical version" of class S simple puncture plays a role. Closing one of two flavor groups, we can isolate one of them with manifest SL(2,Z) invariance of T^2 and a non-abelian flavor group, including presumably new N=2 SCFTs.

6d $\mathcal{N}$=(1,0) theories on T^2
and class S theories
Kantaro Ohmori
Univ. of Tokyo
w/ Hiroyuki Shimizu, Yuji Tachikawa, Kazuya Yo
Part I: arXiv:1503.06217, Part II: arXiv:1508.00
@PI, 19th Oct. 2015


Why 6d $\mathcal{N}=(1,0)$ SCFTs?
• $\mathcal{N}=(2,0)$ theories are known to be important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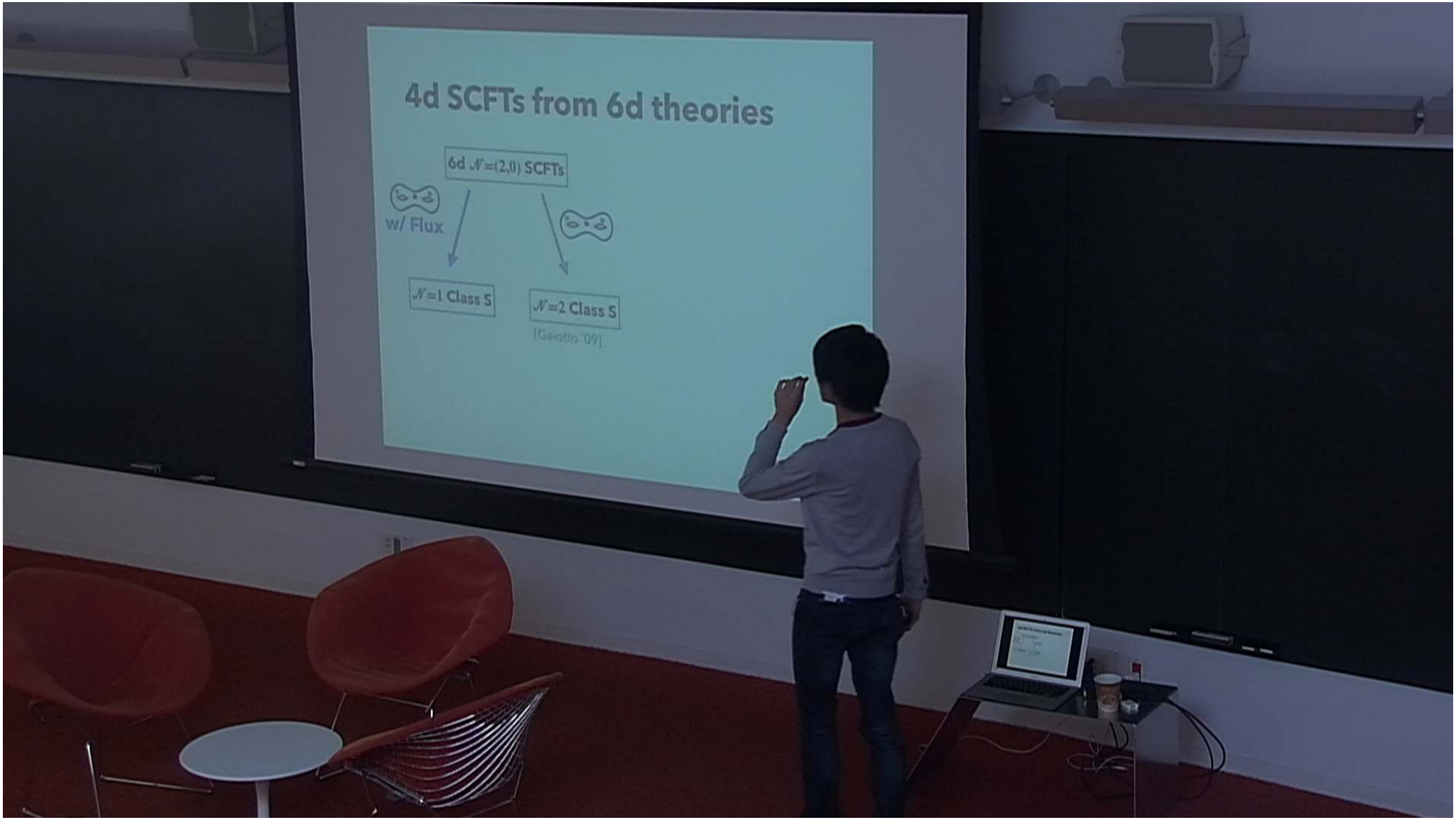
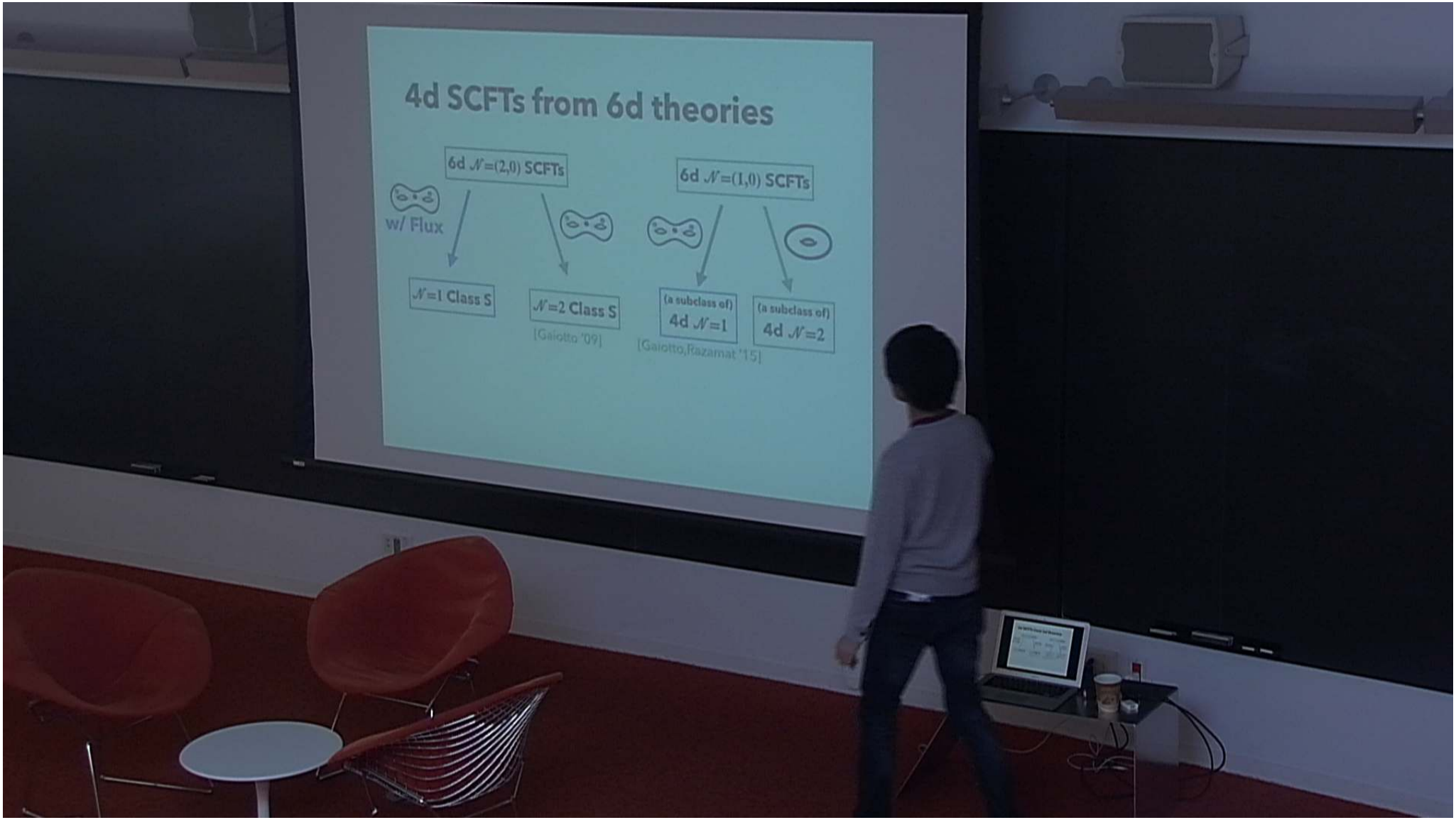
4d SCFTs from 6d theories


4d SCFTs from 6d theories
6d $\mathcal{N}$=(2,0) SCFTs
w/ Flux
$\mathcal{N}$=1 Class S
$\mathcal{N}$=2 Class S
[Gaiotto '09]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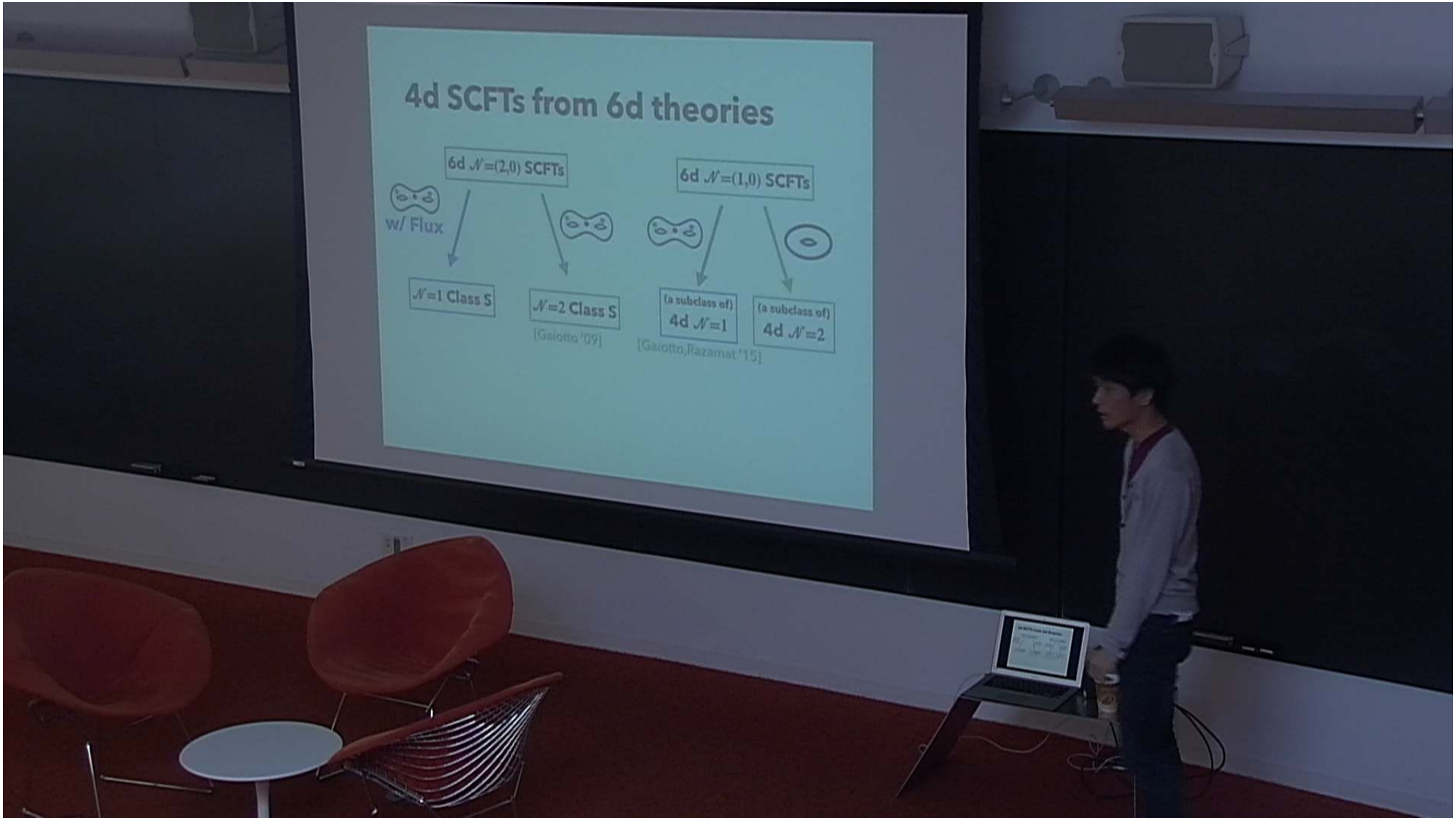
[Gaiotto '09]
(a subclass of) 4d $\mathcal{N}$=1
(a subclass of) 4d $\mathcal{N}$=2
[Gaiotto,Razamat '15]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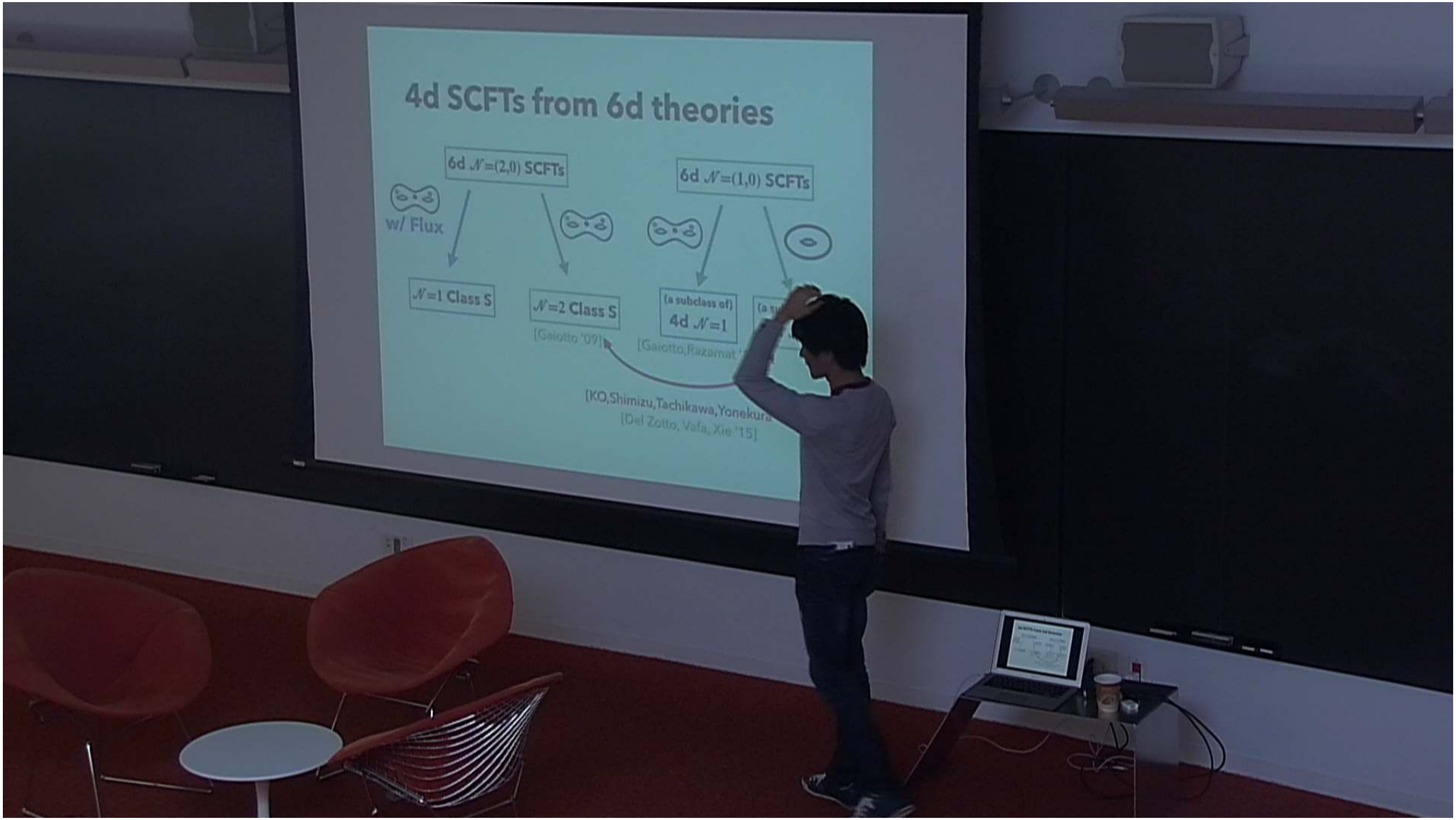
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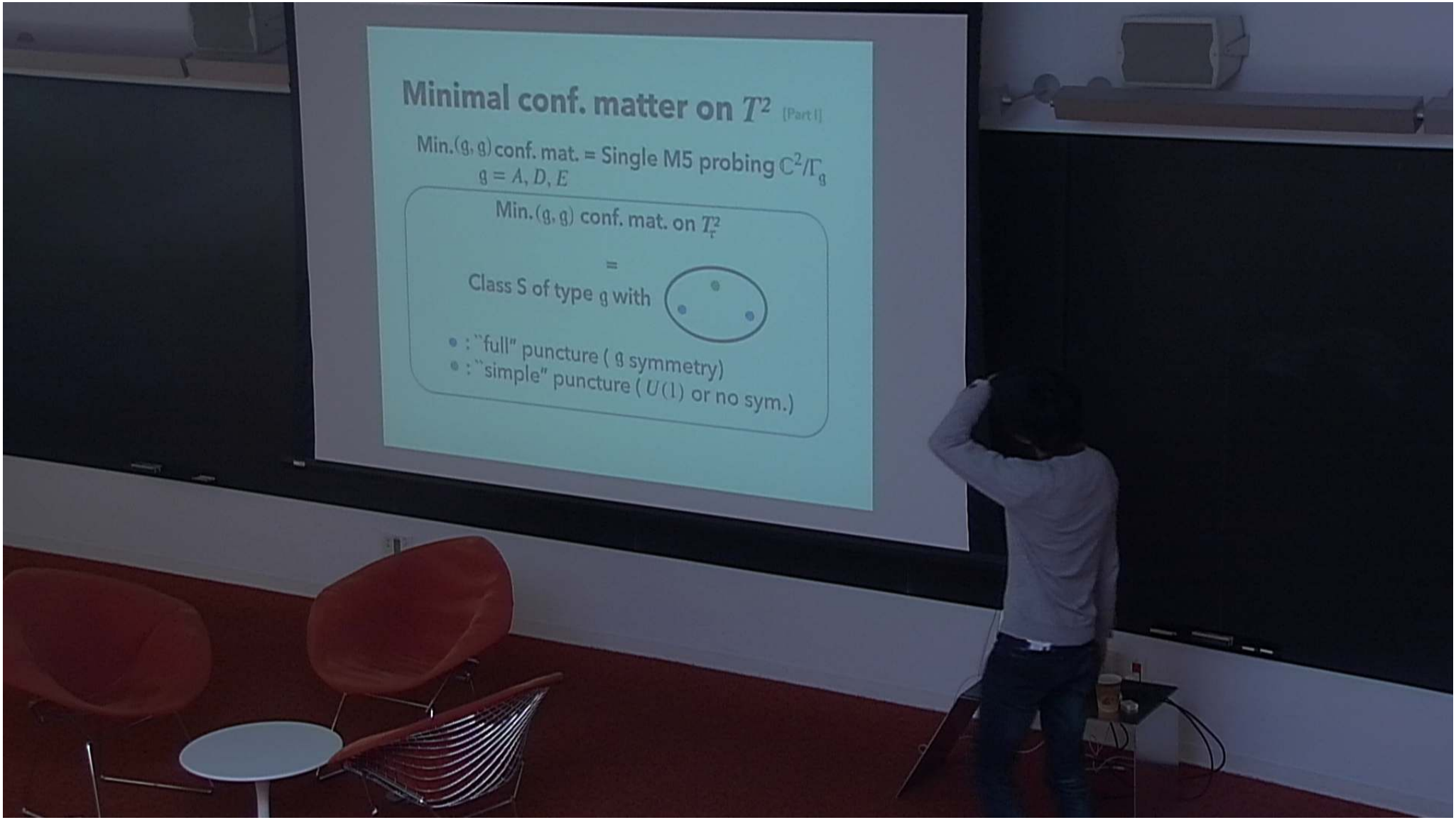
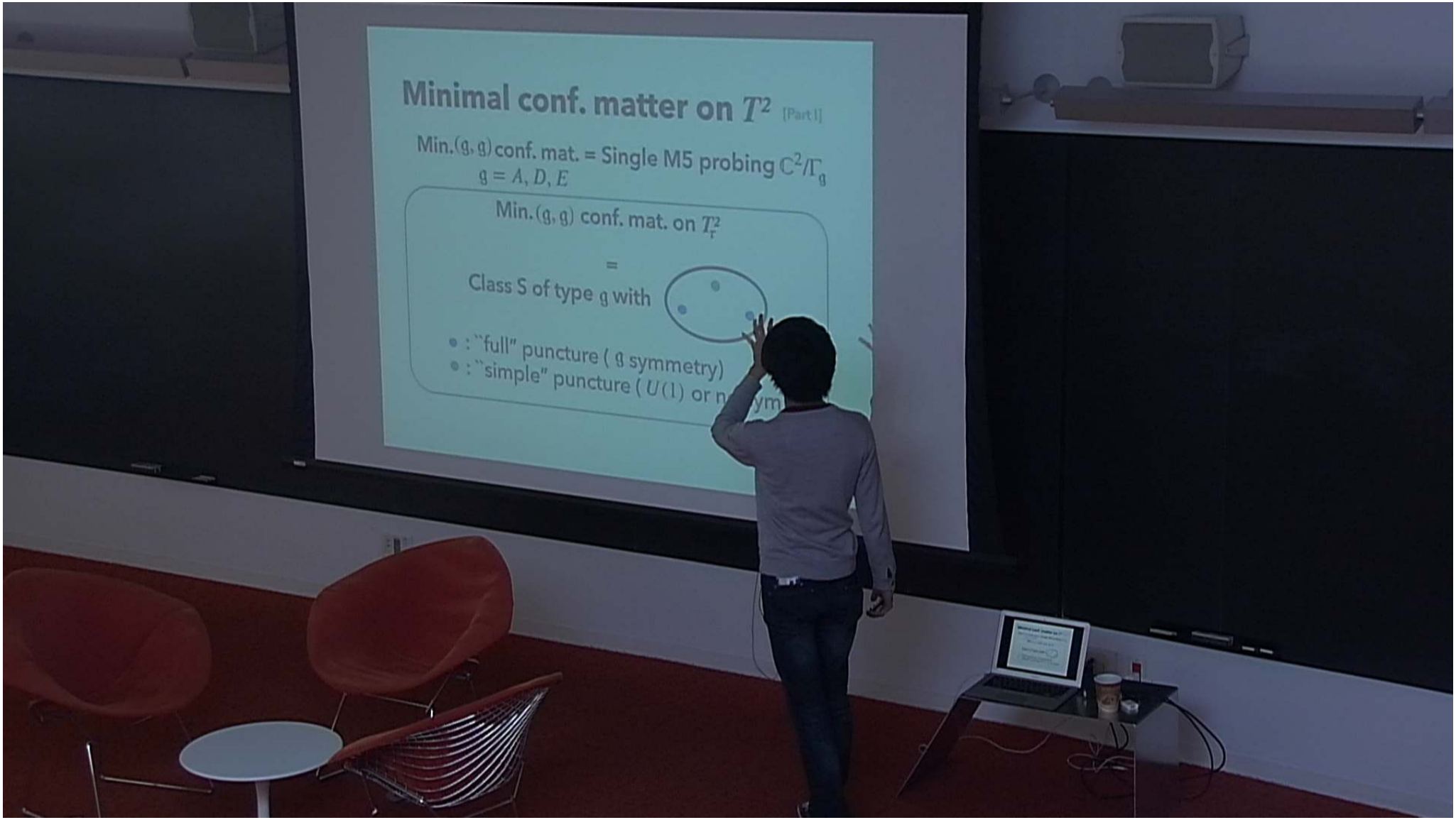
[KO,Shimizu,Tachikawa,Yonekura
[Del Zotto, Vafa, Xie '15]


Minimal conf. matter on T^2 [Part I]
Min.$(\mathfrak{g},\mathfrak{g})$ conf. mat. = Single M5 probing $\mathbb{C}^2/\Gamma_{\mathfrak{g}}$
$\mathfrak{g} = A, D, E$
Min.$(\mathfrak{g},\mathfrak{g})$ conf. mat. on T^2_τ
=
Class S of type $\mathfrak{g}$ with
• : "full" puncture ($\mathfrak{g}$ symmetry)
• : "simple" puncture ($U(1)$ or no sym.)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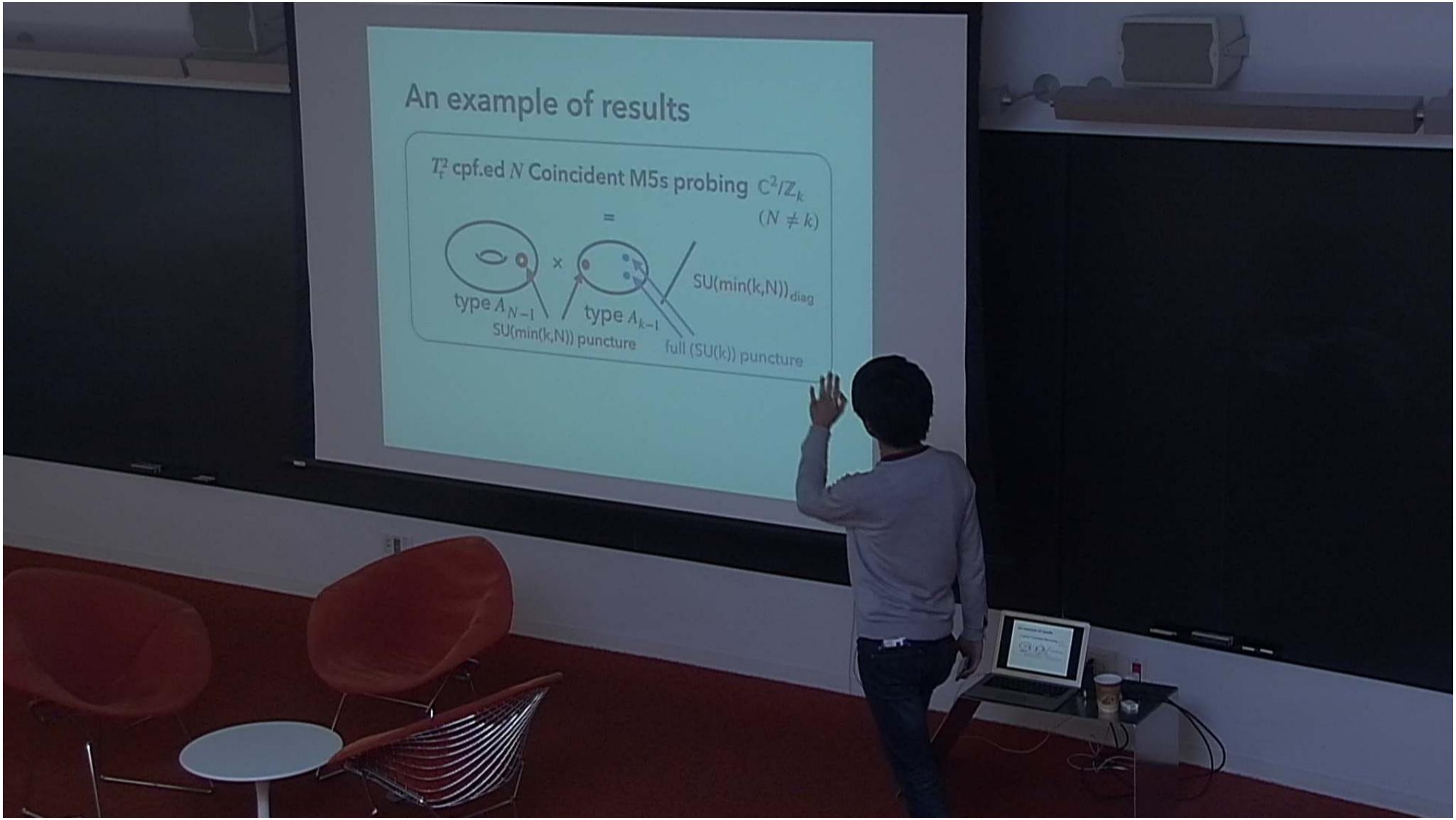
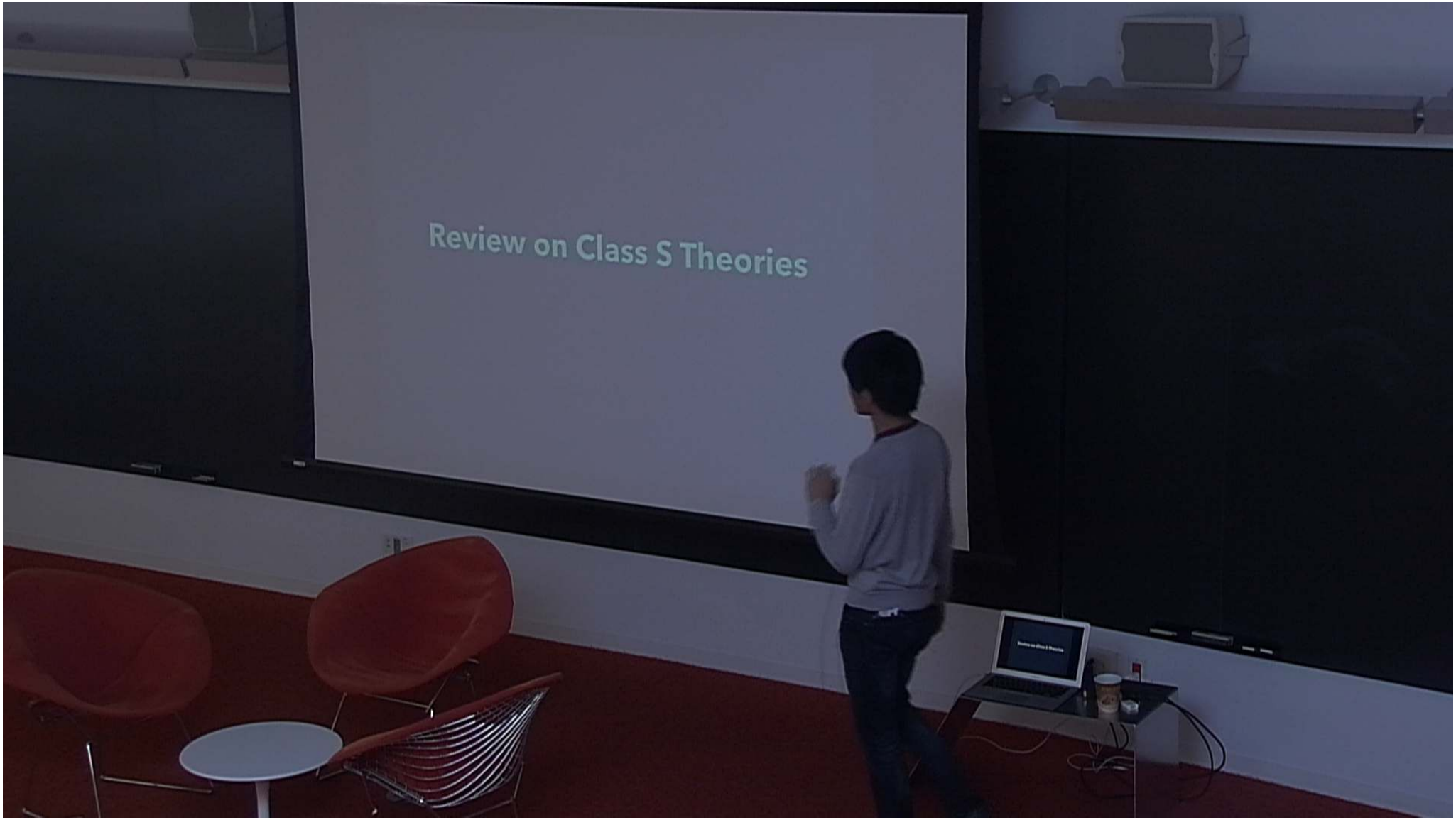
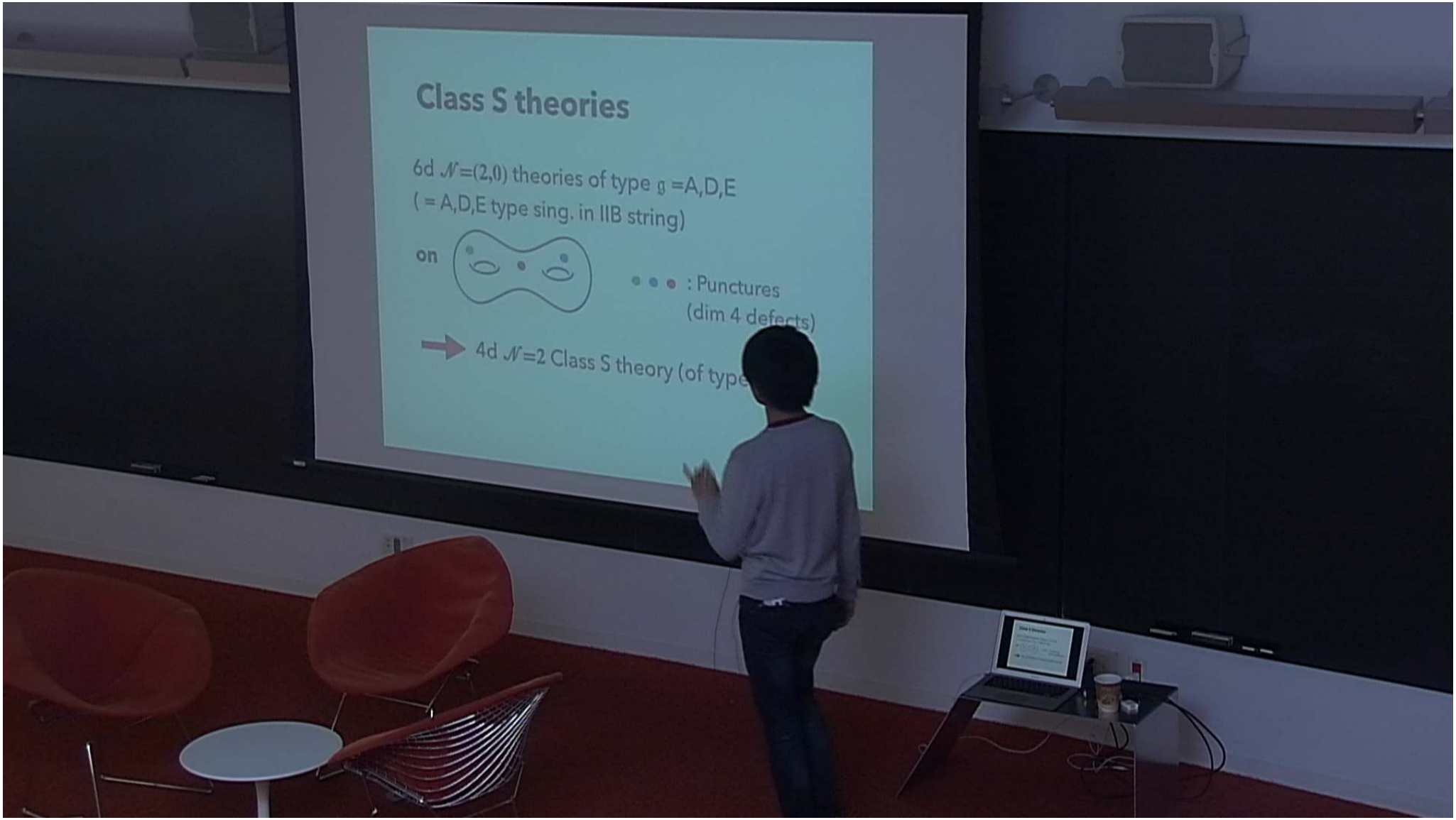
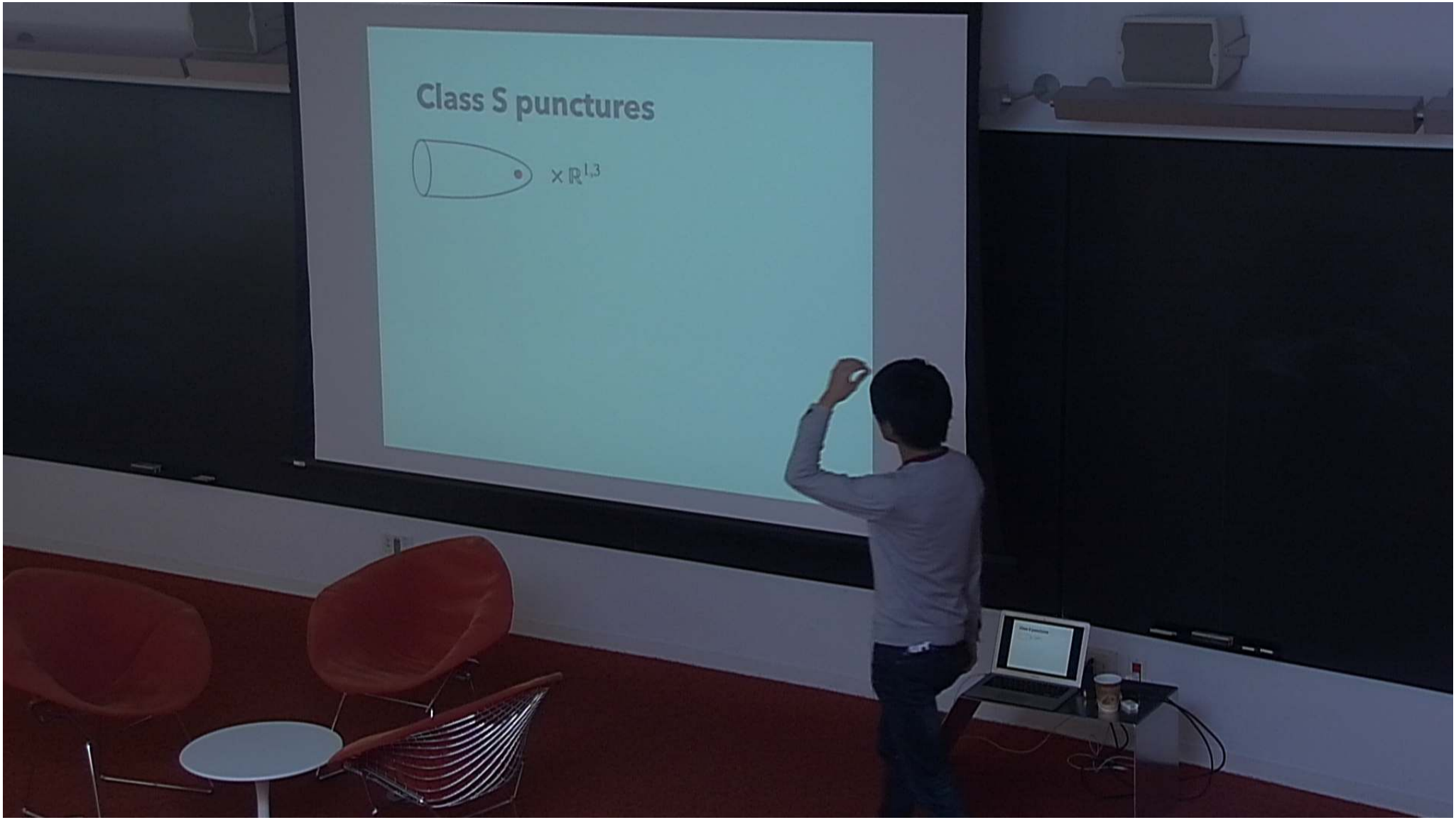
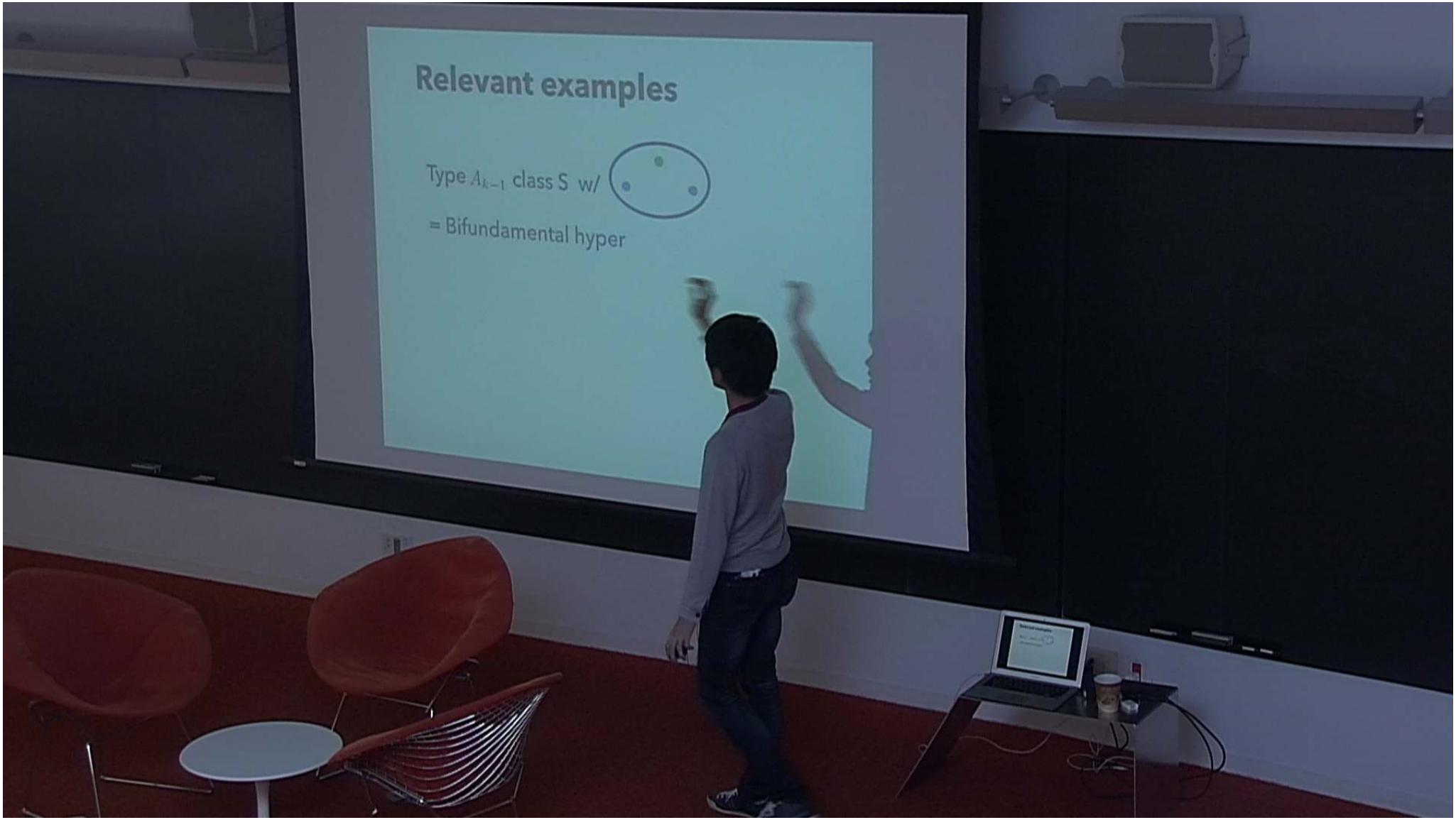
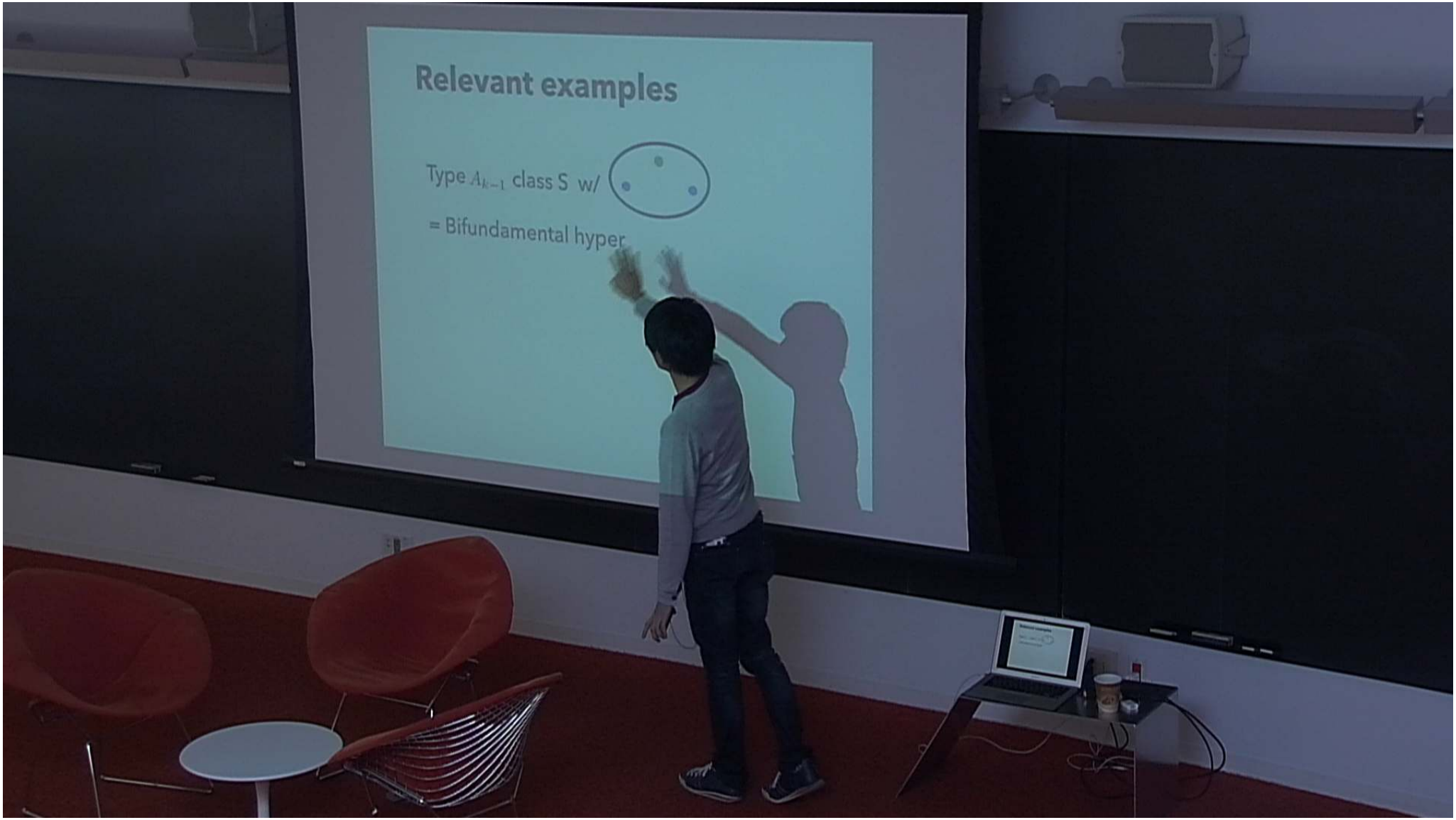

An example of results
T_t^2 cpf.ed N Coincident M5s probing C^2/Z_k
$(N \neq k)$
=
×
type A_{N-1}
SU(min(k,N)) puncture
type A_{k-1}
SU(min(k,N))$_{diag}$
full (SU(k)) puncture


Review on Class S Theories


Class S theories
6d $\mathcal{N}$=(2,0) theories of type $\mathfrak{g}$ =A,D,E
(= A,D,E type sing. in IIB string)
on
: Punctures
(dim 4 defects)
4d $\mathcal{N}$=2 Class S theory (of type


Class S punctures
$\times \mathbb{R}^{1,3}$


Relevant examples
Type A_{k-1} class S w/
= Bifundamental hyper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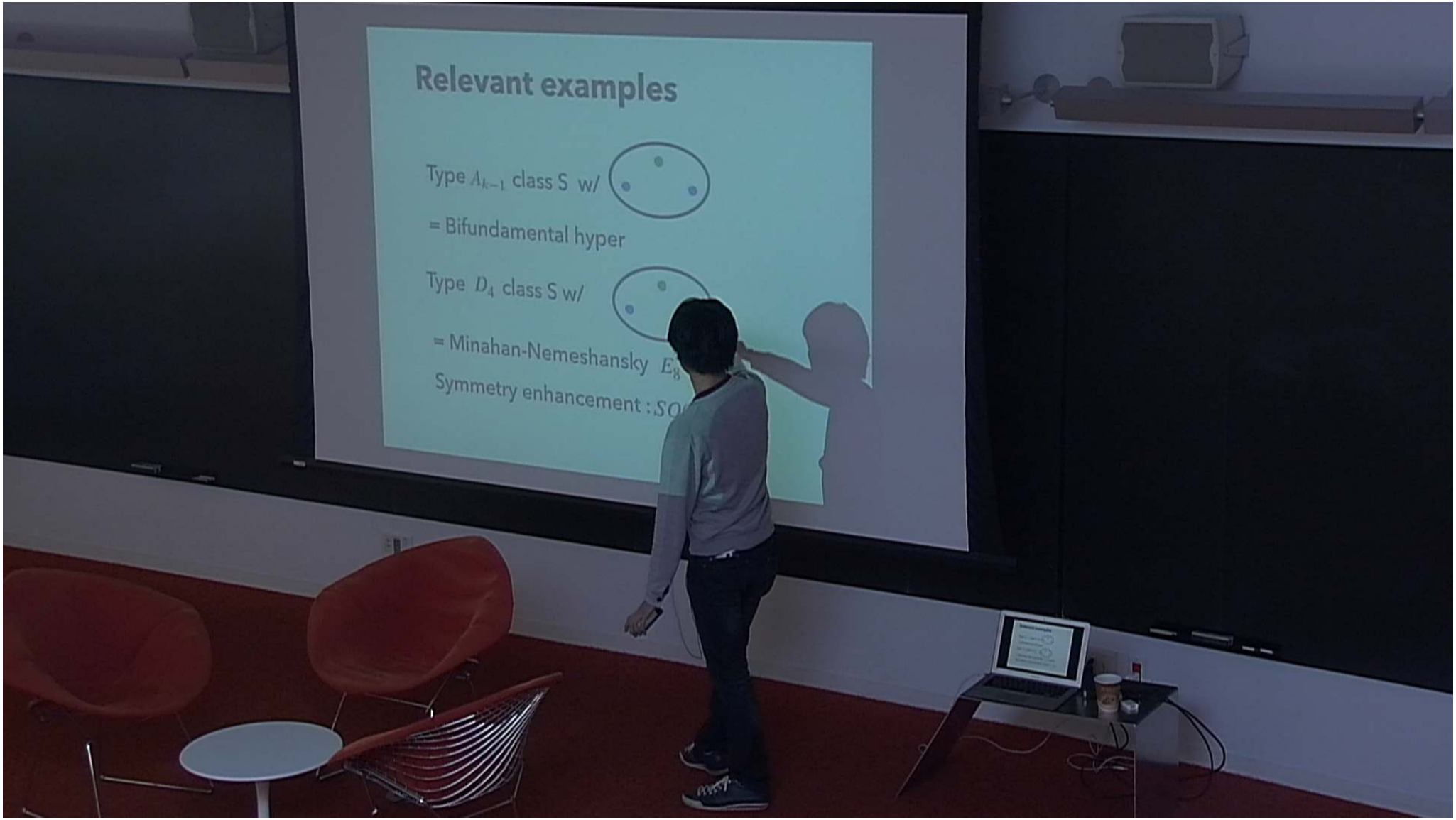
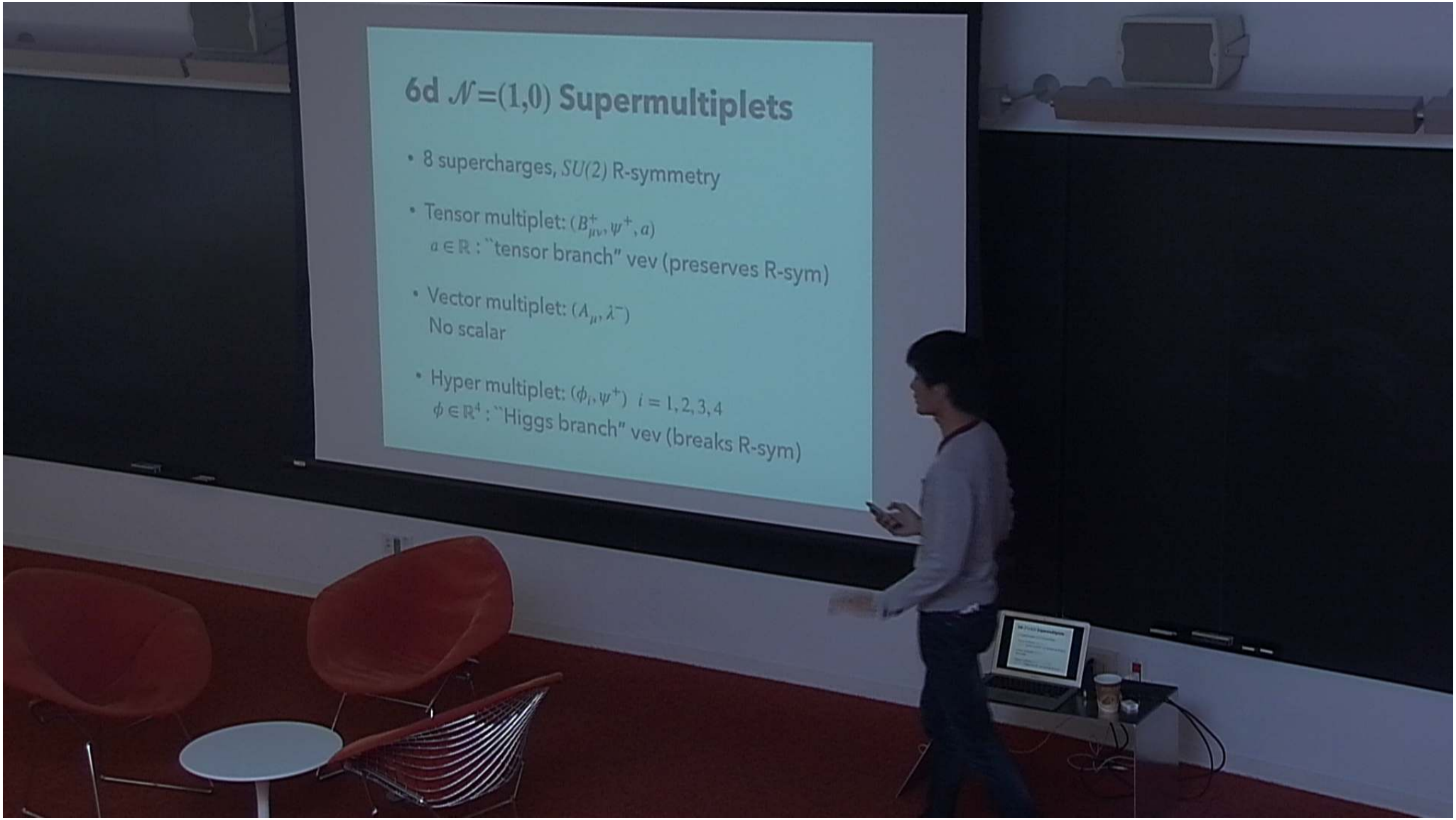
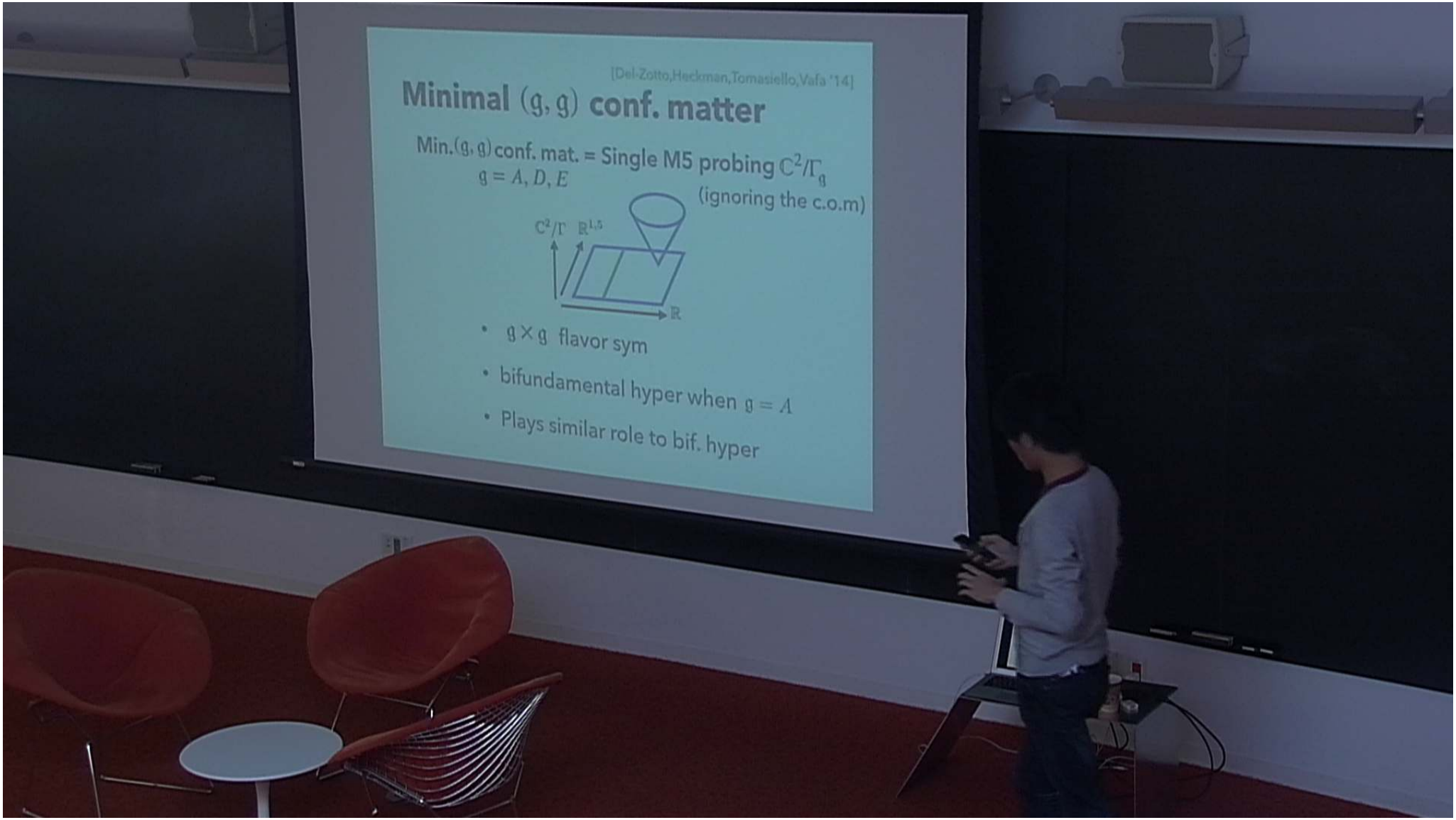
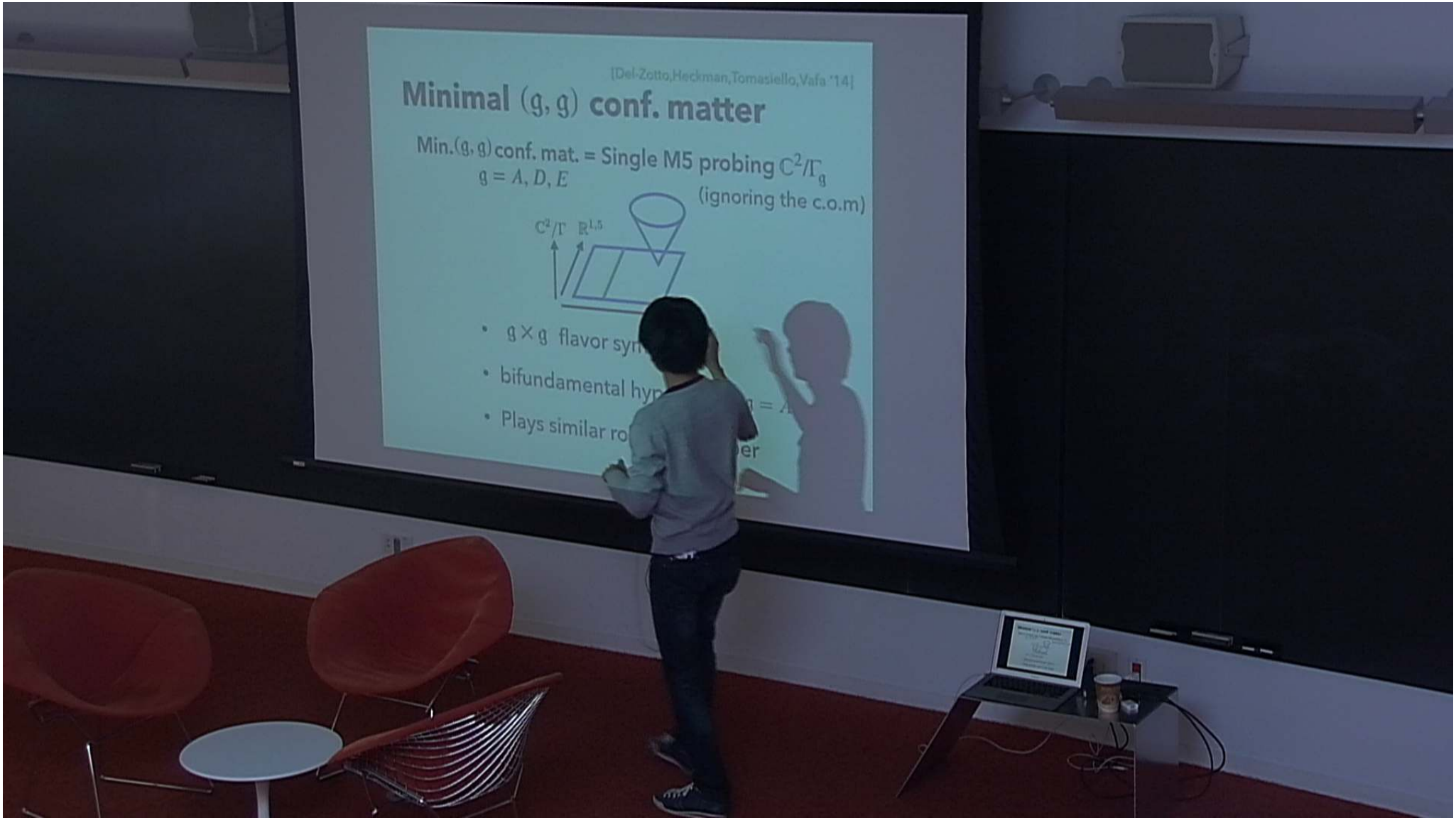

Relevant examples
Type A_{k-1} class S w/
= Bifundamental hyper
Type D_4 class S w/
= Minahan-Nemeshansky E_8
Symmetry enhancement : SO

6d Conformal Matter


6d $\mathcal{N}=(1,0)$ Supermultiplets
• 8 supercharges, $SU(2)$ R-symmetry
• Tensor multiplet: $(B^+_{\mu\nu}, \psi^+, a)$
$a \in \mathbb{R}$: "tensor branch" vev (preserves R-sym)
• Vector multiplet: (A_μ, λ^-)
No scalar
• Hyper multiplet: (ϕ_i, ψ^+) $i = 1,2,3,4$
$\phi \in \mathbb{R}^4$: "Higgs branch" vev (breaks R-sym)


[Del-Zotto,Heckman,Tomasiello,Vafa '14]
Minimal $(\mathfrak{g},\mathfrak{g})$ conf. matter
Min.$(\mathfrak{g},\mathfrak{g})$ conf. mat. = Single M5 probing $\mathbb{C}^2/\Gamma_{\mathfrak{g}}$
$\mathfrak{g} = A, D, E$
(ignoring the c.o.m)
$\mathbb{C}^2/\Gamma$
$\mathbb{R}^{1,5}$
$\mathbb{R}$
• $\mathfrak{g}\times\mathfrak{g}$ flavor sym
• bifundamental hyper when $\mathfrak{g} = A$
• Plays similar role to bif. hyper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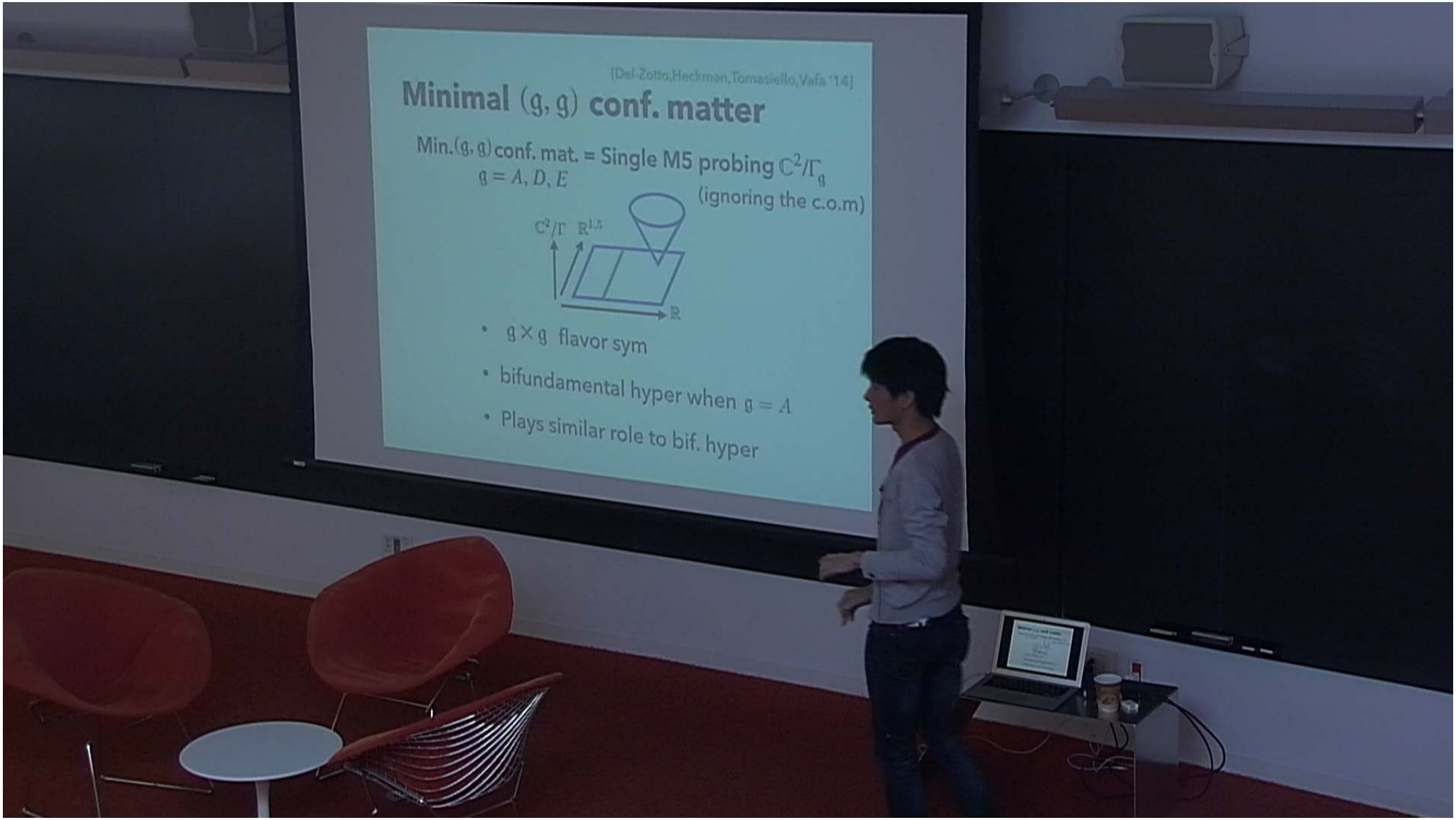
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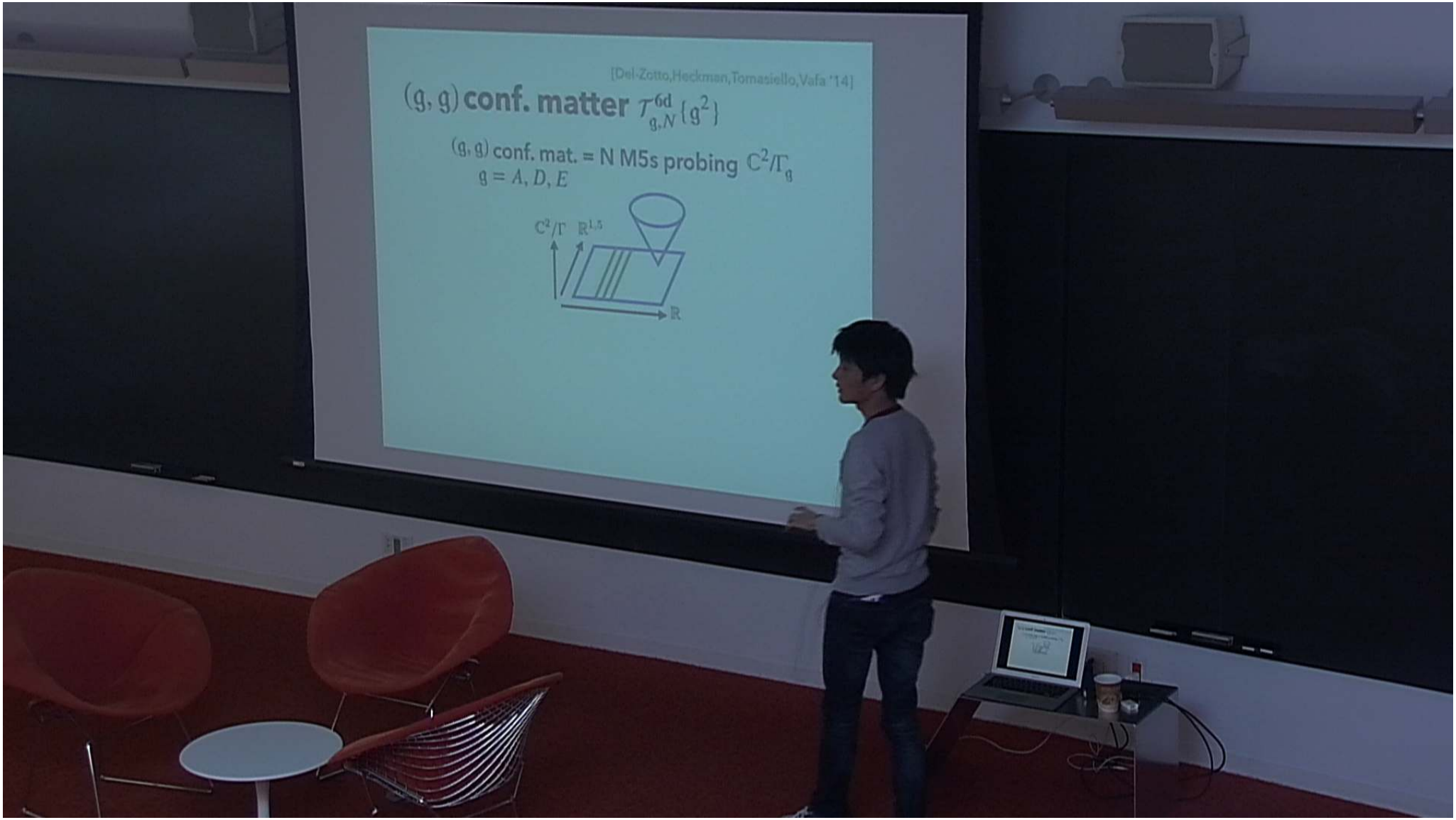
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$(\mathfrak{g},\mathfrak{g})$ conf. matter $\mathcal{T}^{6d}_{\mathfrak{g},N}\{\mathfrak{g}^2\}$
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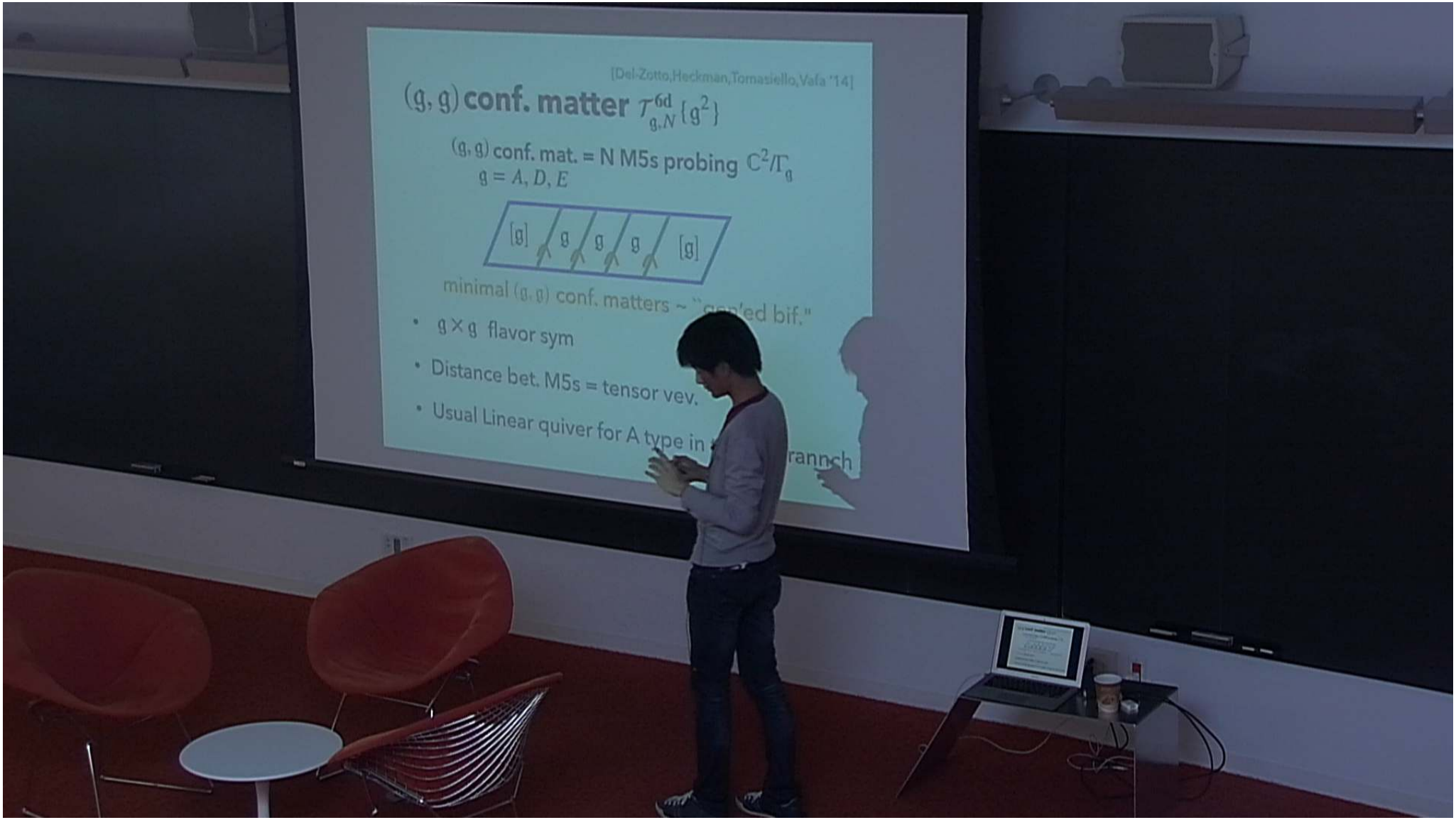
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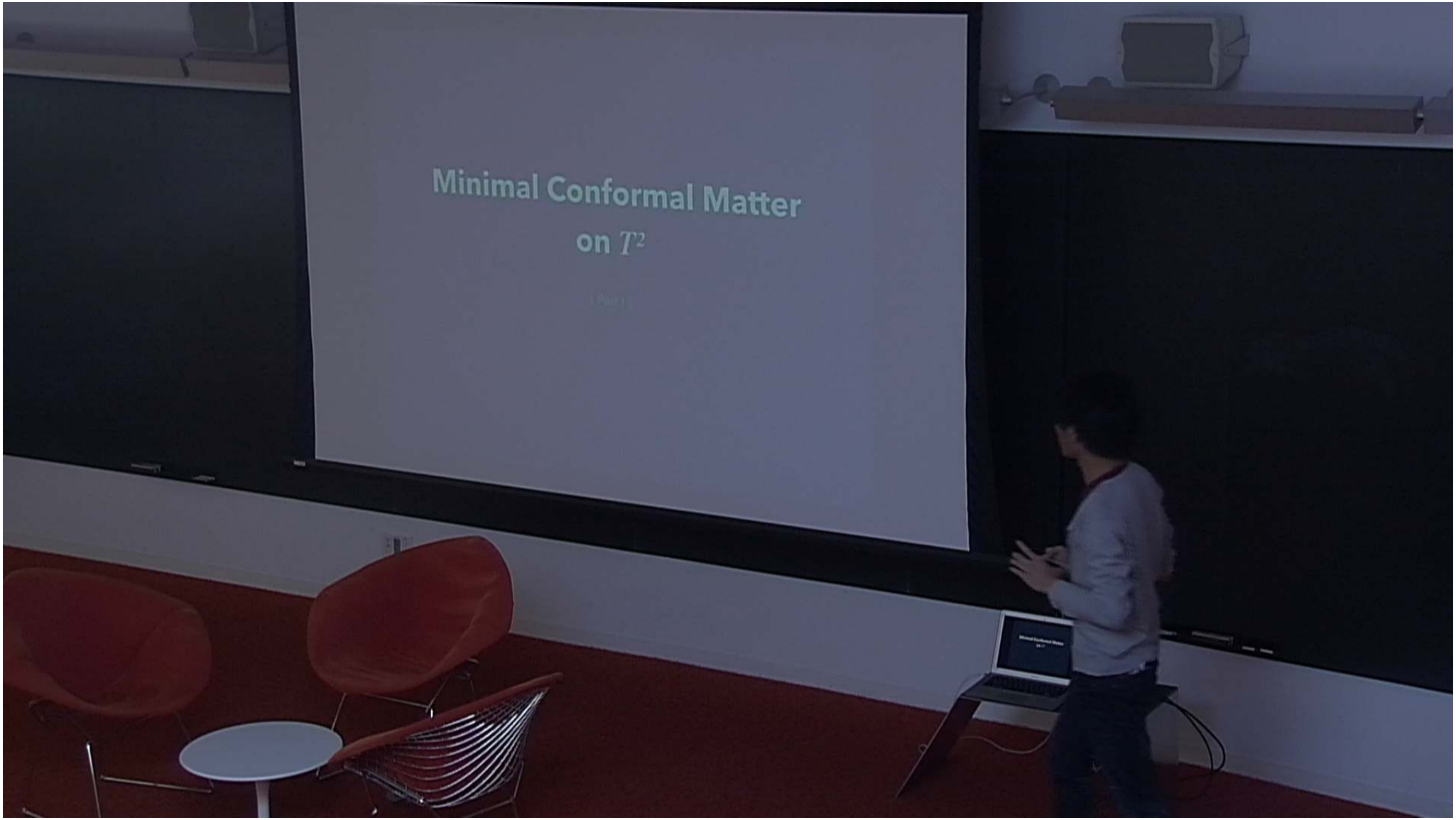
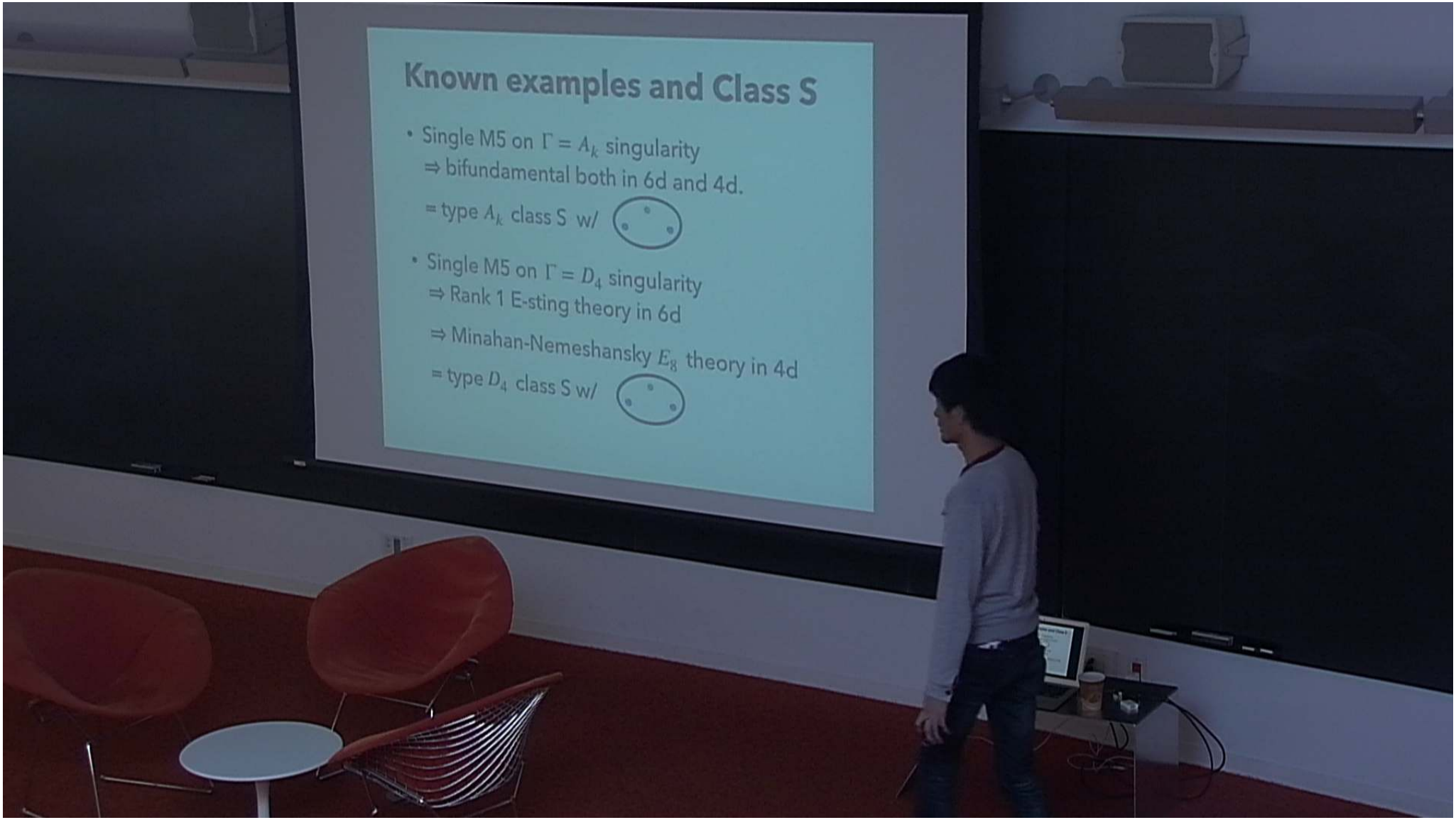
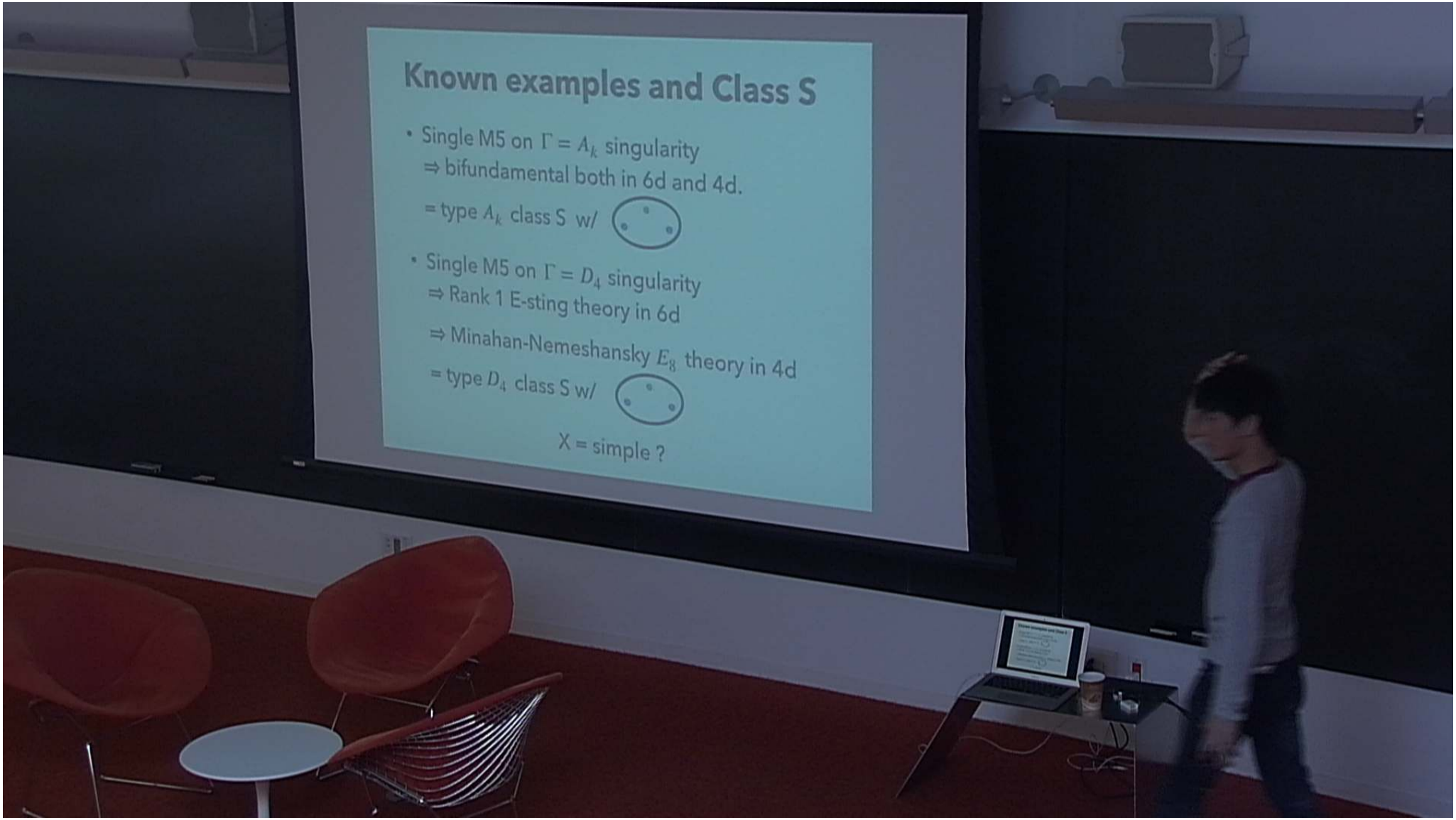
[g] g g g [g]
minimal $(\mathfrak{g},\mathfrak{g})$ conf. matters ~ "
ed bif."
$\mathfrak{g}\times\mathfrak{g}$ flavor sym
Distance bet. M5s = tensor vev.
Usual Linear quiver for A type in
rannch


Minimal Conformal Matter
on T^2


Known examples and Class S
• Single M5 on $\Gamma = A_k$ singularity
⇒ bifundamental both in 6d and 4d.
= type A_k class S w/
• Single M5 on $\Gamma = D_4$ singularity
⇒ Rank 1 E-sting theory in 6d
⇒ Minahan-Nemeshansky E_8 theory in 4d
= type D_4 class S w/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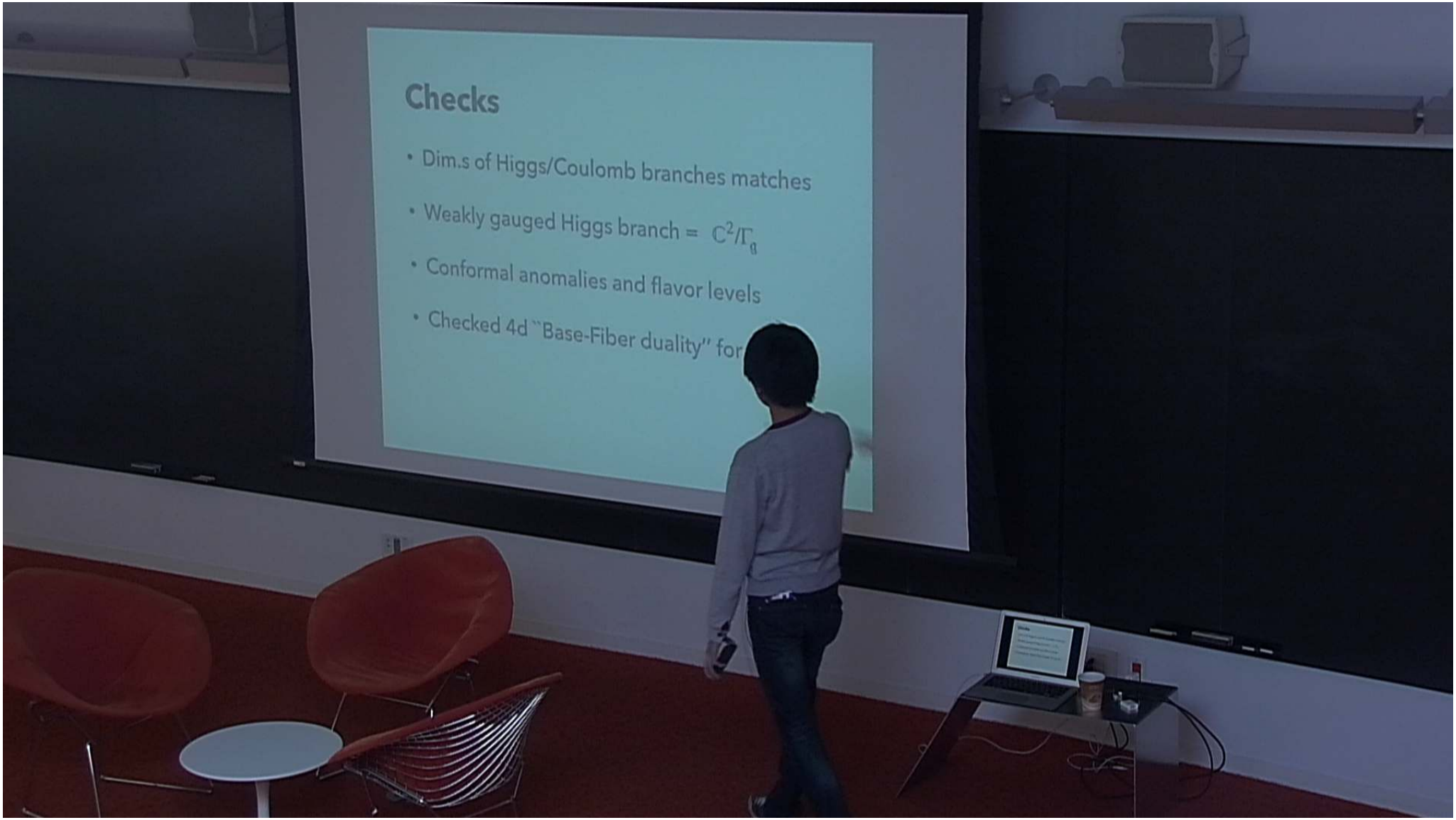
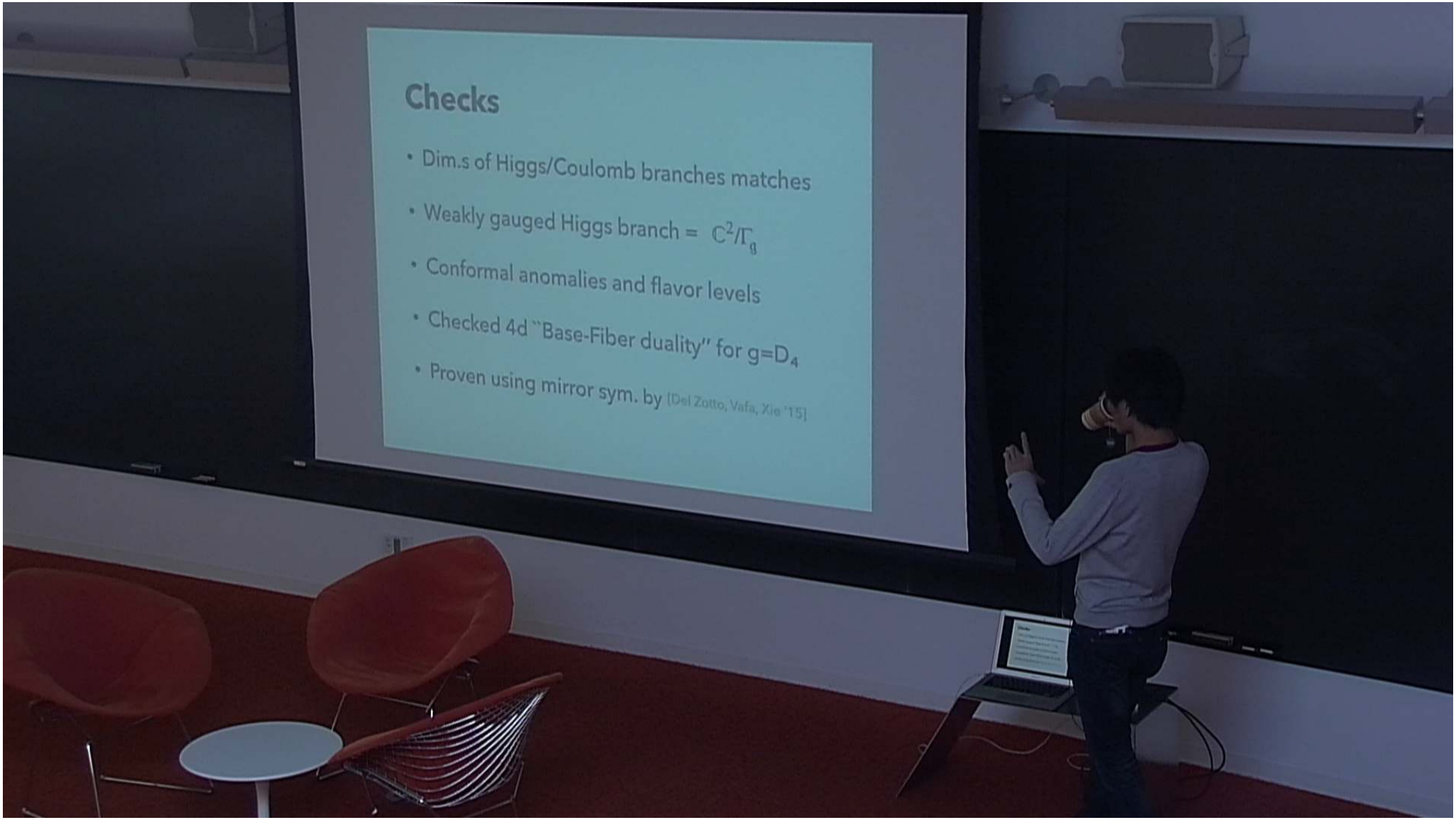
X = simple ?


Checks
• Dim.s of Higgs/Coulomb branches matches
• Weakly gauged Higgs branch = $\mathbb{C}^2/\Gamma_g$
• Conformal anomalies and flavor levels
• Checked 4d "Base-Fiber duality" for


Checks
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• Weakly gauged Higgs branch = $\mathbb{C}^2/\Gamma_g$
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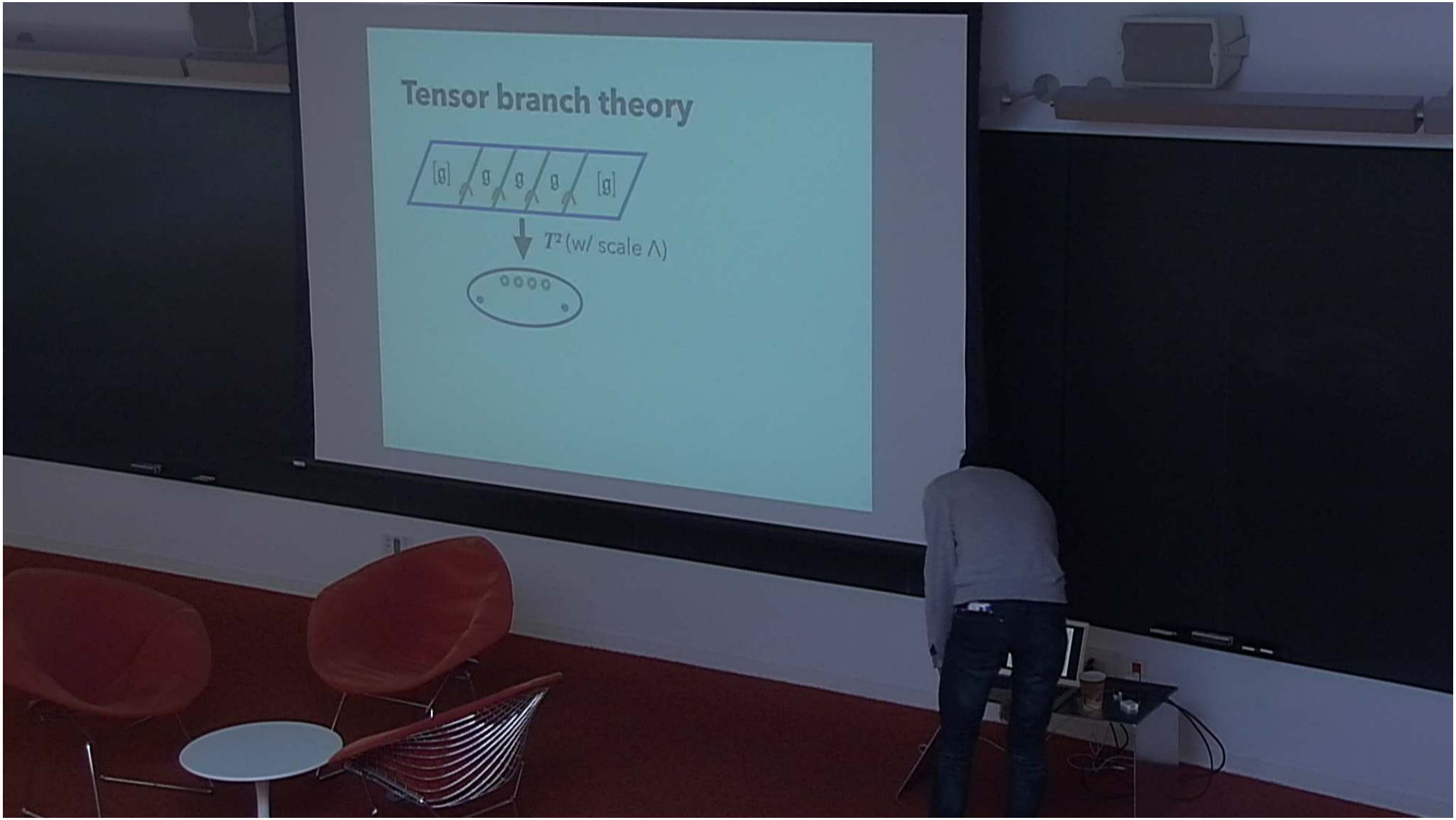
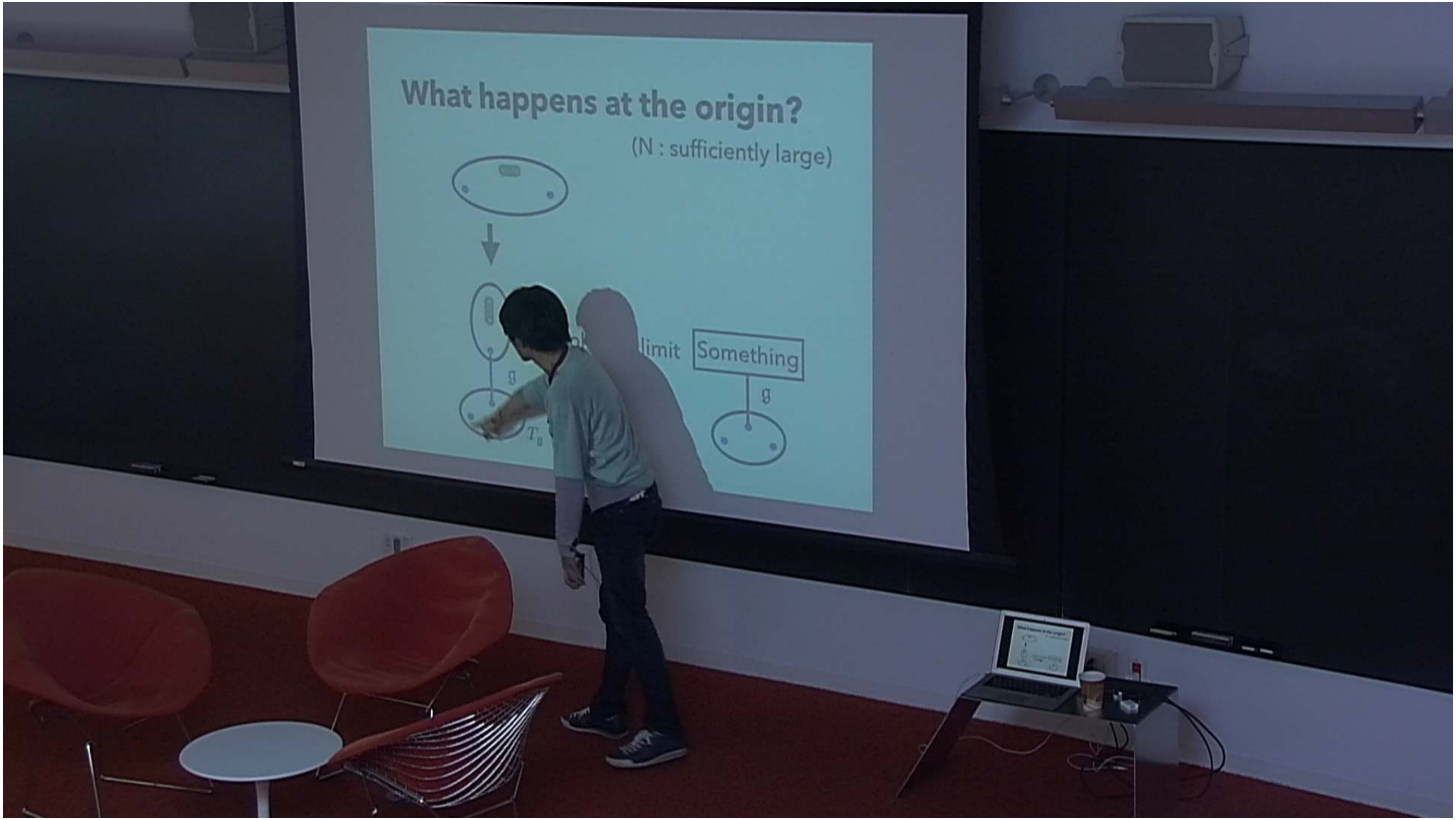
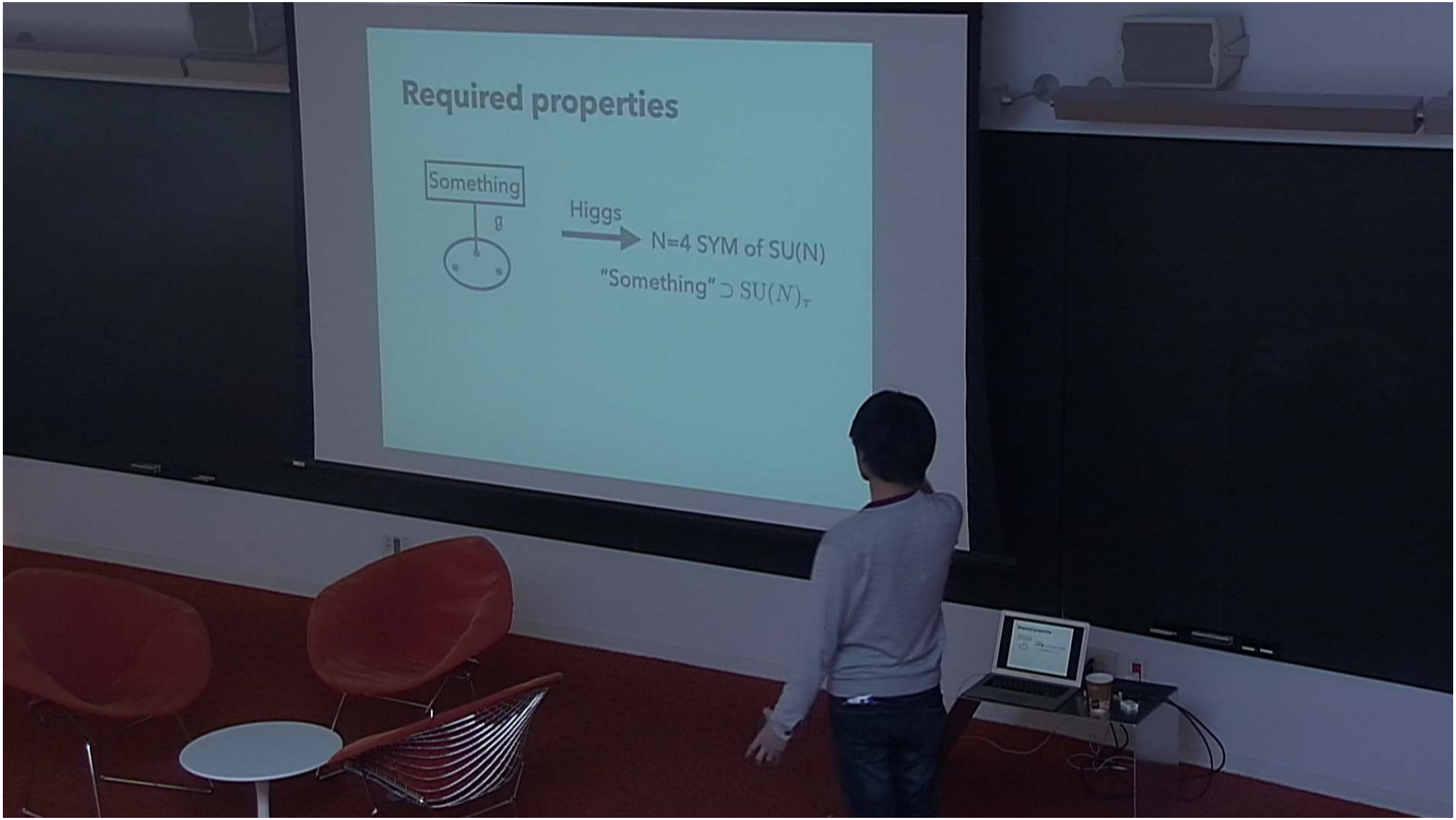
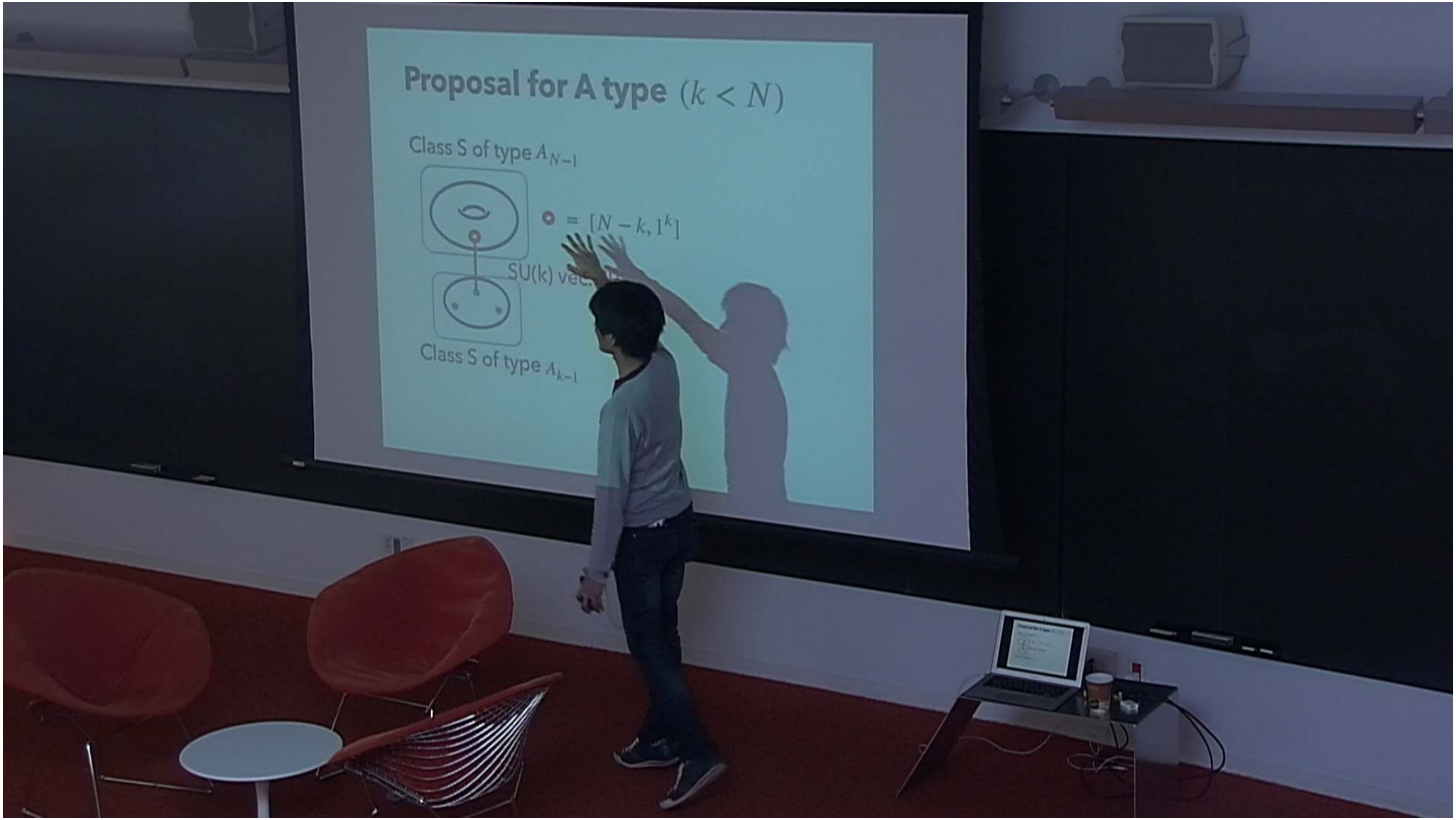
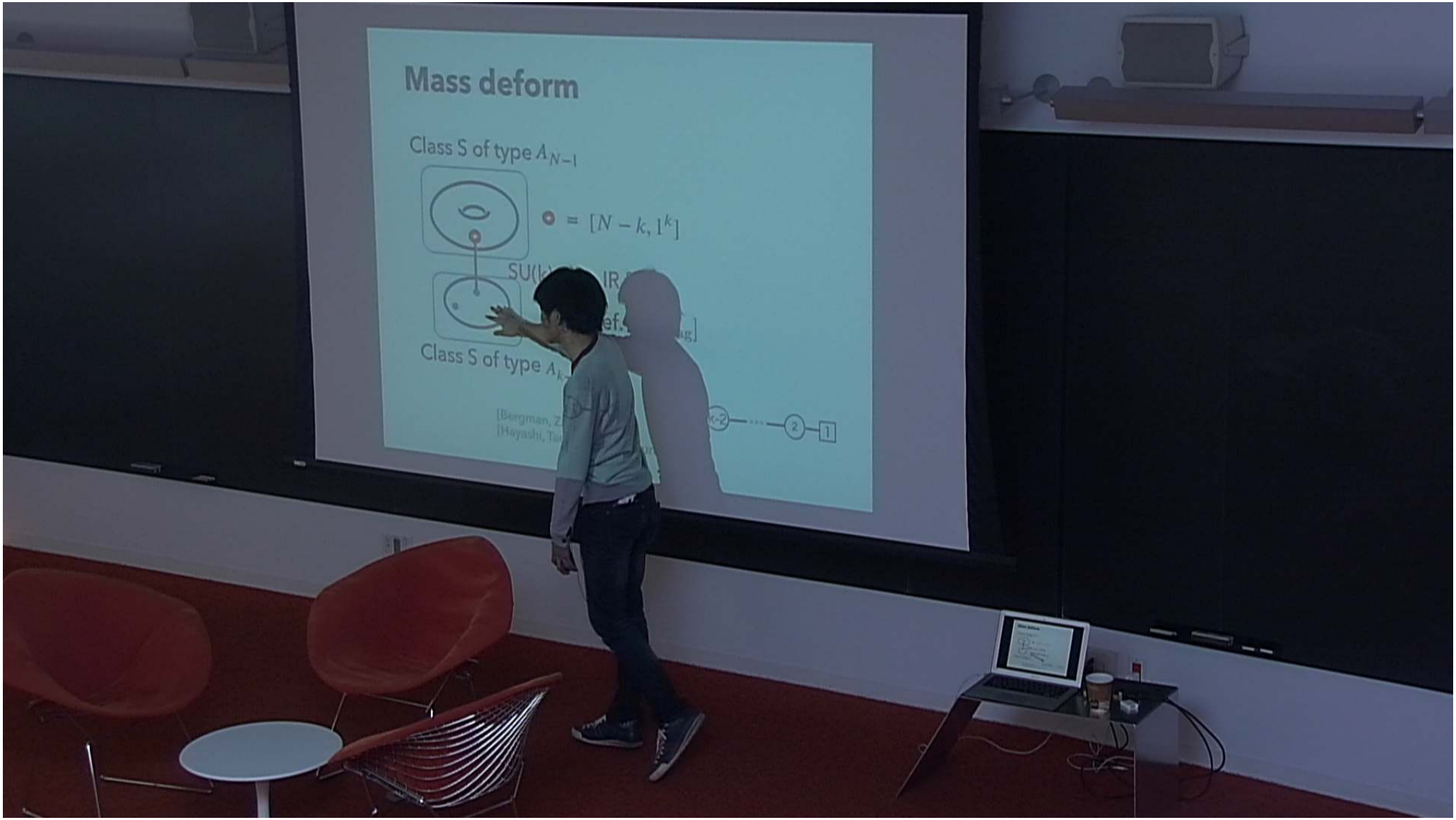
• Checked 4d "Base-Fiber duality" for g=D_4
• Proven using mirror sym. by [Del Zotto, Vafa, Xie '15]

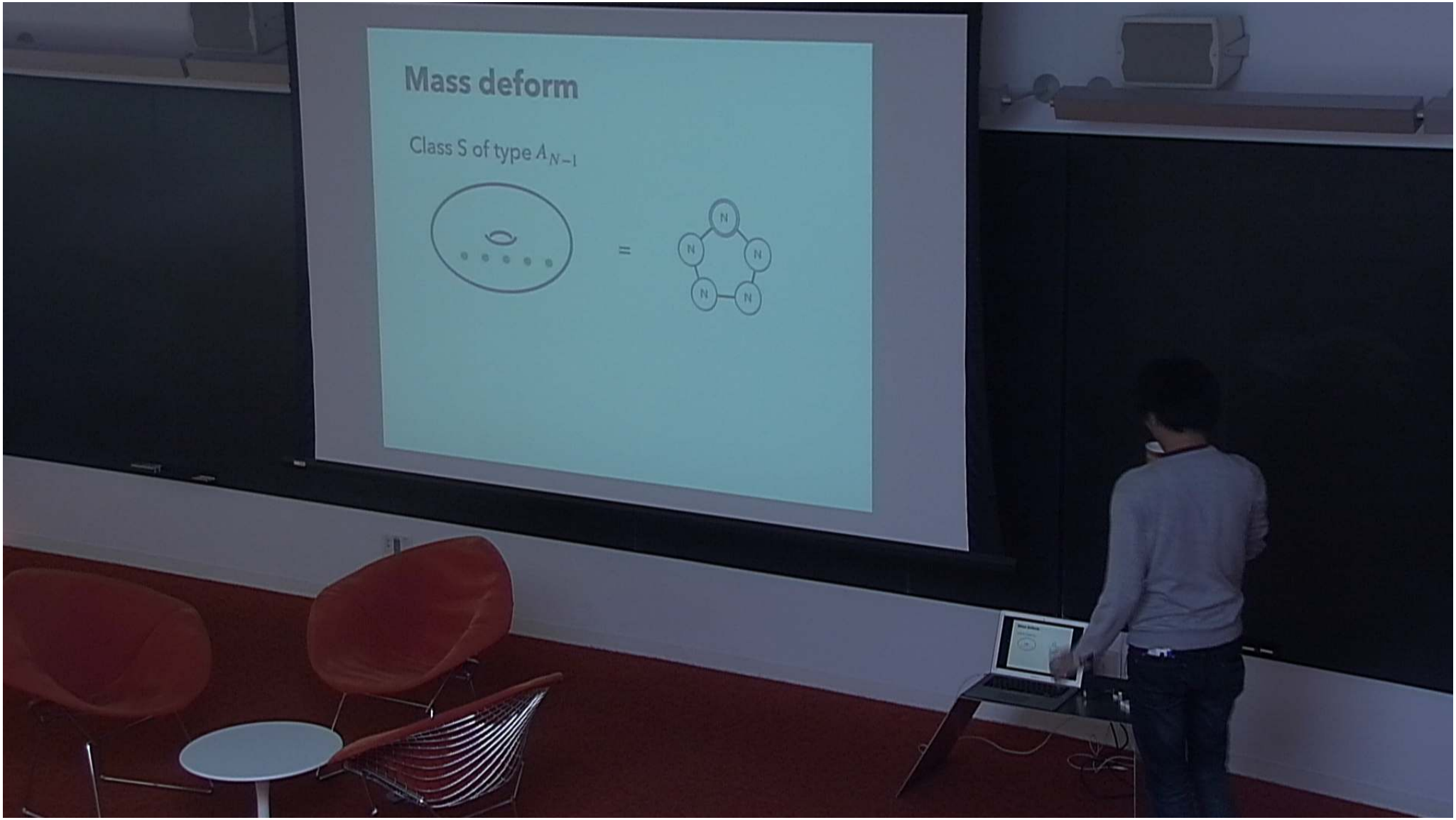

Tensor branch theory
[g]
g
g
g
[g]
T^2 (w/ scale Λ)

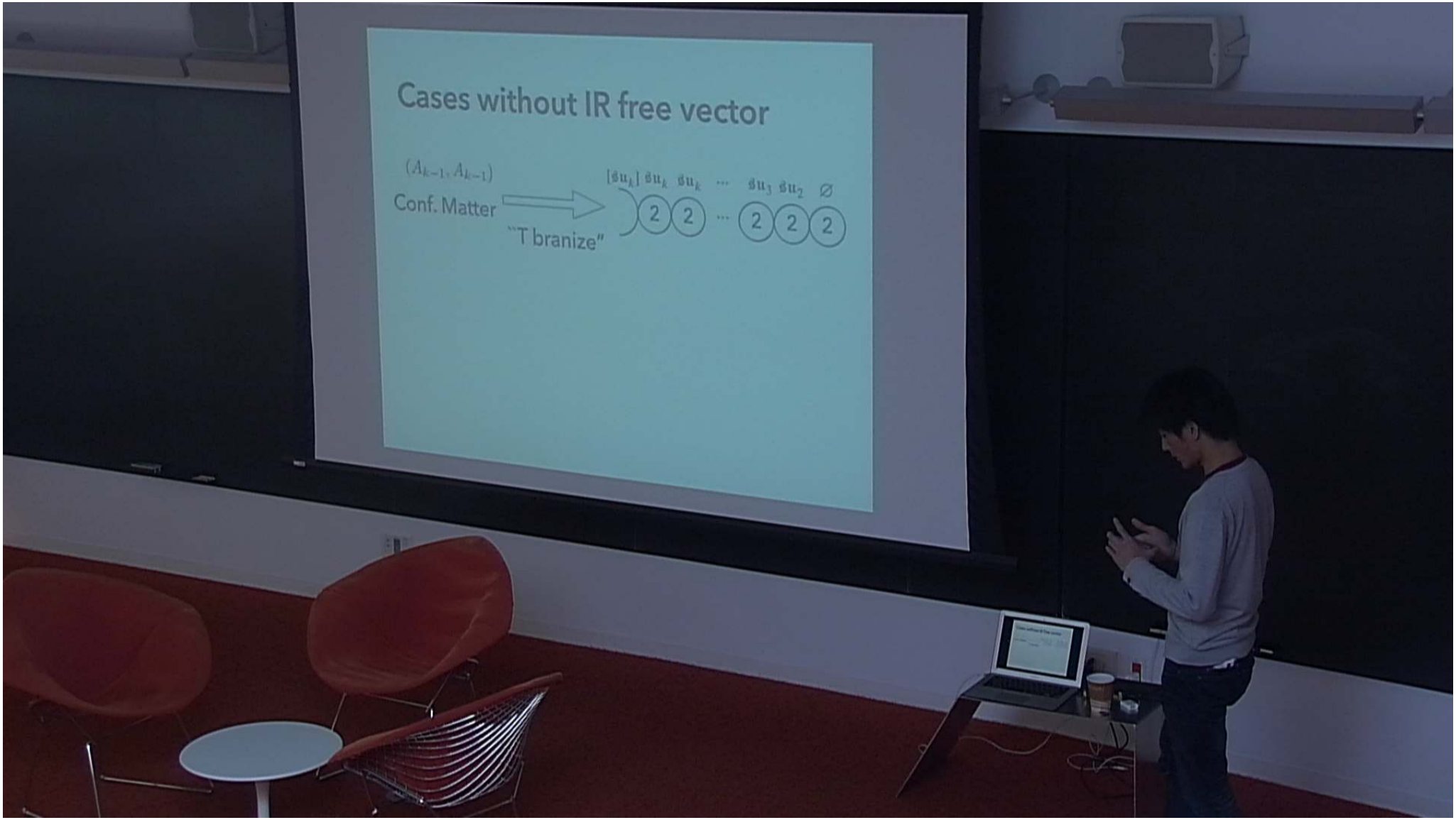

What happens at the origin?
(N : sufficiently large)
limit
Something

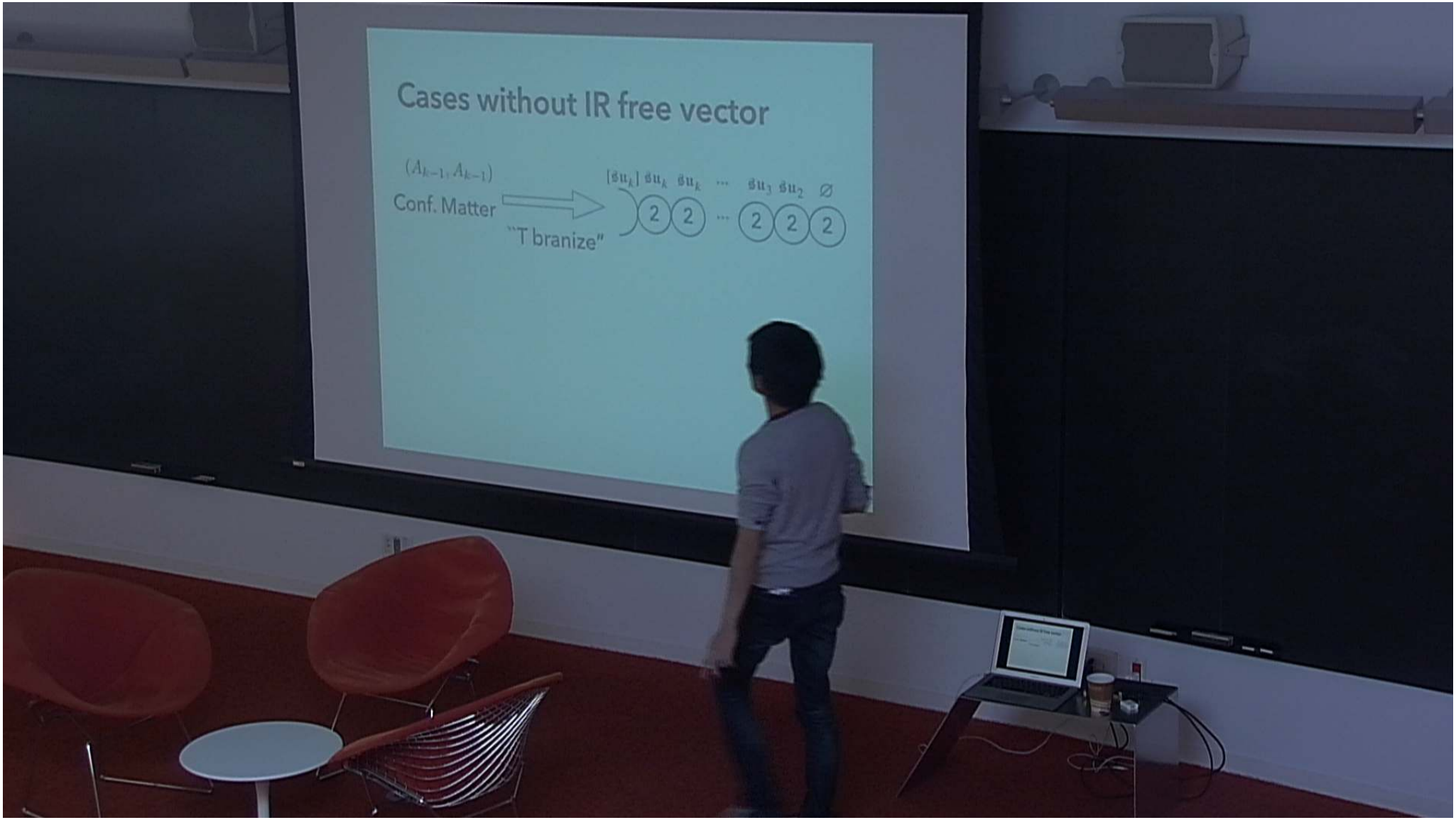

Required properties
Something
g
Higgs
N=4 SYM of SU(N)
"Something" ⊃ SU(N)τ


Proposal for A type $(k < N)$
Class S of type A_{N-1}
$= [N-k, 1^k]$
SU(k) ve
Class S of type A_{k-1}


Mass deform
Class S of type A_{N-1}
$= [N-k, 1^k]$
Class S of type A_{k-1}
[Bergman, Z
[Hayashi, Ta
k-2
2
1


Mass deform
Class S of type A_{N-1}
=
N
N
N
N
N


Cases without IR free vector
(A_{k-1}, A_{k-1})
Conf. Matter
"T branize"
$[\mathfrak{su}_k]$ $\mathfrak{su}_k$ $\mathfrak{su}_k$ ⋯ $\mathfrak{su}_3$ $\mathfrak{su}_2$ ∅
2 2 ⋯ 2 2 2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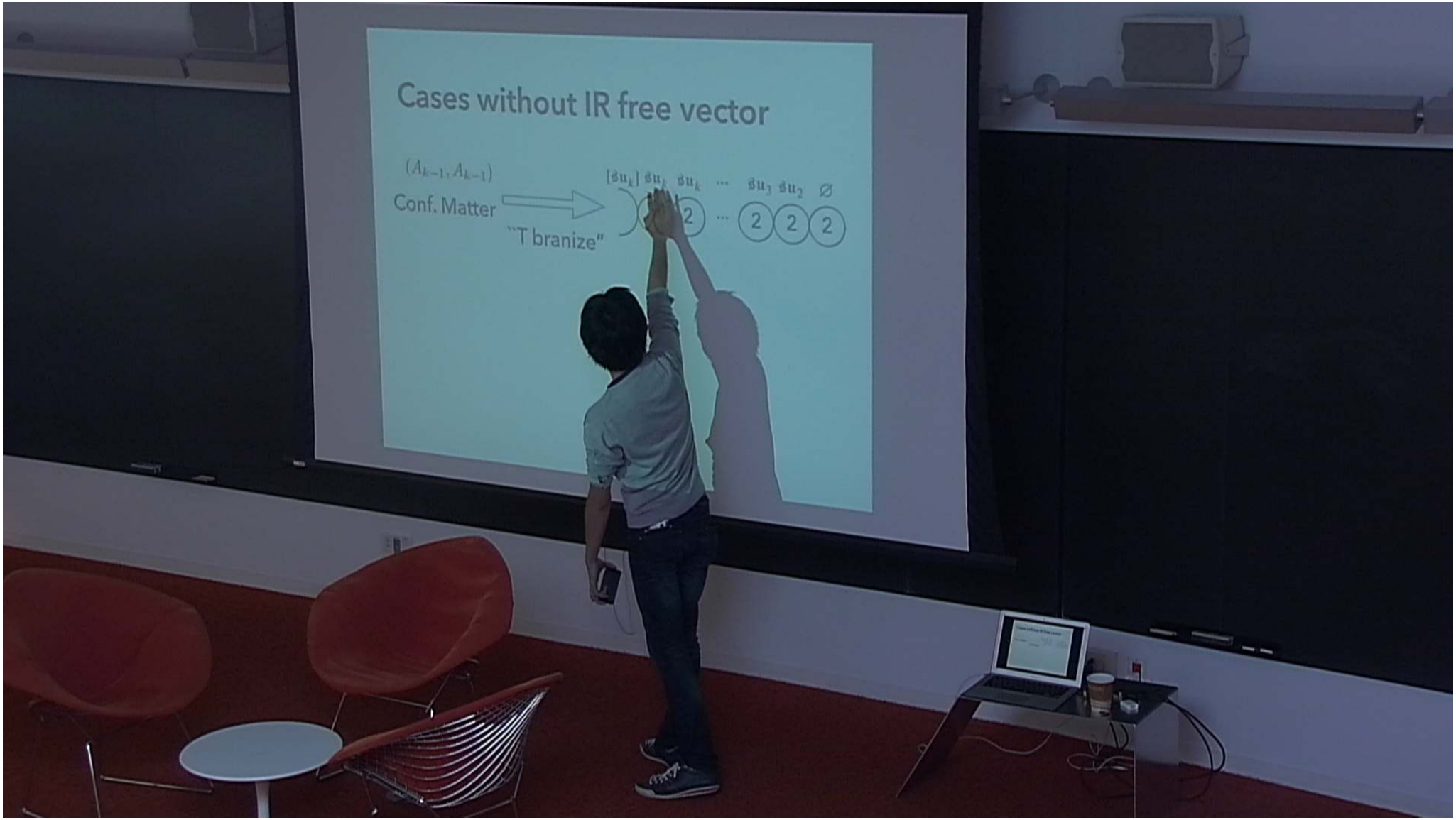
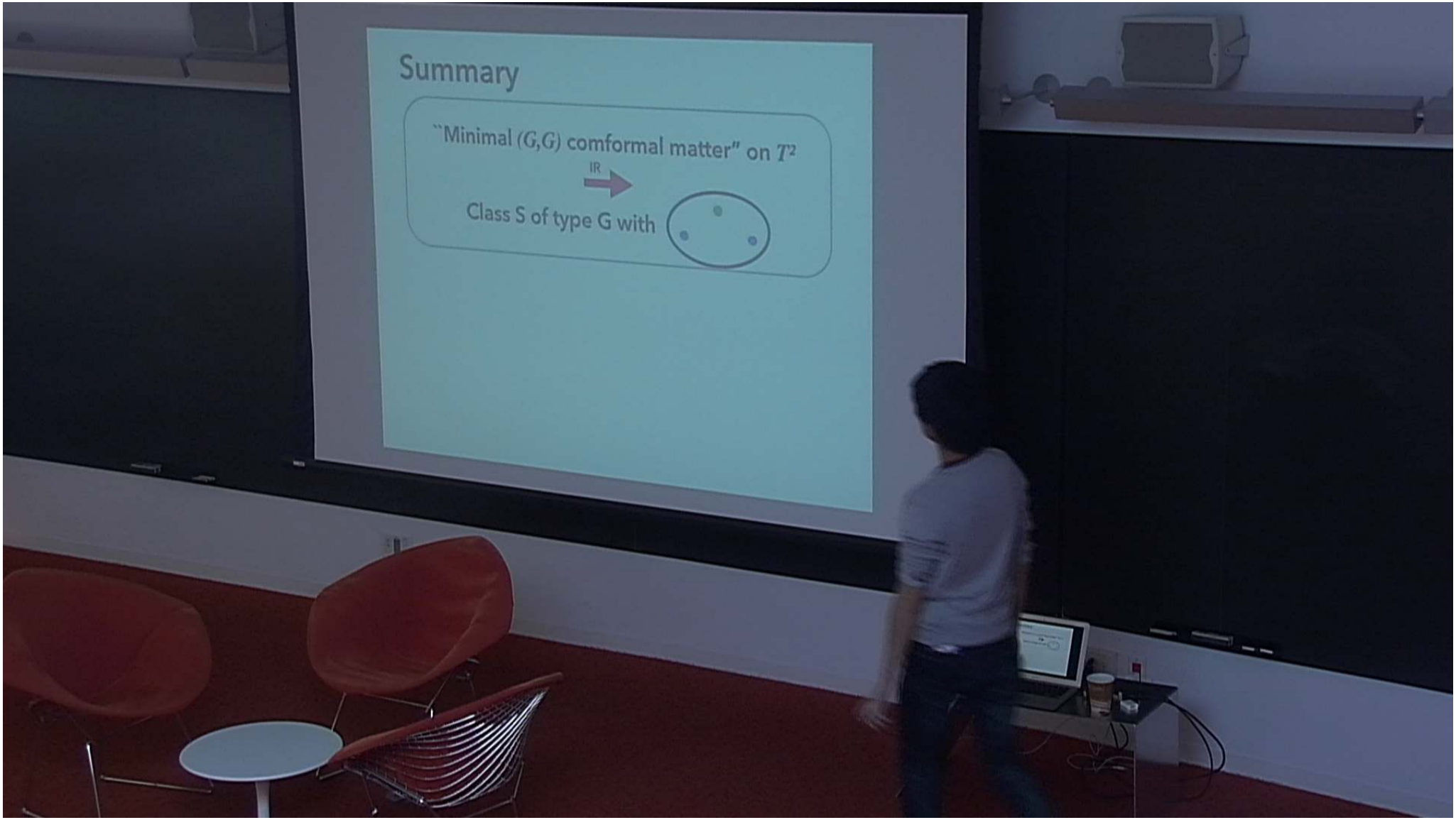
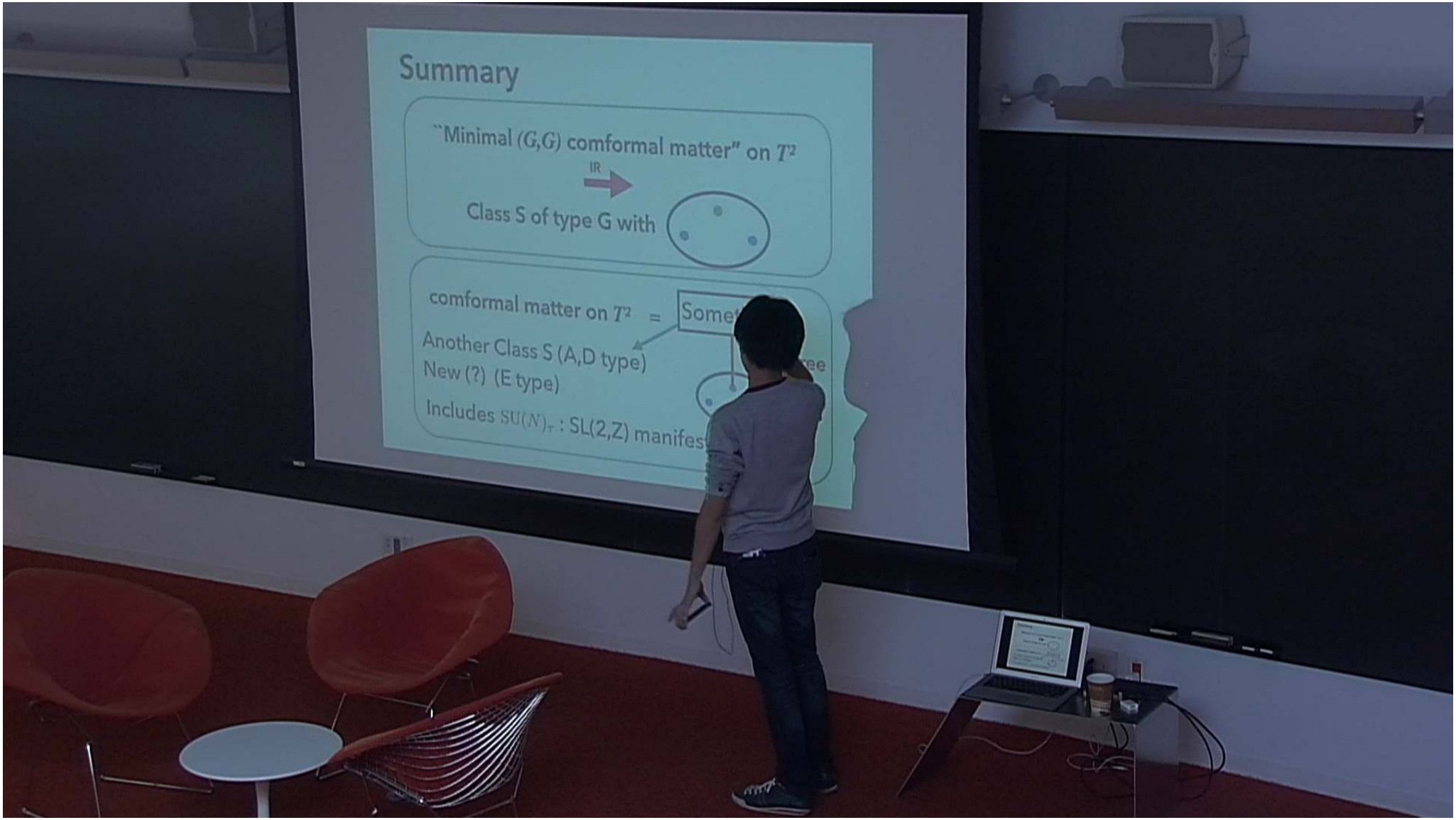
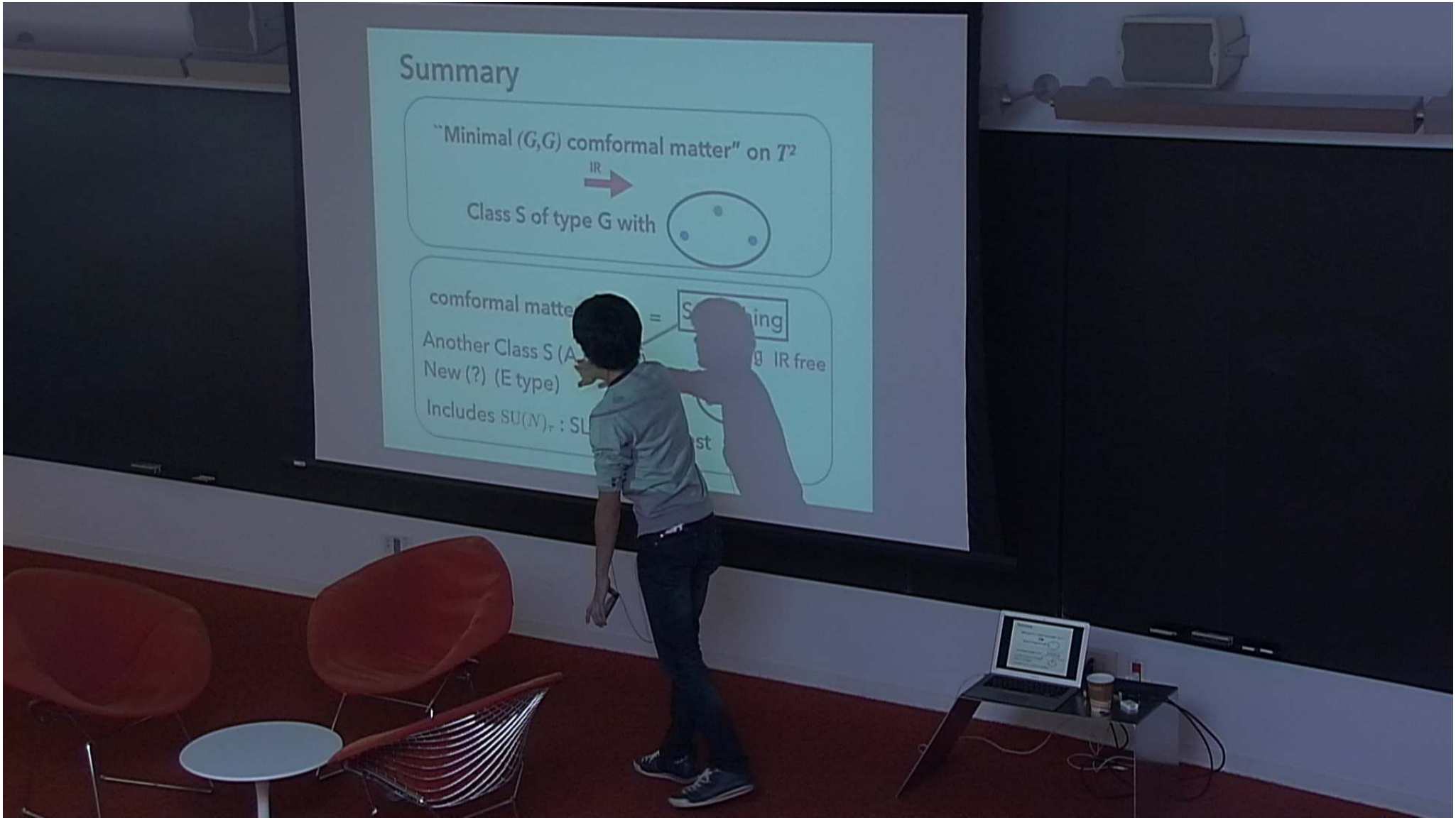
Conf. Matter
"T branize"
$[\mathfrak{su}_k]\ \mathfrak{su}_k\ \mathfrak{su}_k\ \cdots\ \mathfrak{su}_3\ \mathfrak{su}_2\ \varnothing$
2 2 ... 2 2 2


Cases without IR free vector
(A_{k-1}, A_{k-1})
Conf. Matter
"T branize"
$[\mathfrak{su}_k]$ $\mathfrak{su}_k$ $\mathfrak{su}_k$ ⋯ $\mathfrak{su}_3$ $\mathfrak{su}_2$ ∅
2 ⋯ 2 2 2


Summary
``Minimal (G,G) comformal matter'' on T^2
IR
Class S of type G with


Summary
``Minimal (G,G) comformal matter'' on T^2
IR
Class S of type G with
comformal matter on T^2 =
Another Class S (A,D type)
New (?) (E type)
Includes $SU(N)_\tau$: SL(2,Z) manifes


Summary
"Minimal (G,G) comformal matter" on T²
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Class S of type G with
comformal matte
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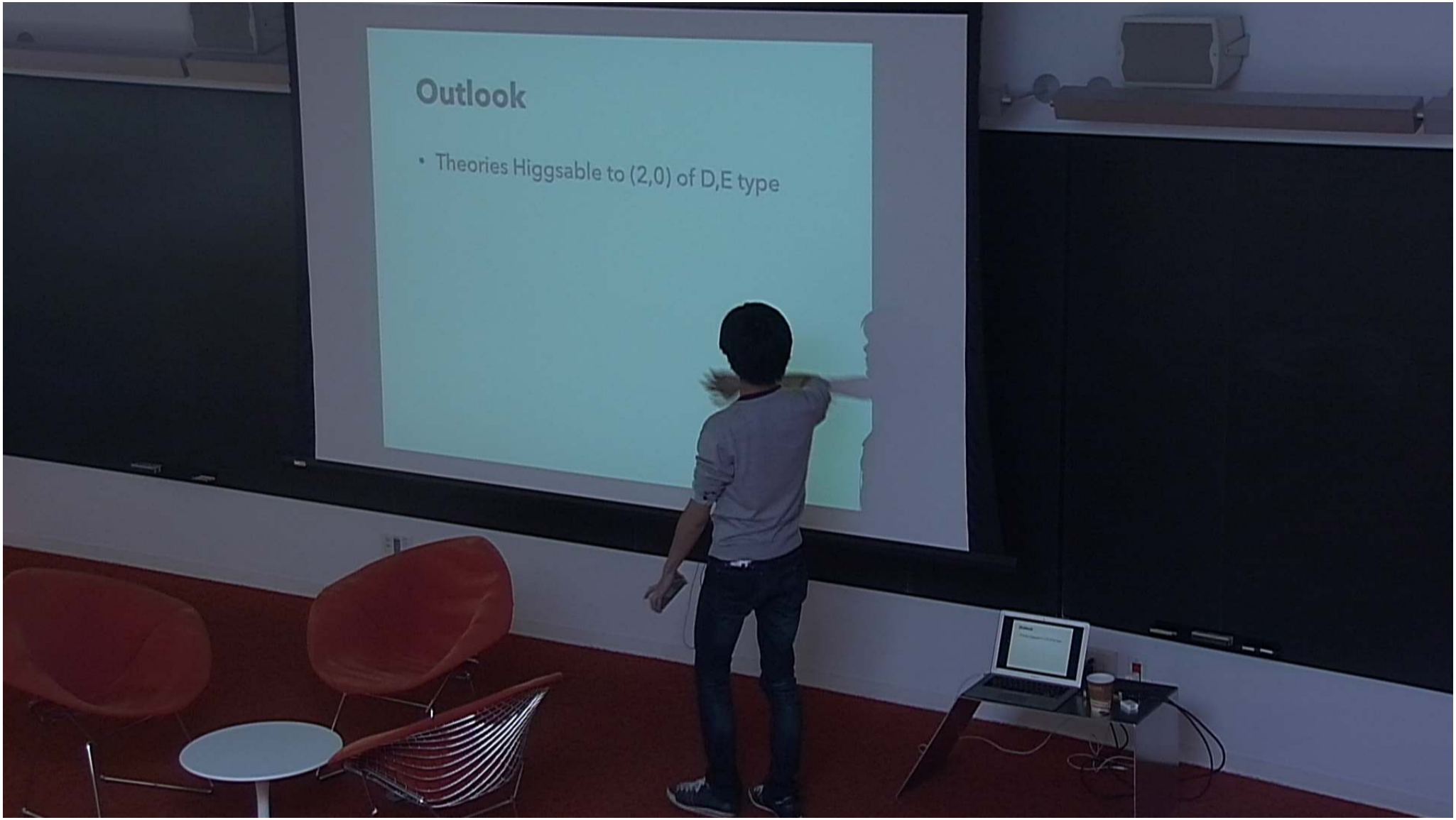
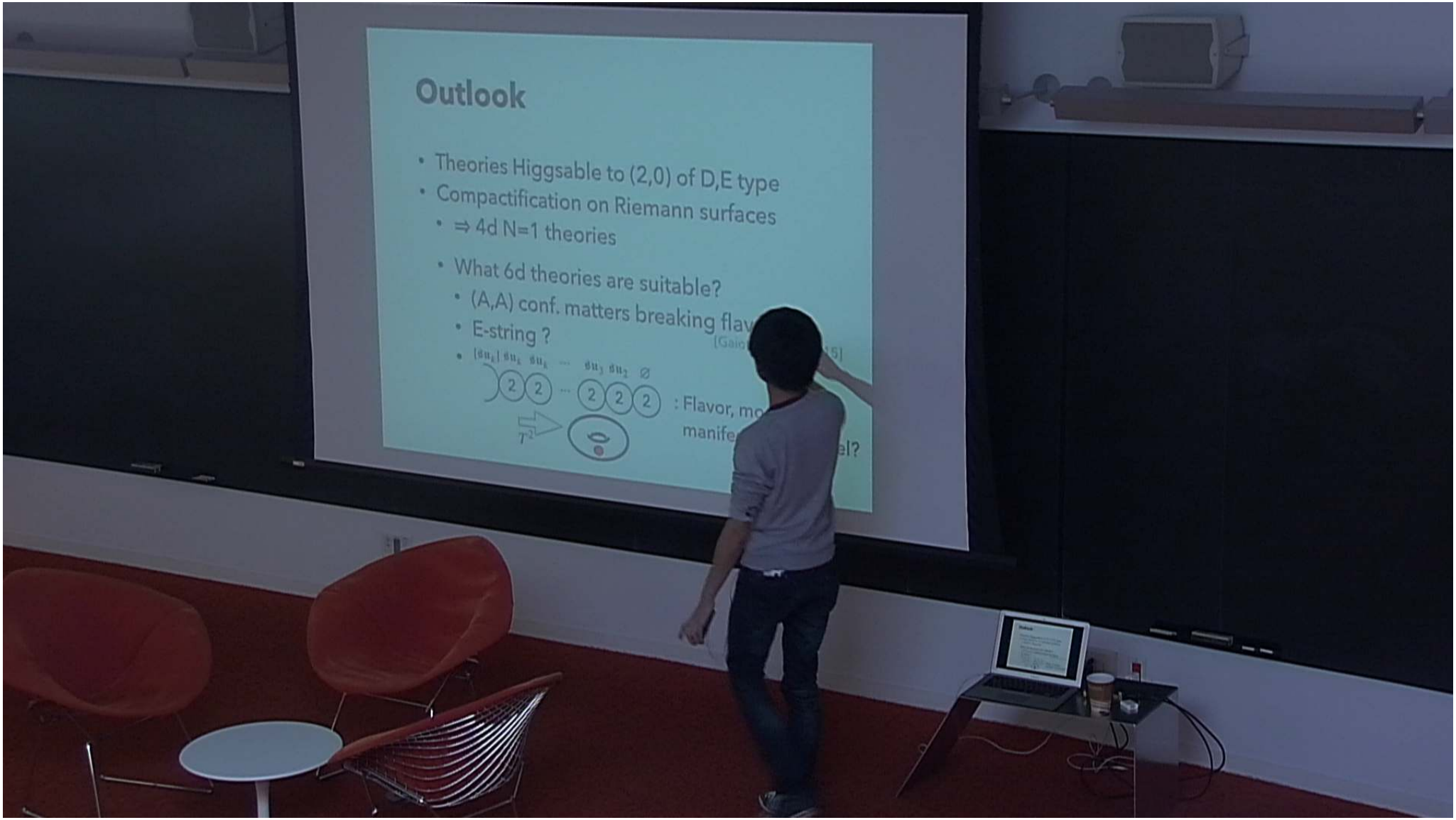
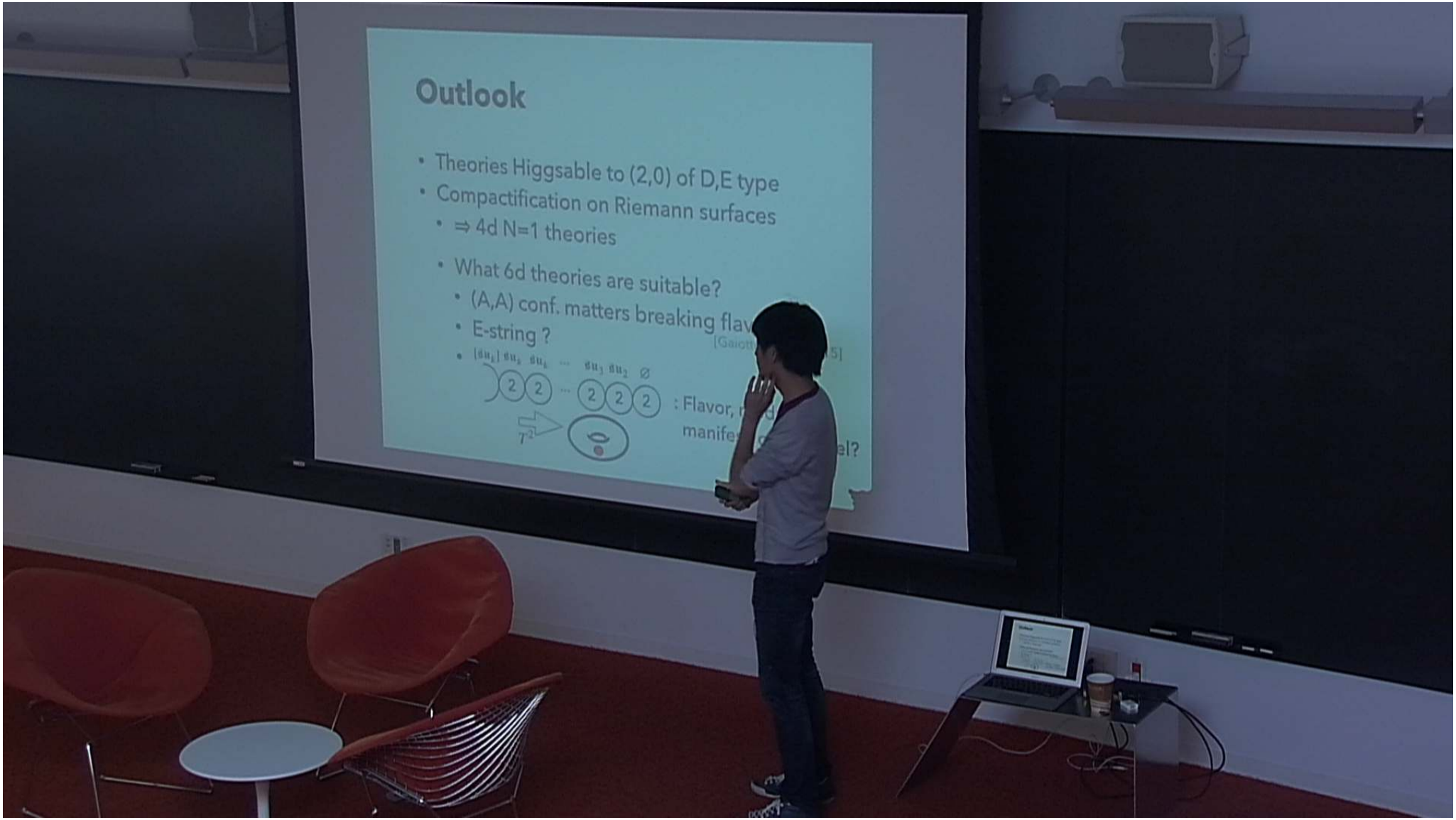

Outlook
• Theories Higgsable to (2,0) of D,E type


Outlook
• Theories Higgsable to (2,0) of D,E type
• Compactification on Riemann surfaces
• ⇒ 4d N=1 theories
• What 6d theories are suitable?
• (A,A) conf. matters breaking flav
• E-string ?
: Flavor, mo
manife
el?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[Gaiotto
5]
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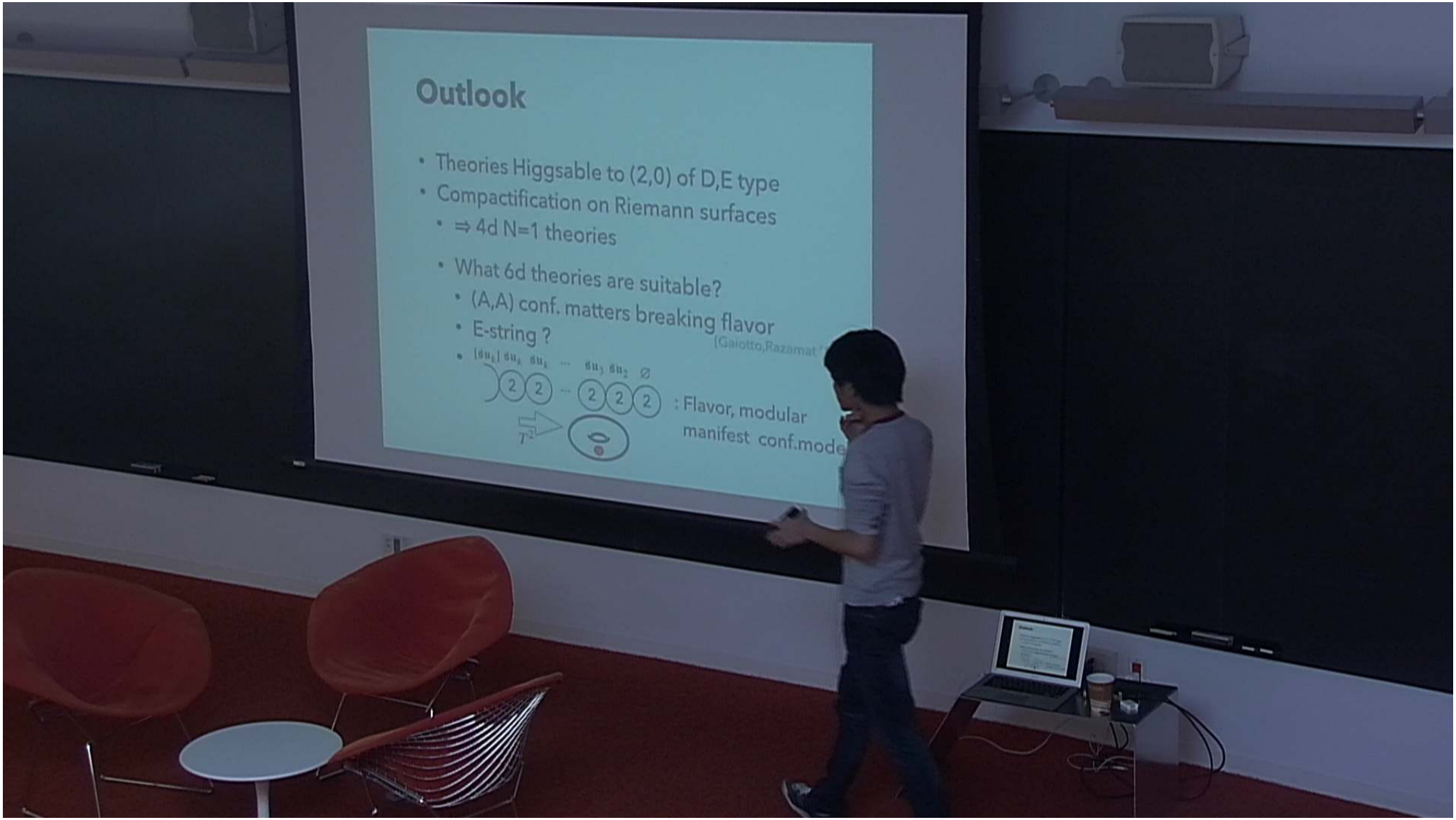
manife
el?


Outlook
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• E-string ?
[Gaiotto,Razamat
: Flavor, modular
manifest conf.mode

Thank you!

Cases without IR free vector
Conf. Matter
"T branize"
Full closing
Higgsable to (2,0)
Tensor mode w.o/ vec. ⇒ 4d SCFT