Title: Modular Berry Connection

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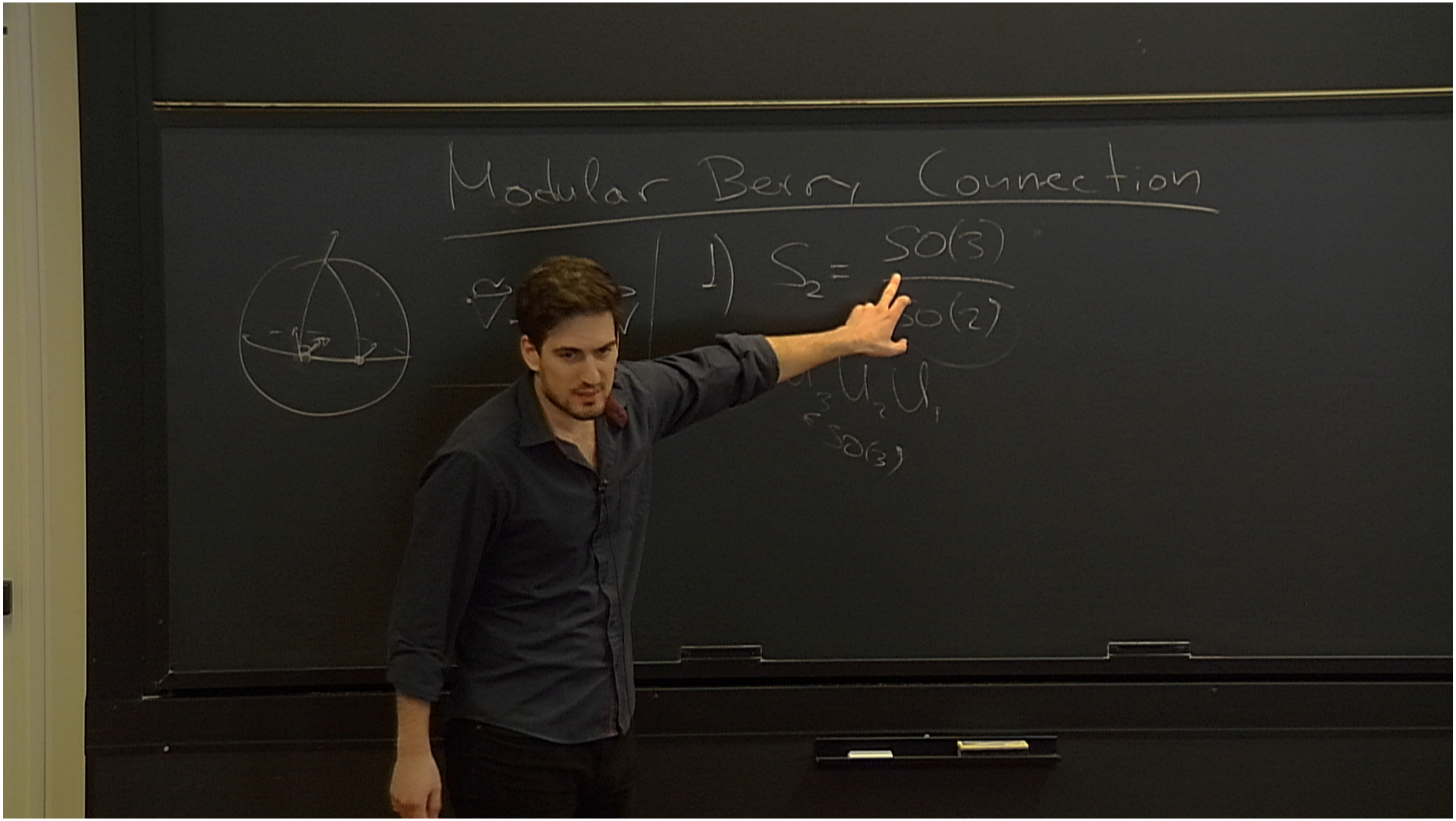
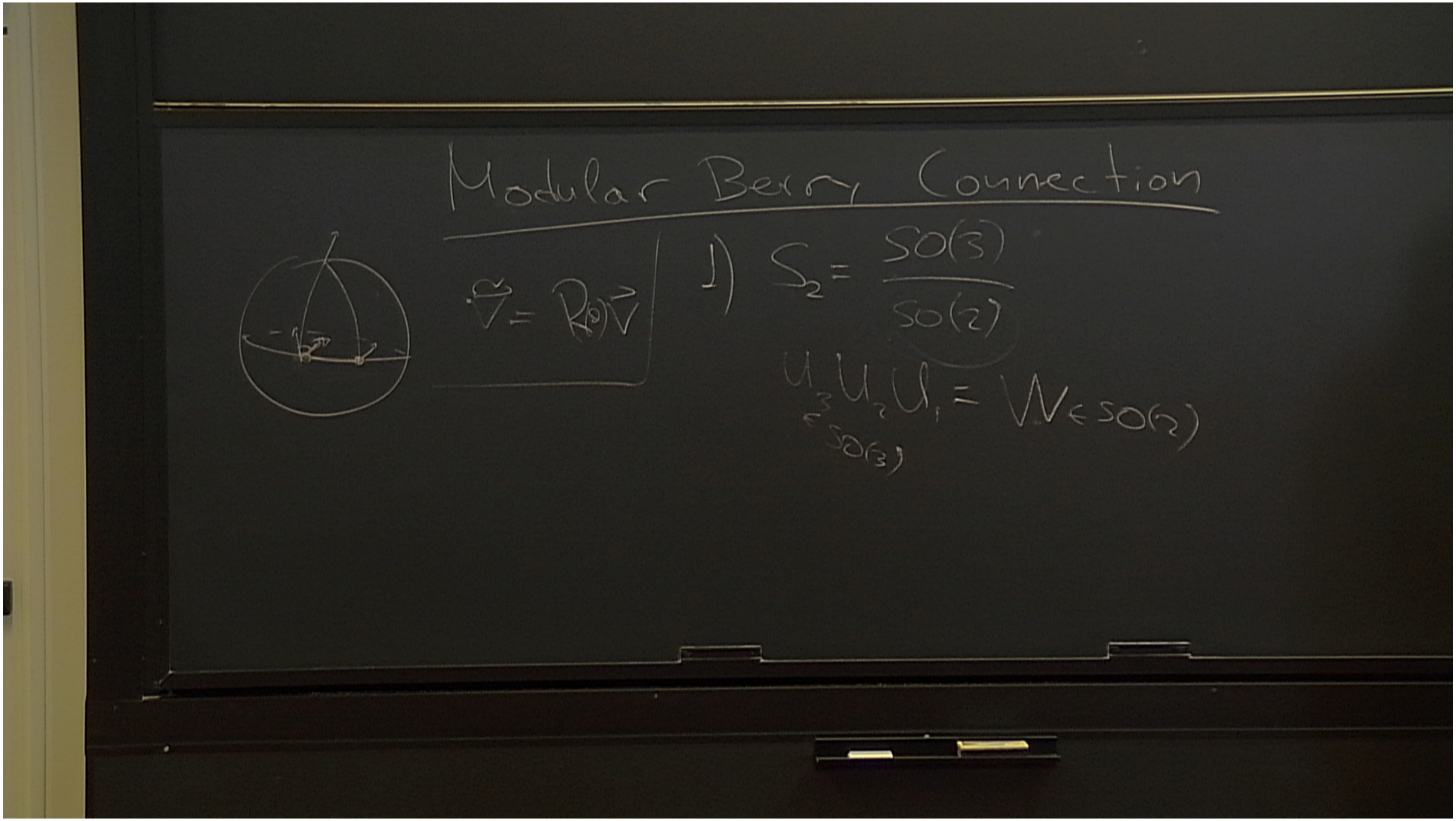
URL: http://pirsa.org/18020082

Abstract: <p>States of a CFT's subregions are consistent with a given global state. For a holographic CFT, this amounts to different entanglement wedges being patches of the same geometry. What relations between them make this possible?</p>

<p> </p>

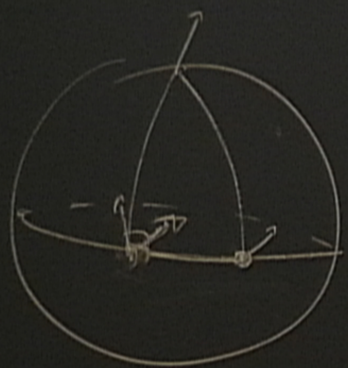
<p>I will propose a Berry experiment to study this question. Berry introduced a connection to describe transformations induced by adiabatically varying Hamiltonians. I will introduce a connection to study how the zero modes of a modular Hamiltonian are affected by varying the CFT subregion that supplies it. I will explain the geometric meaning of modular Berry phases in the bulk and describe an experiment to measure them which involves observers moving with adiabatically varying accelerations. </p>


Modular Berry Connection
1) $S_2 = \frac{SO(3)}{SO(2)}$
SO(3)



Modular Berry Connection
$\tilde{\vec{v}} = R(\theta)\vec{v}$
1) $S_2 = \frac{SO(3)}{SO(2)}$
$U_3 U_2 U_1 = W \in SO(2)$
$\in SO(3)$

Modular Berry Connection



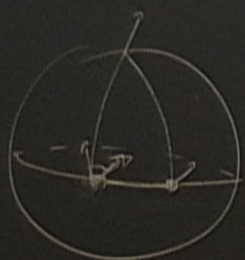
$$\boxed{\tilde{\vec{v}} = R(\theta)\vec{v}}$$

1) $S_2 = \dfrac{SO(3)}{SO(2)}$

$\underbrace{U_3}_{\in SO(3)} U_2 U_1 = W \in SO(2)$

2) $R \neq 0$

Modular Berry Connection



$$\boxed{\dot{\vec{V}} = R(\theta)\vec{V}}$$

1) $S_2 = \frac{SO(3)}{SO(2)}$

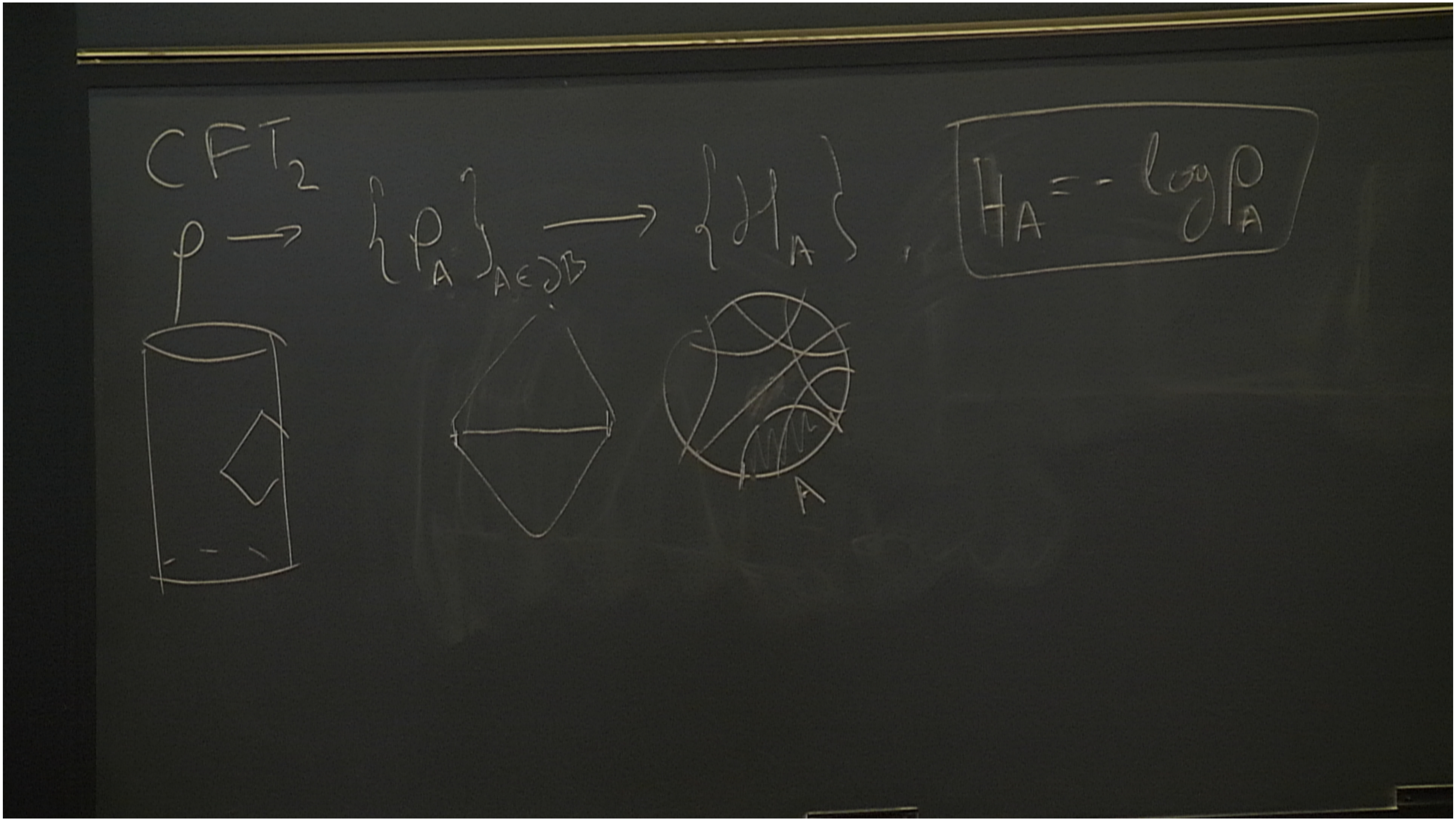
$\underbrace{U_3 U_2 U_1}_{\in SO(3)} = W \in SO(2)$

2) $R \neq 0$

$H(\vec{\lambda})$

$\underbrace{U}_{\in SO(3)} H(\vec{\lambda}) U^\dagger = H(\vec{\lambda}')$

$\underbrace{W}_{\in SO(2)} H(\vec{\lambda}) W^\dagger = H(\vec{\lambda})$


CFT2
ρ → {ρA}A∈∂B → {HA},
HA = - log ρA
A

Modular Berry Connection

$|0\rangle_{CFT_2}$

1) $[H_A, H_A] = 0$

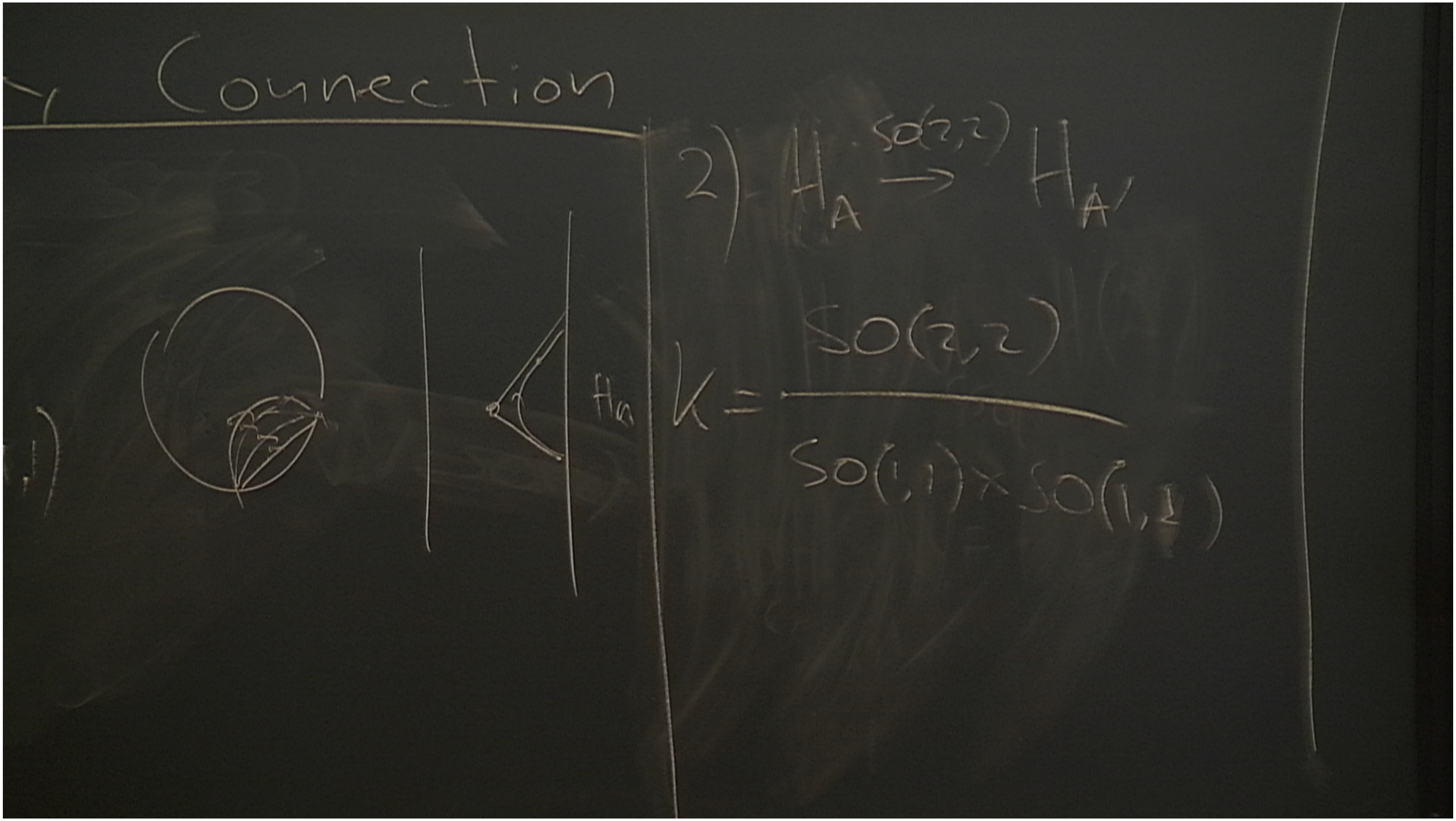
$[P_A, H_A] = 0$

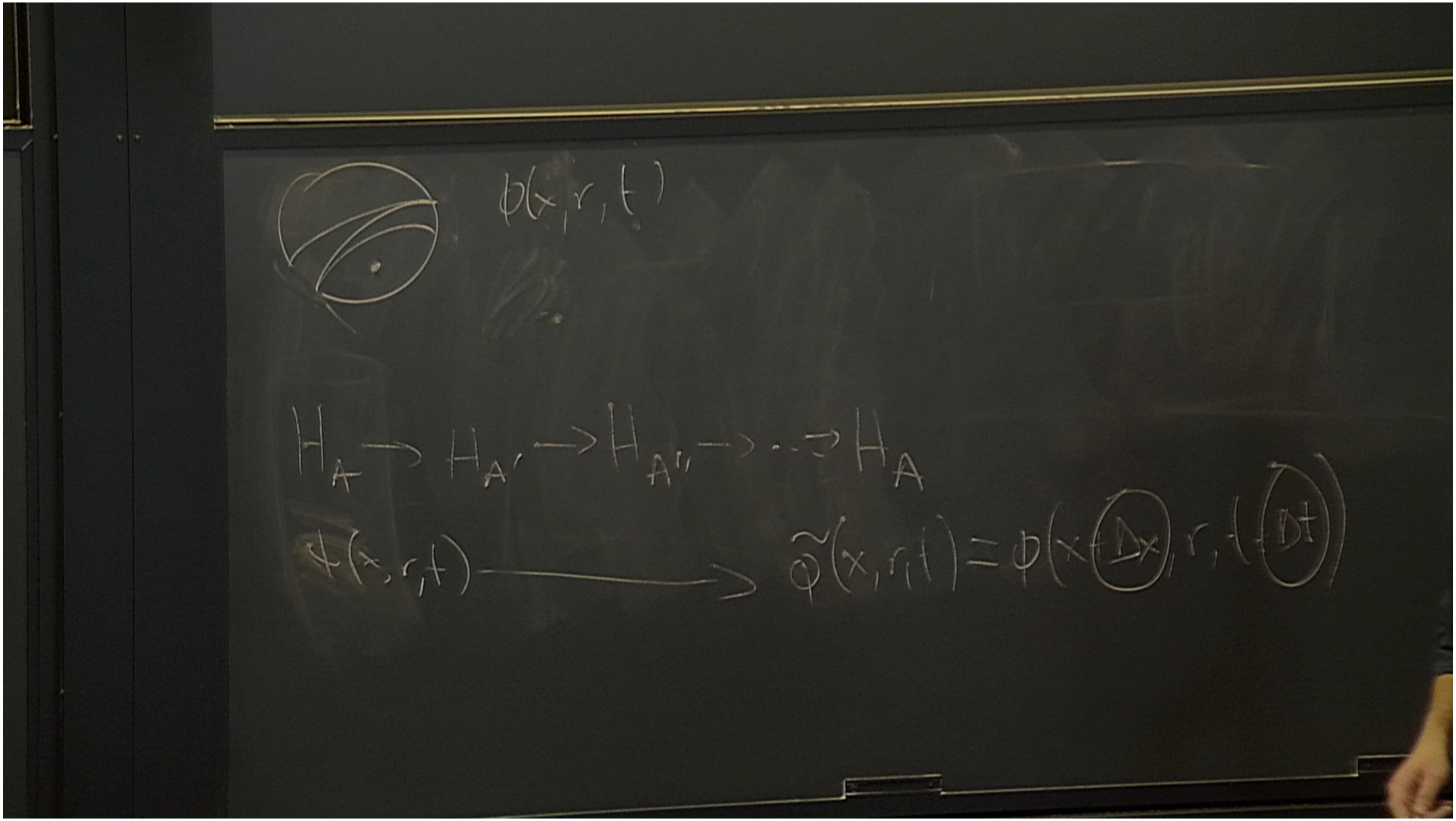
H_A, P_A

$SO(1,1)\times SO(1,1)$

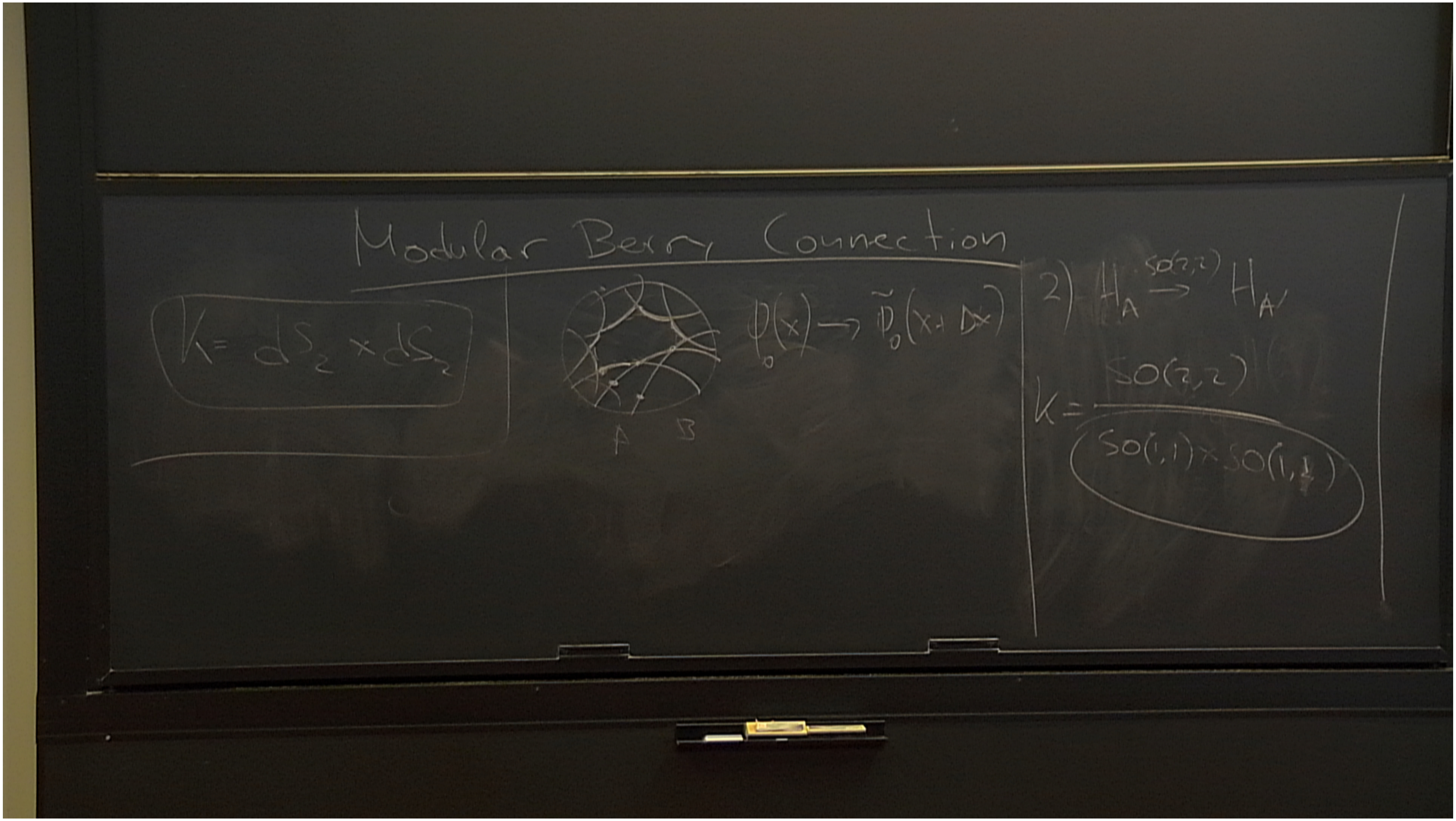
H_A

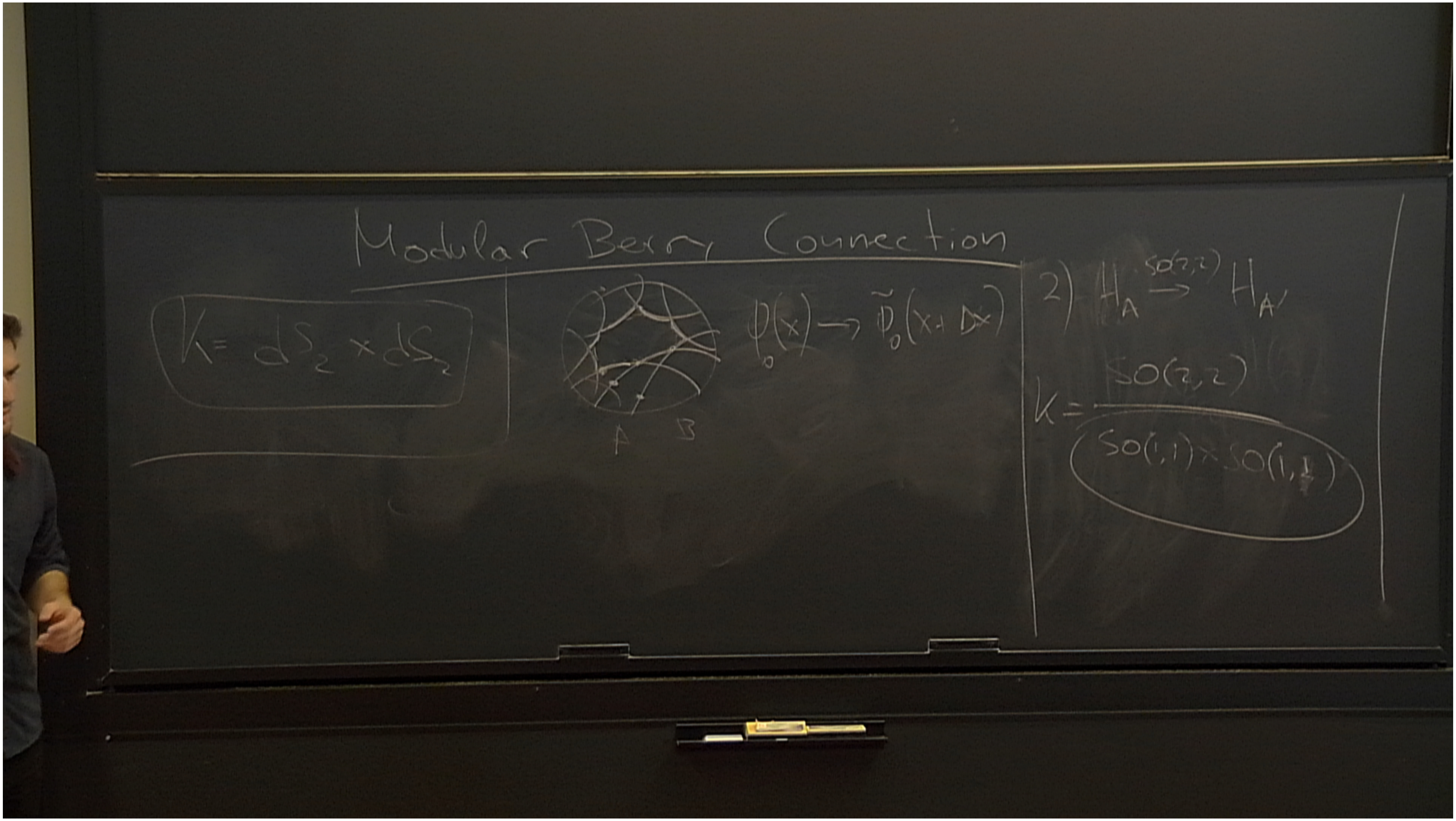
2)

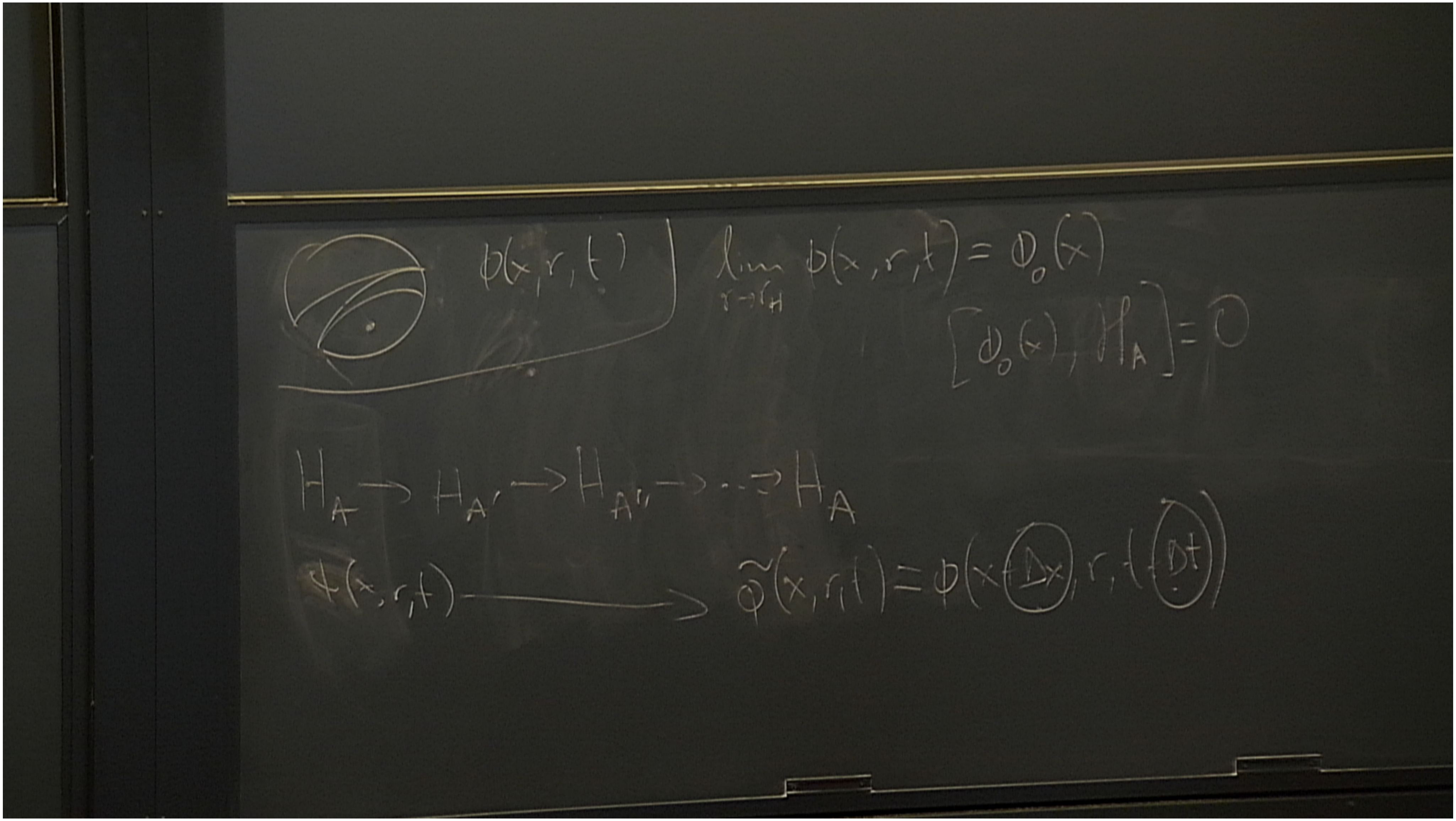

Connection
2) $H_A \xrightarrow{SO(2,2)} H_{A'}$
$K = \frac{SO(2,2)}{SO(1,1)\times SO(1,1)}$
H_A



$\phi(x, r, t)$
$H_A \to H_{A'} \to H_{A''} \to \cdots \to H_A$
$\phi(x, r, t) \longrightarrow \tilde{\phi}(x, r, t) = \phi(x + \Delta x, r, t + \Delta t)$


Modular Berry Connection
K = dS2 × dS2
φ0(x) → φ̃0(x + Δx)
A
B
2) HA → HA'
SO(2,2)
K = SO(2,2) / SO(1,1) × SO(1,1)


Modular Berry Connection
K = dS2 × dS2
A B
φ0(x) → φ̃0(x + Δx)
2) HA → SO(2,2) HA'
K = SO(2,2) / SO(1,1) × SO(1,1)


$\phi(x,r,t)$
$\lim_{r\to r_H} \phi(x,r,t) = \mathcal{O}_0(x)$
$[\mathcal{O}_0(x), H_A] = 0$
$H_A \to H_{A'} \to H_{A''} \to \cdots \to H_A$
$\phi(x,r,t) \longrightarrow \tilde{\phi}(x,r,t) = \phi(x+\Delta x, r, t+\Delta t)$

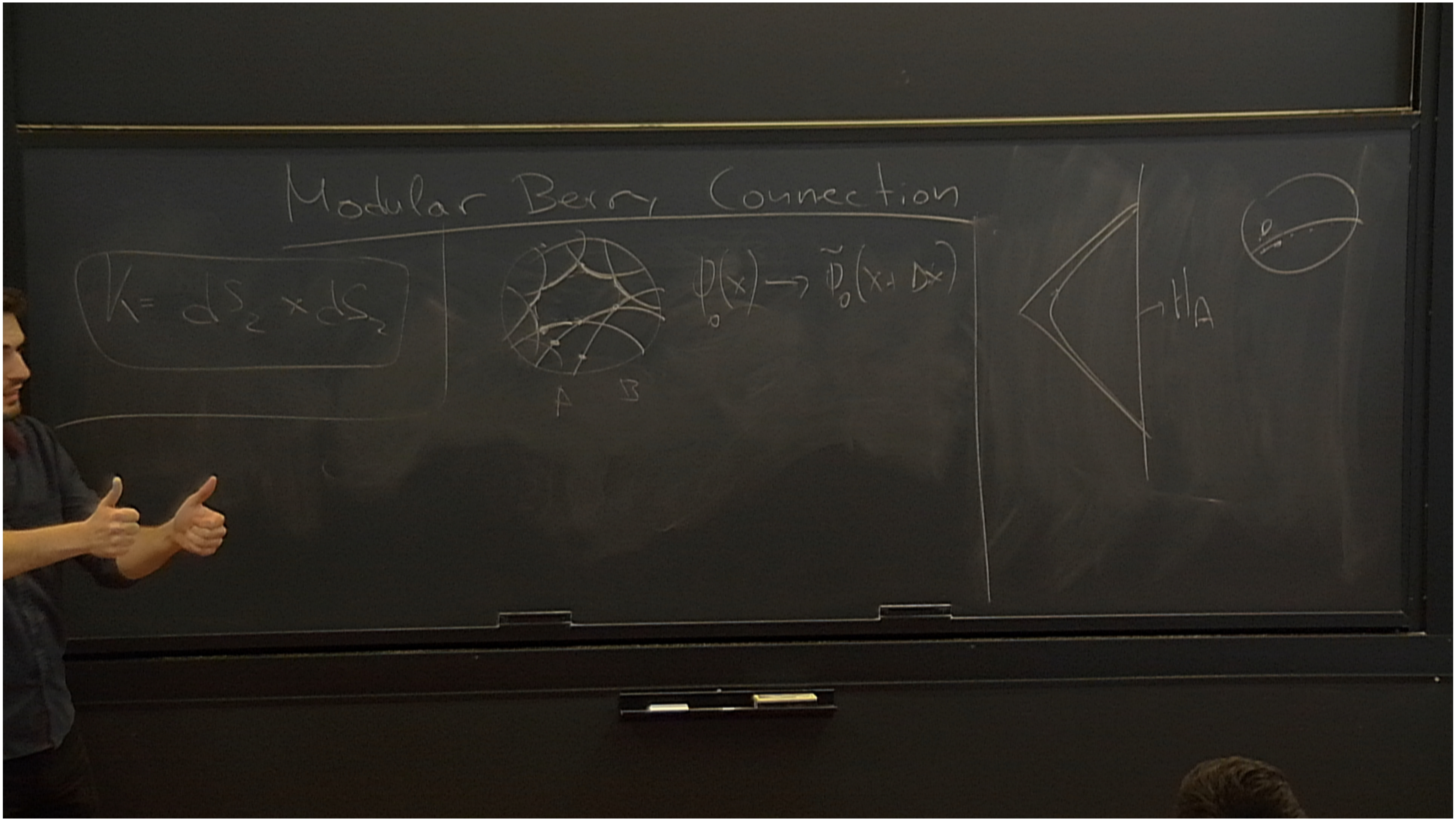
$$\phi(x,r,t)$$

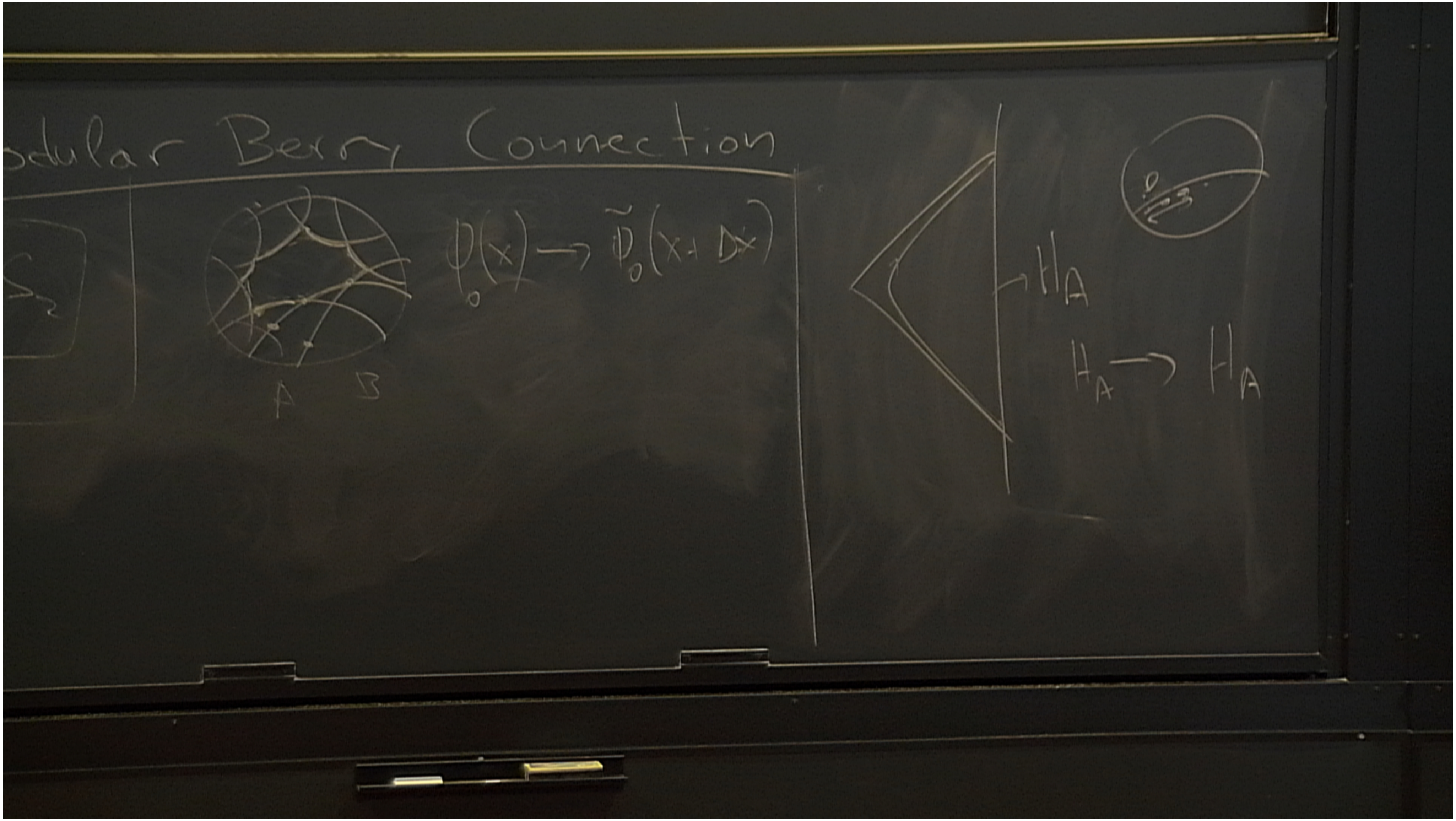
$$\lim_{r\to r_H}\phi(x,r,t)=\Phi_0(x)$$

$$[\Phi_0(x), H_A]=0$$

$$H_A \to H_{A'} \to H_{A''} \to \cdots \to H_A$$

$$\phi(x,r,t) \longrightarrow \tilde{\phi}(x,r,t)=\phi(x+\Delta x, r, t+\Delta t)$$


Modular Berry Connection
K = dS2 x dS2
A B
φ0(x) → φ̃0(x + Δx)
HA


odular Berry Connection
φ0(x) → φ̃0(x+Δx)
A
B
HA
HA → HA

$$\tilde{\phi}(x, r, t) = \phi(x + \boxed{Dx}, r, t + \boxed{Dt})$$