

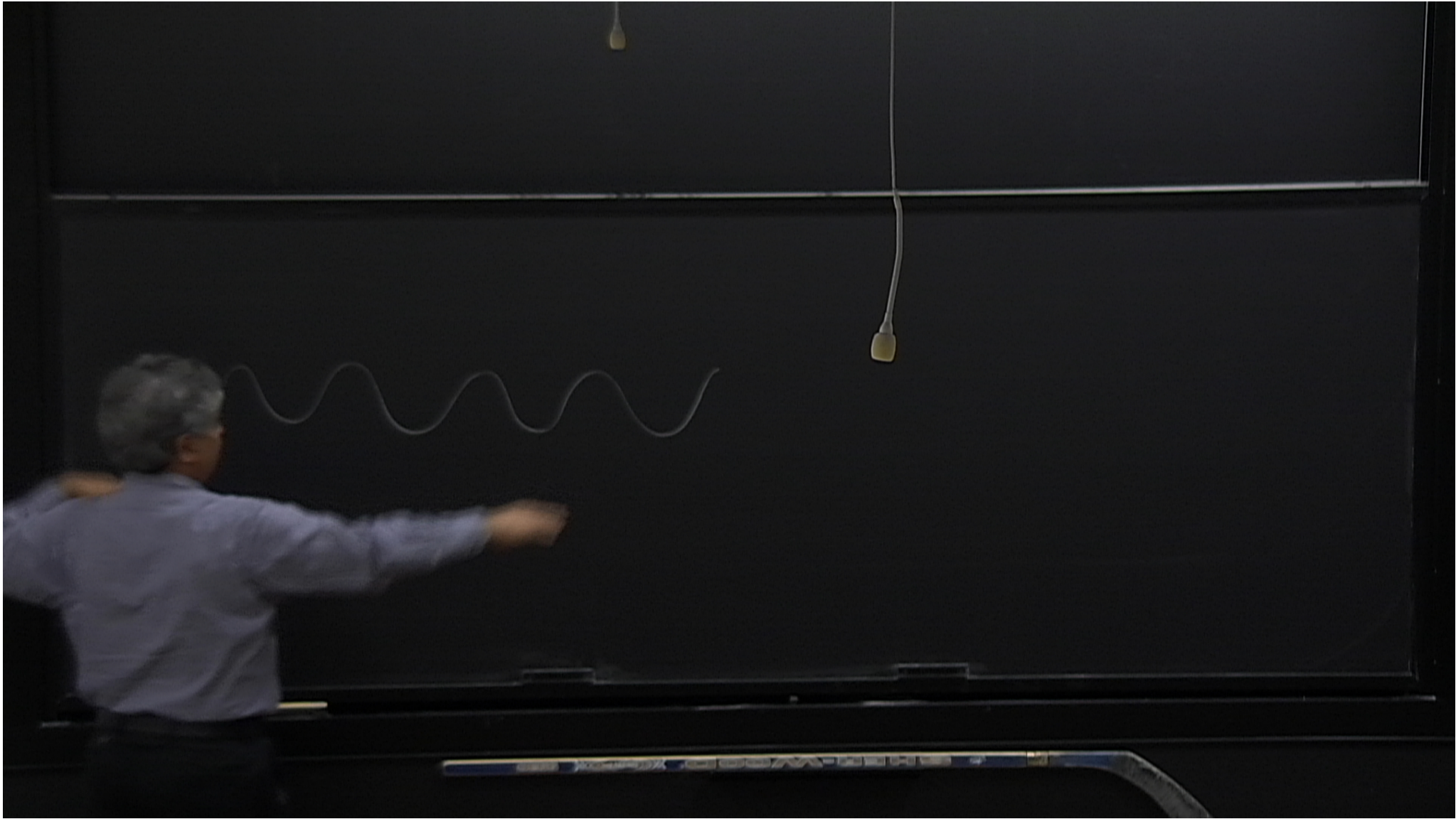
Title: Researcher Presentation: Subir Sachdev

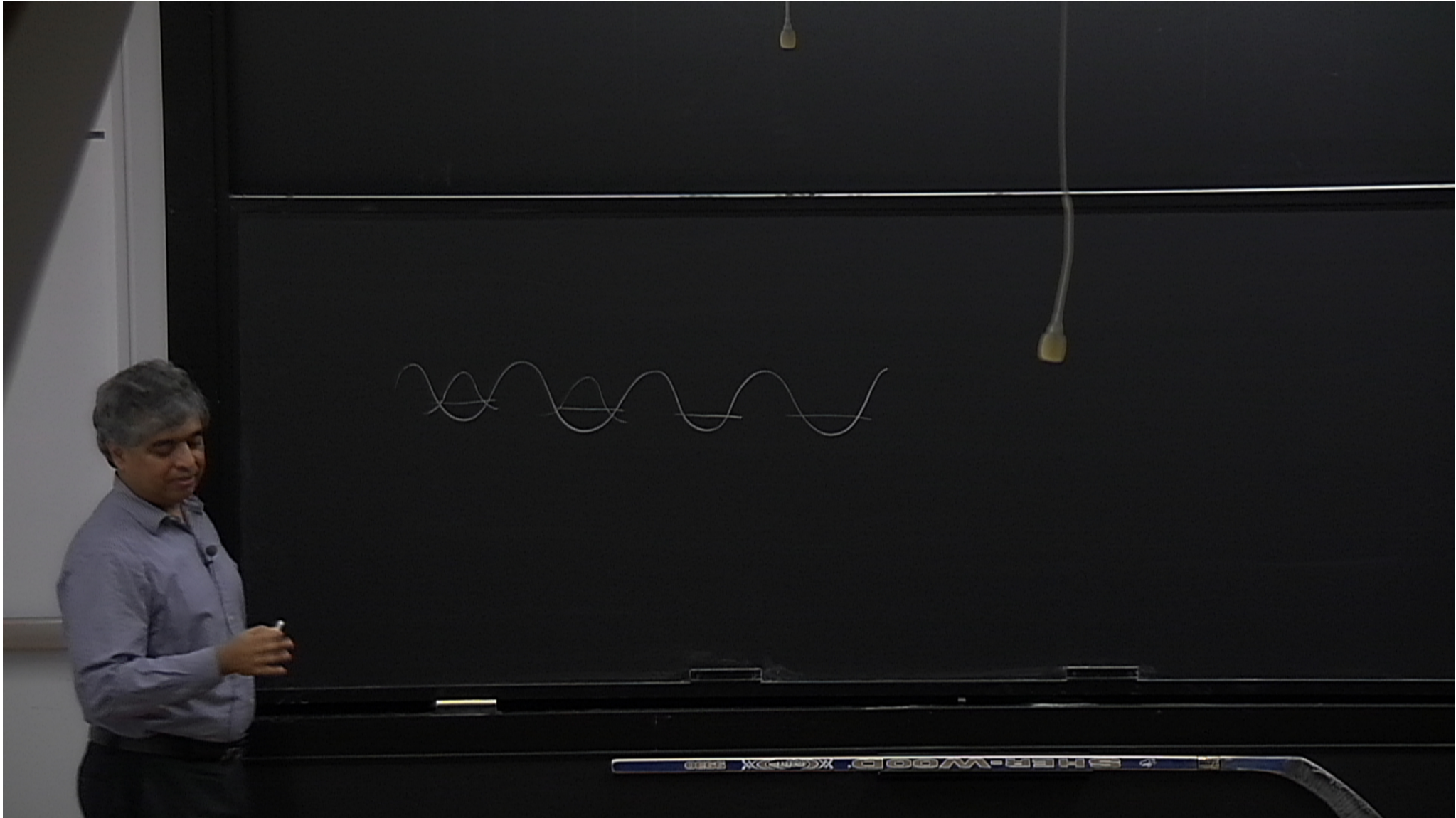
Date: Dec 14, 2011 04:00 PM

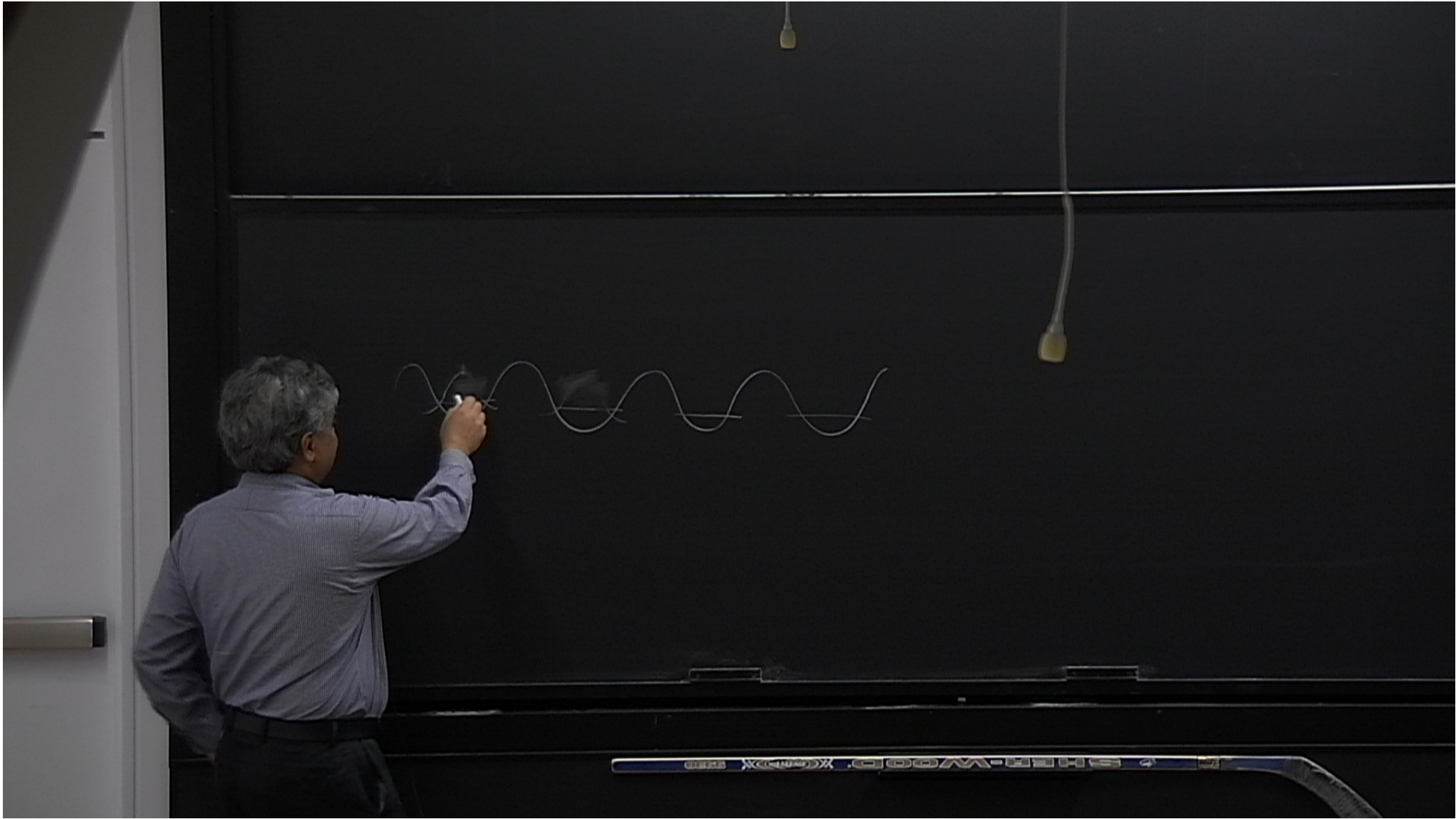
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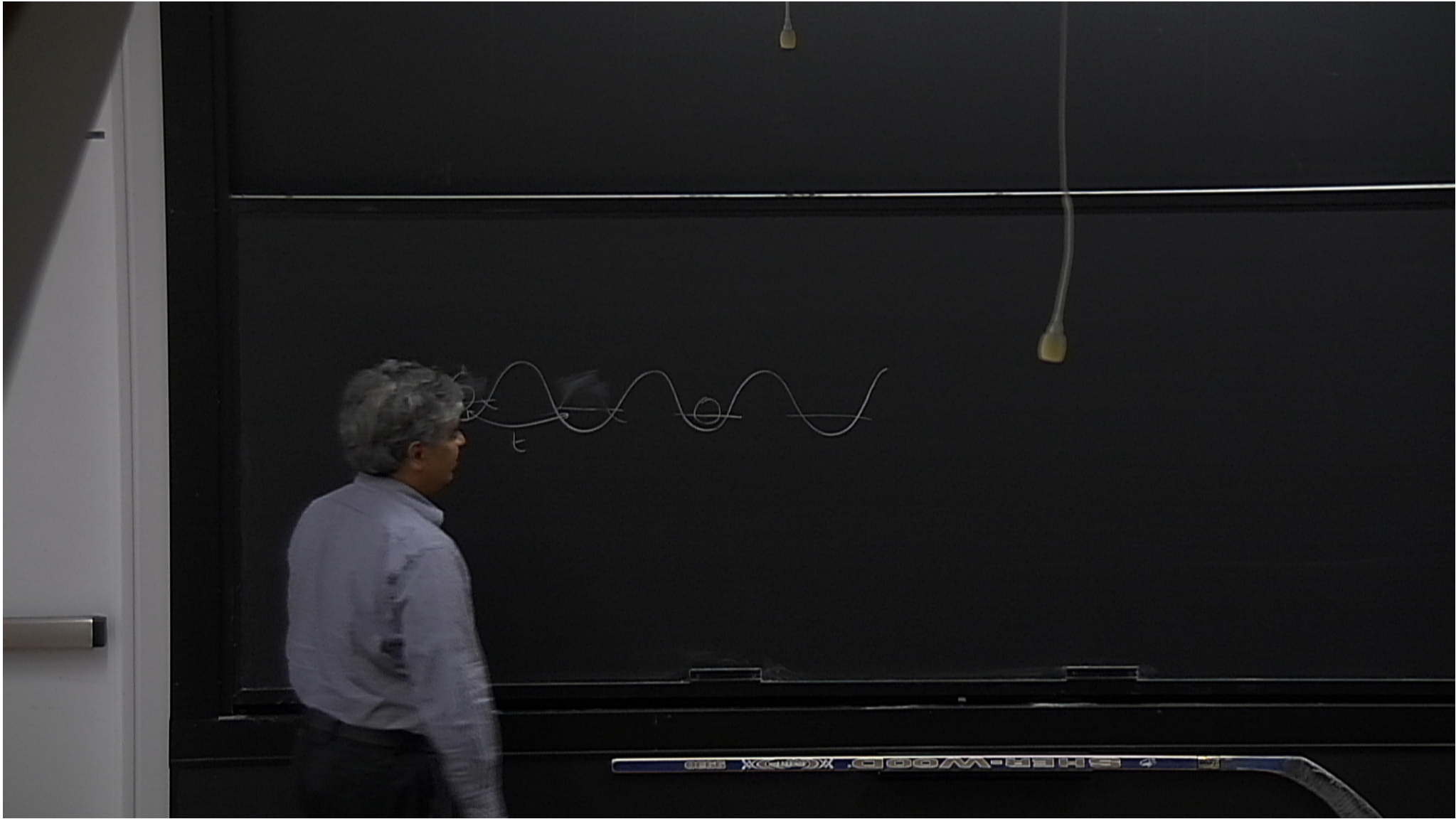
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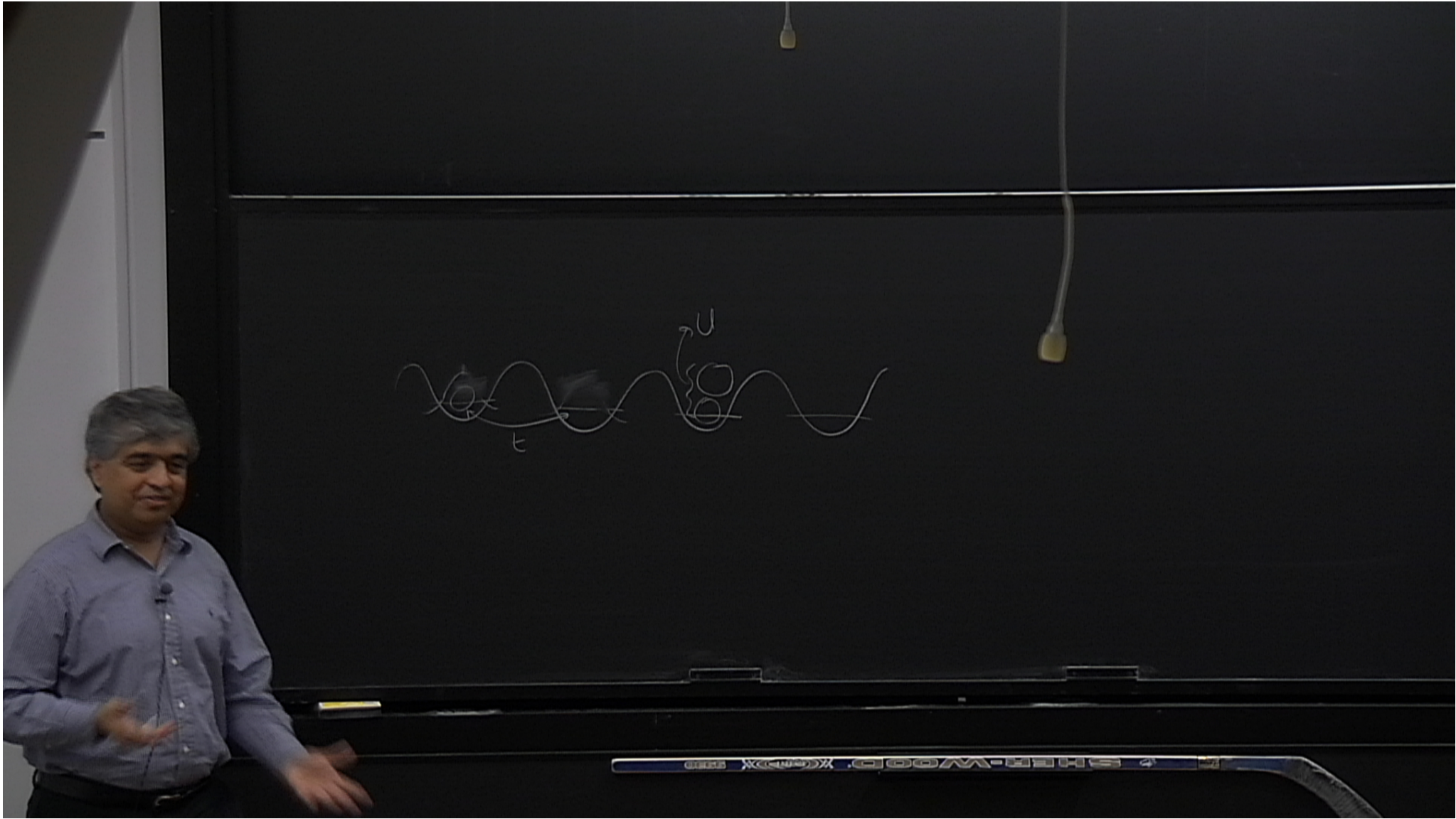


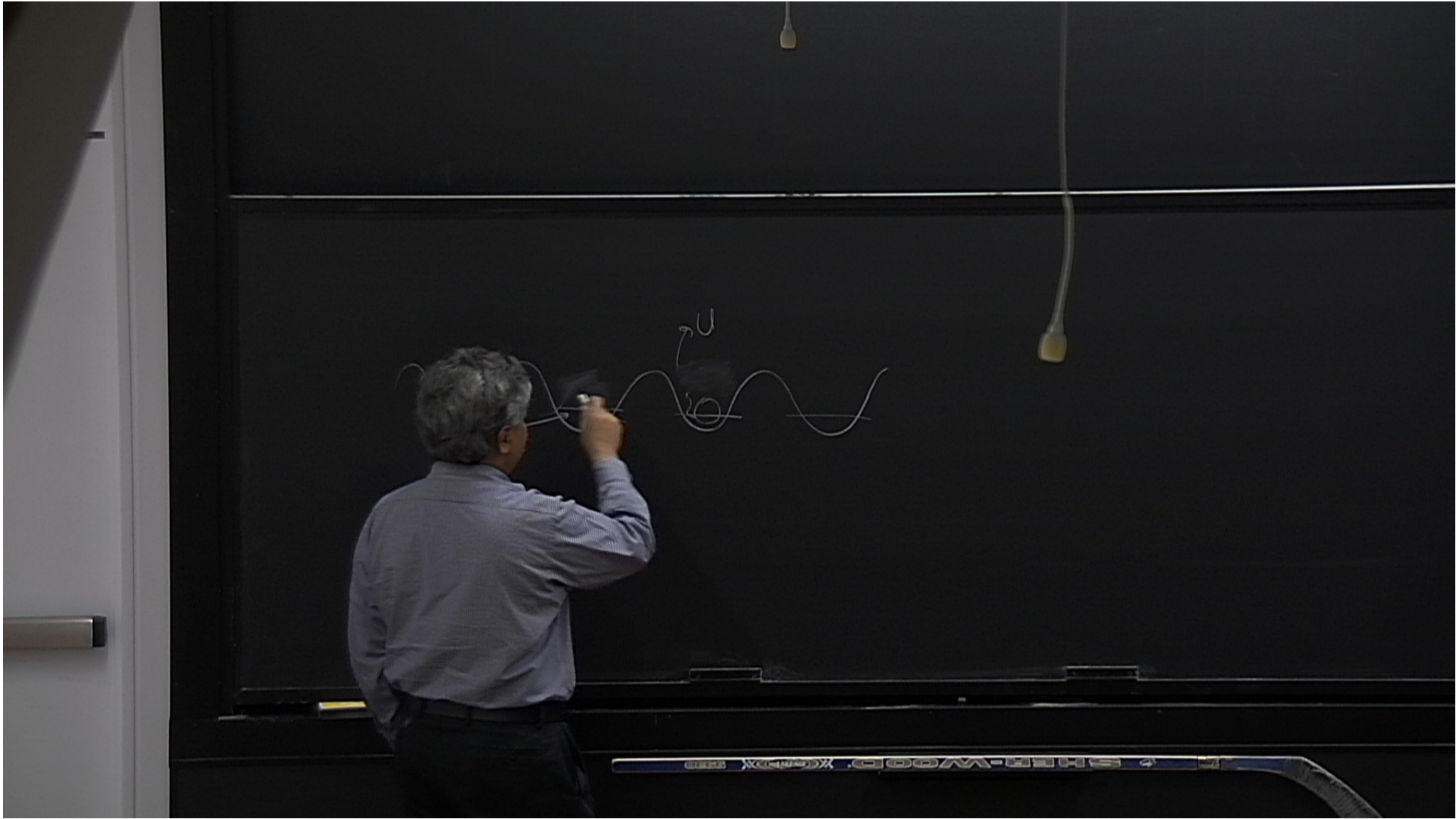


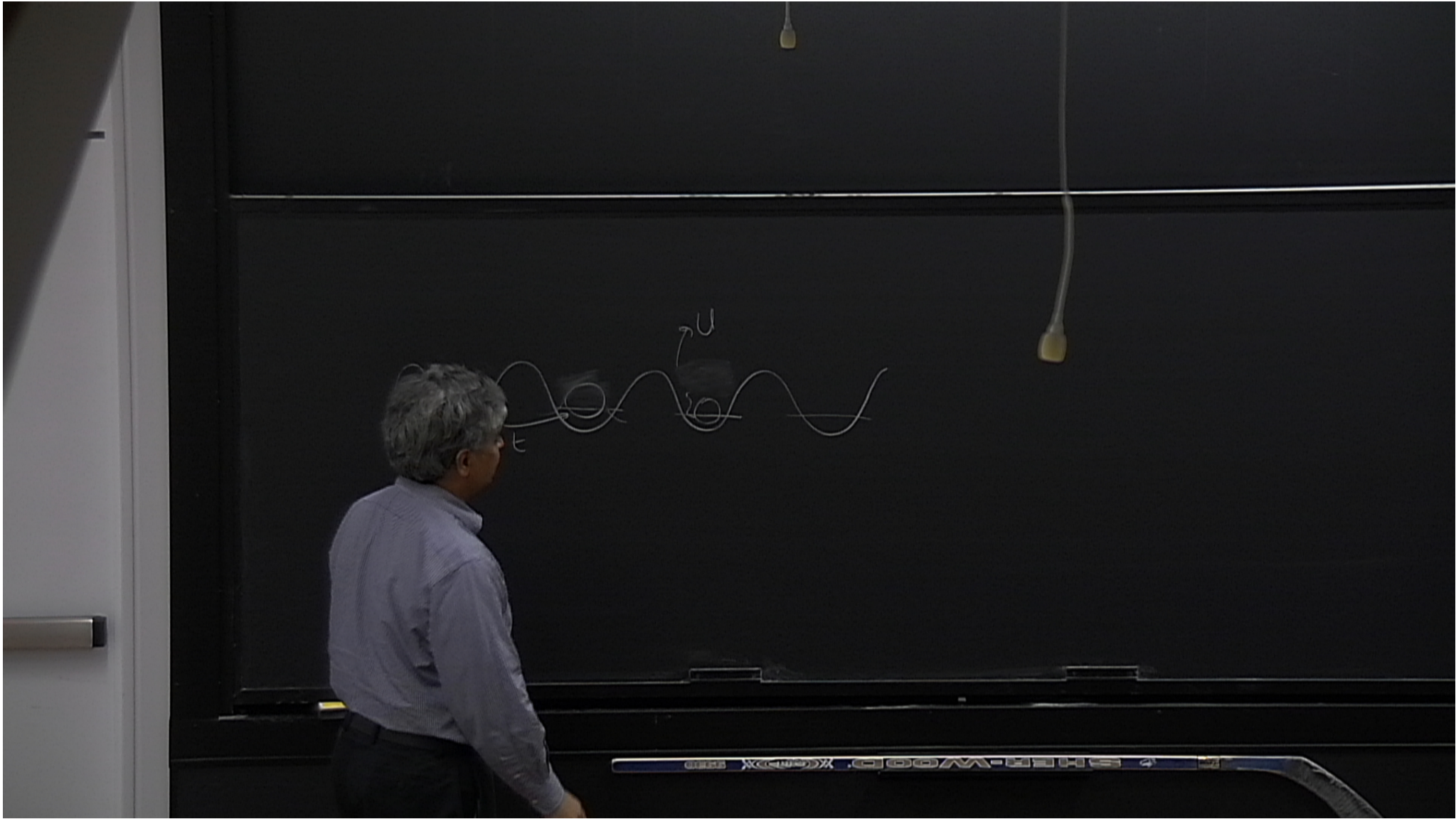


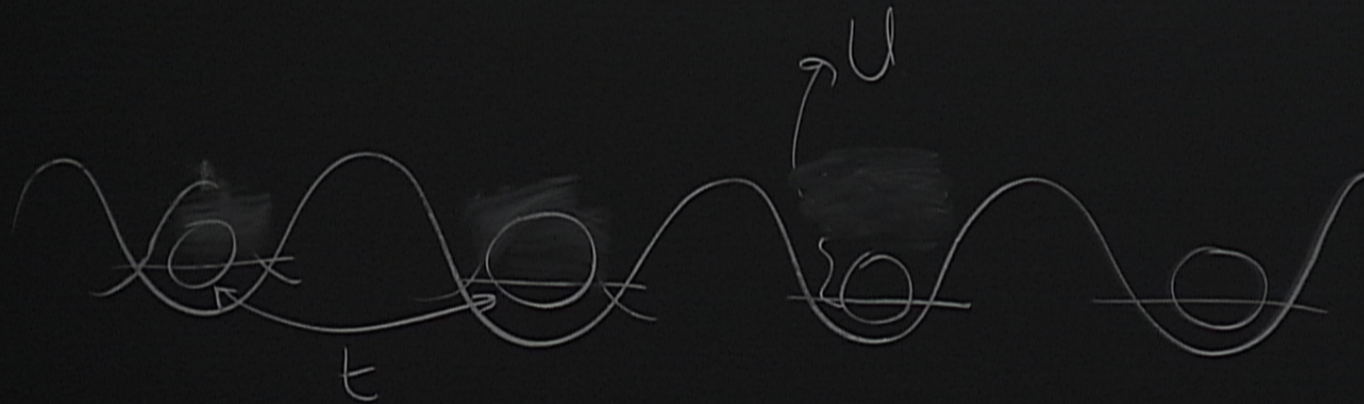




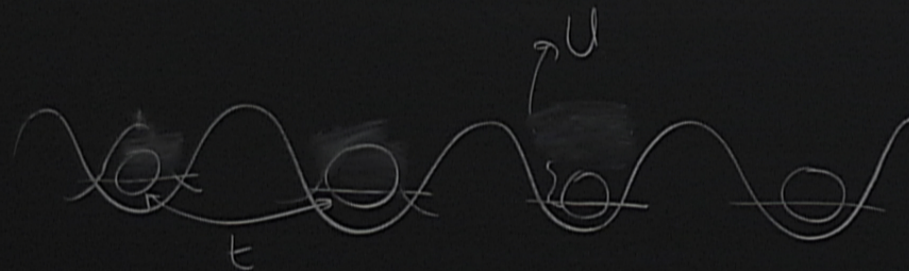




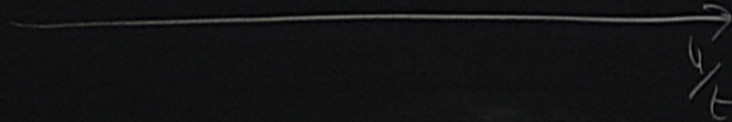


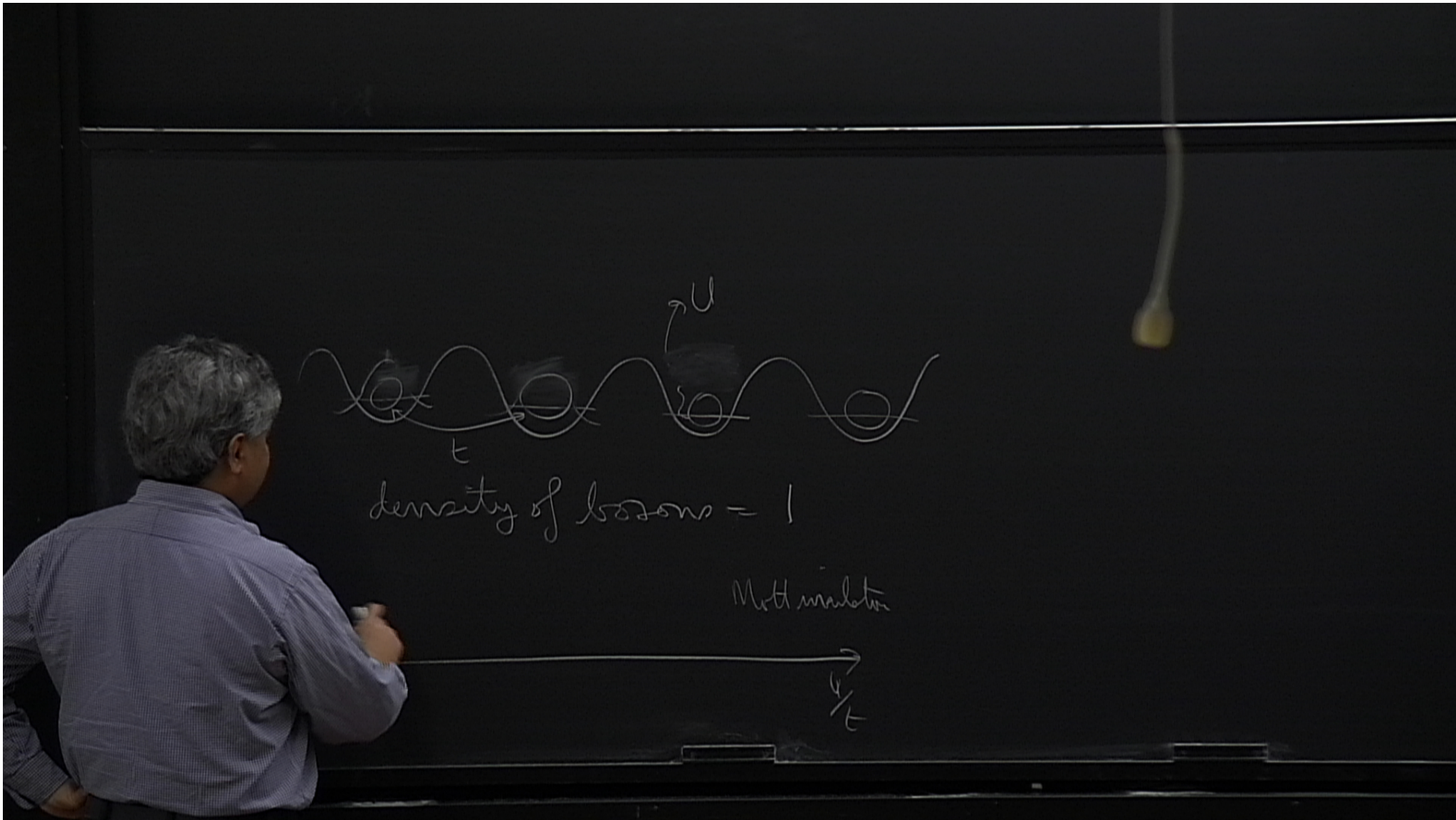


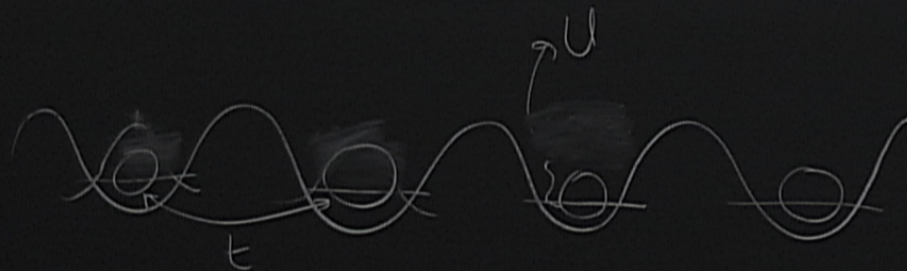
density of bosons = 1



density of bosons = 1





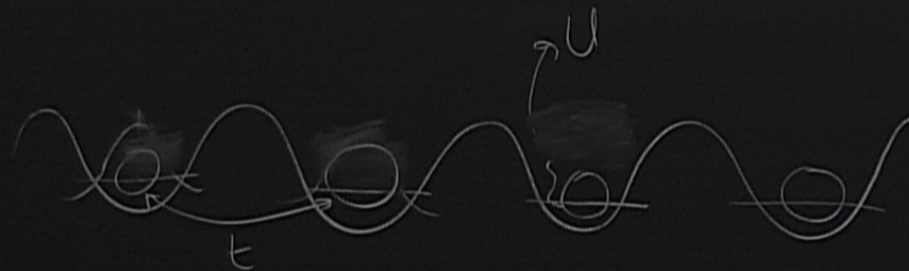


density of bosons = 1

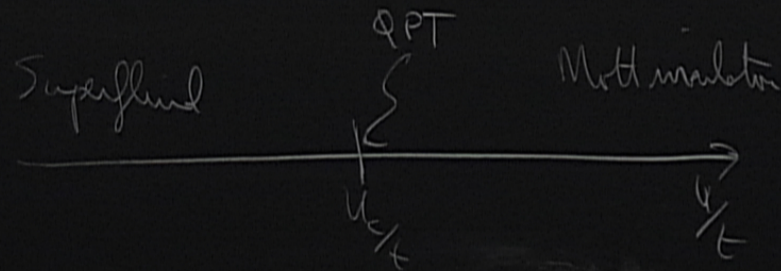
Superfluid

Mott insulator



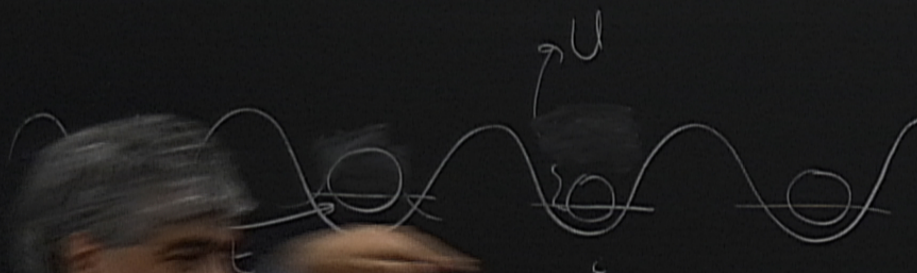


density of bosons = 1



b_i

$$b_k = \sum_i b_i e^{ik \cdot \lambda_i}$$

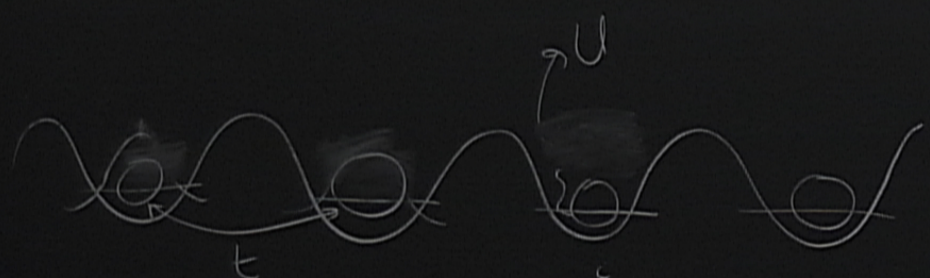


number of bosons = 1

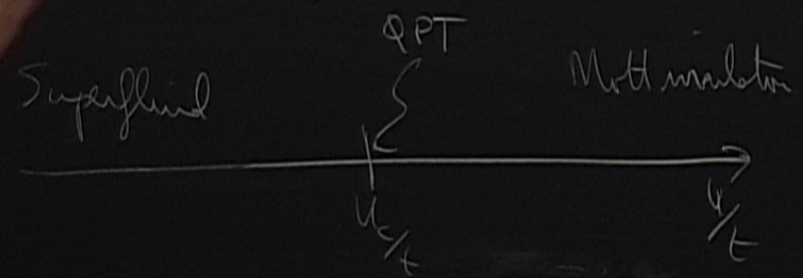
QPT

Mott insulator





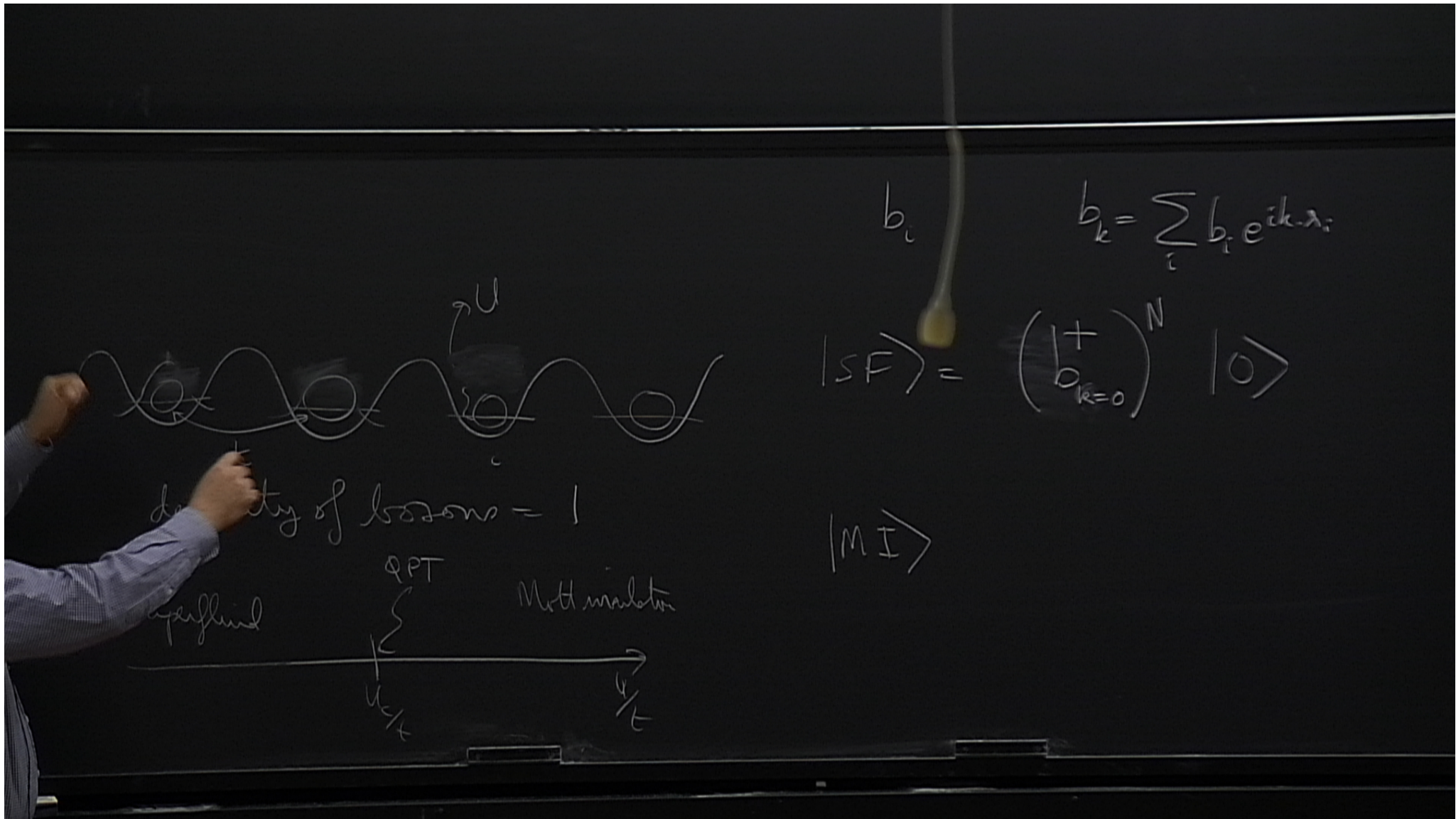
density of bosons = 1



$$b_i$$

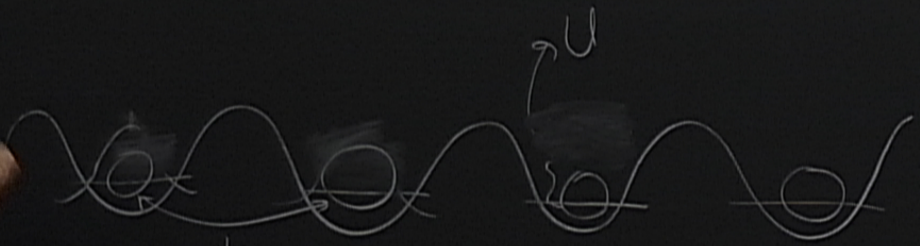
$$b_k = \sum_i b_i e^{ik \cdot r_i}$$

$$|SF\rangle = \left(\prod_{k \neq 0} (1 + b_{k=0})^N \right) |0\rangle$$

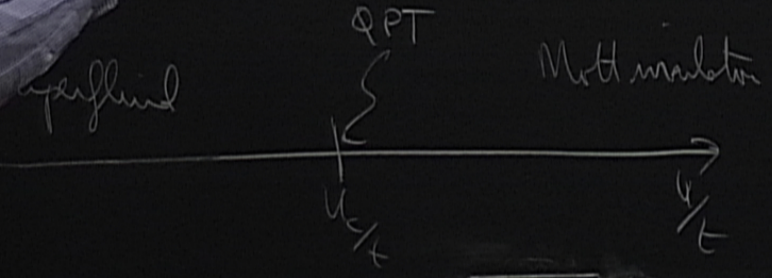


$$b_i$$

$$b_k = \sum_i b_i e^{ik \cdot r_i}$$

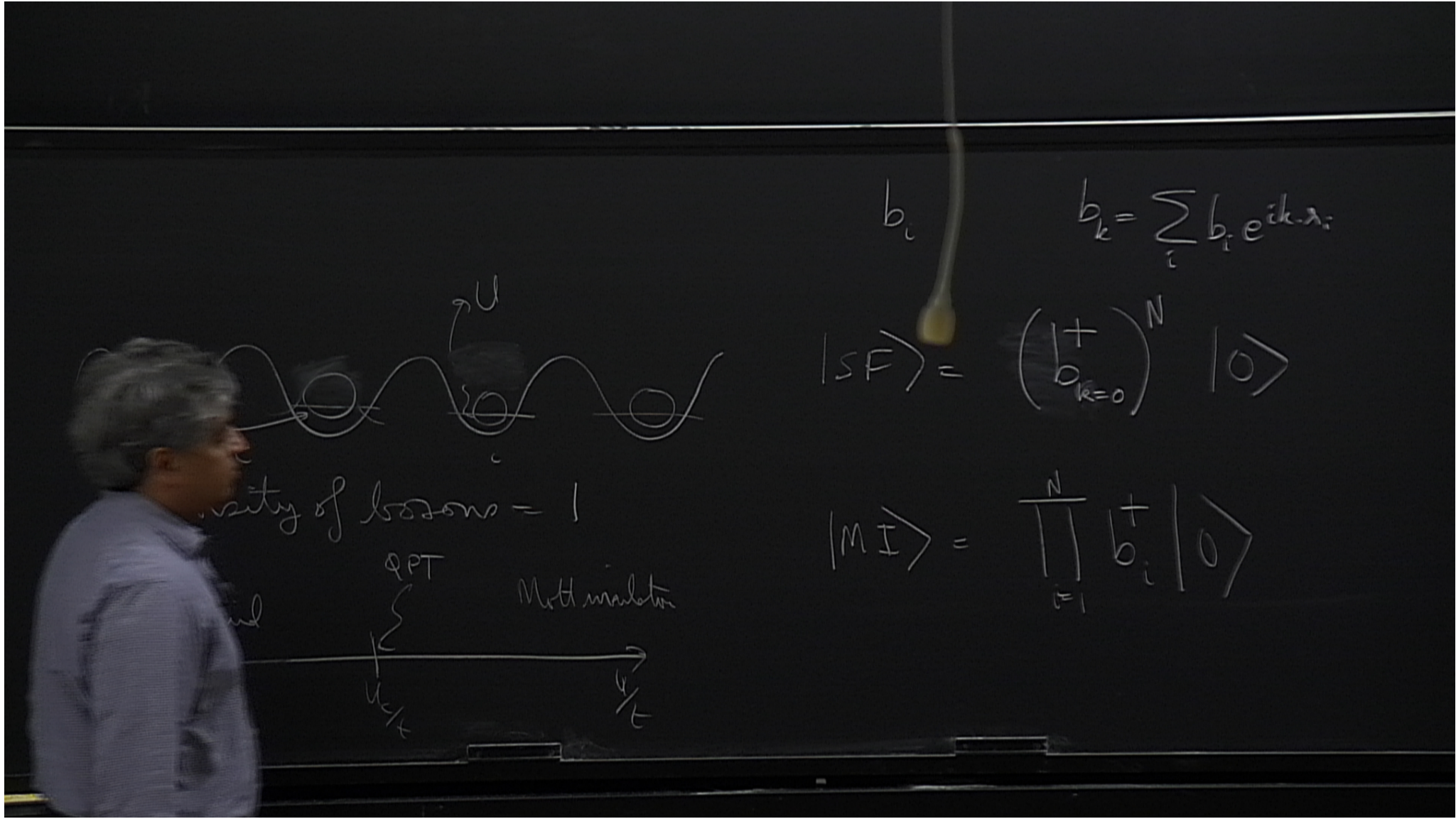


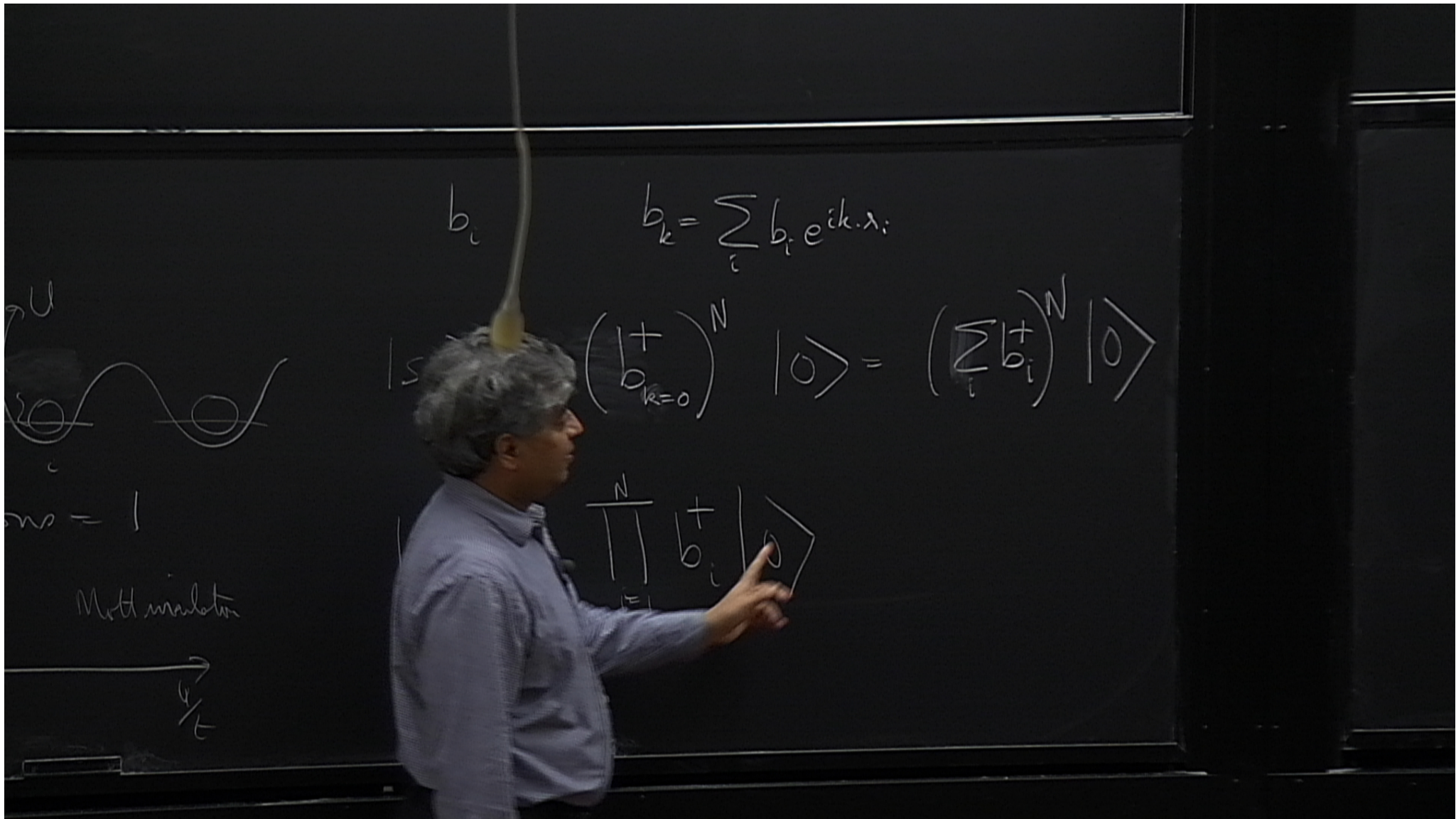
density of bosons = 1

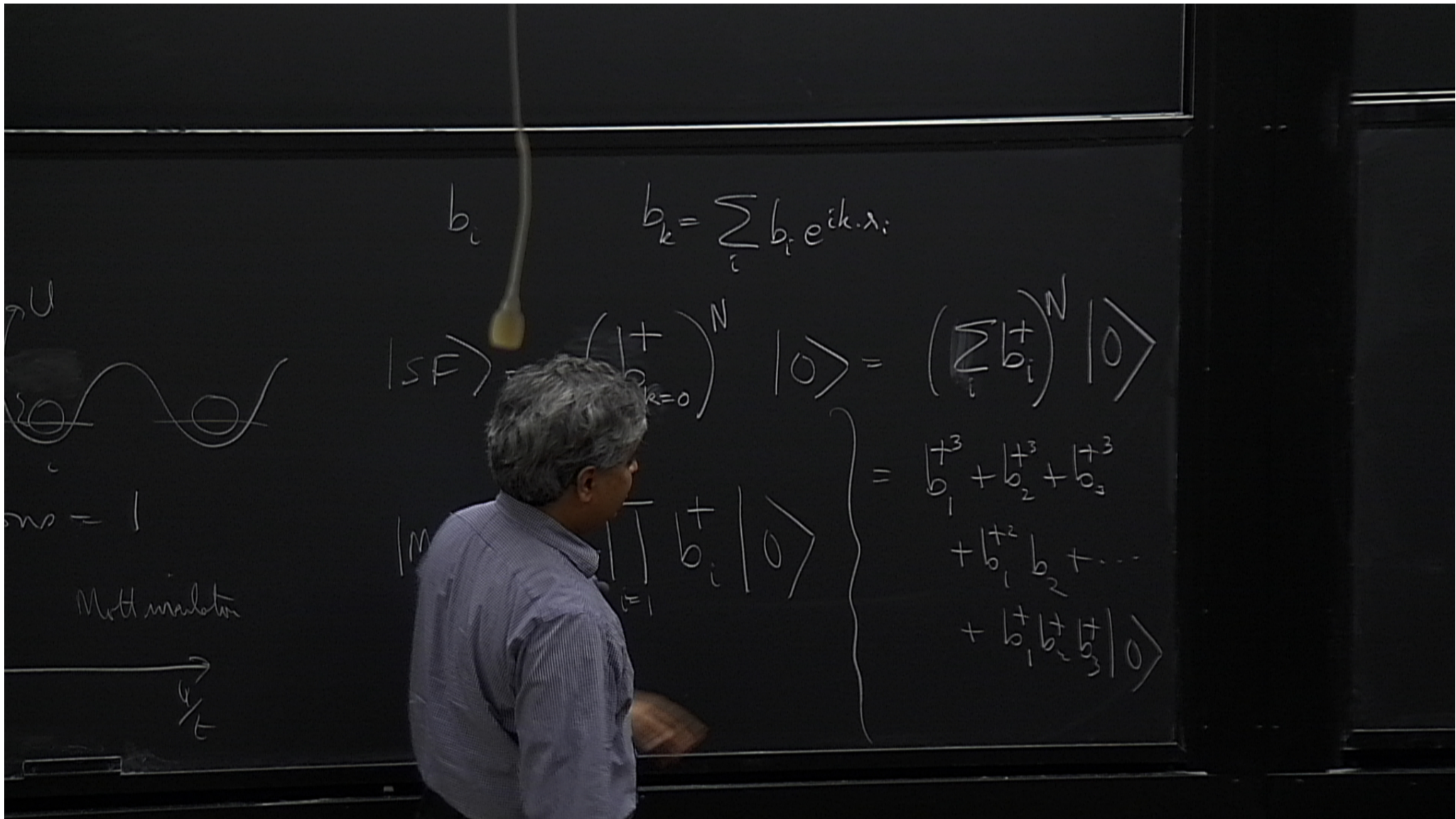


$$|SF\rangle = \left(\prod_{k=0}^{+} \right)^N |0\rangle$$

$$|MI\rangle$$

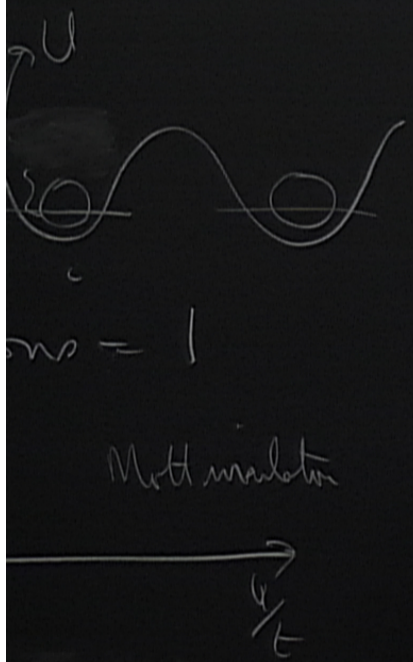






$$b_i$$

$$b_k = \sum_i b_i e^{ik \cdot \lambda}$$

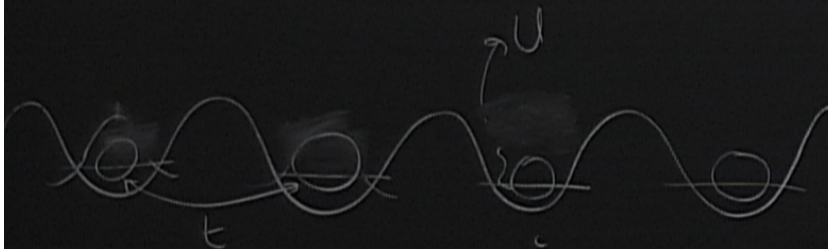


$$|SF\rangle = \left(\prod_{k=0}^{N-1} (1 + b_k^+) \right) |0\rangle$$

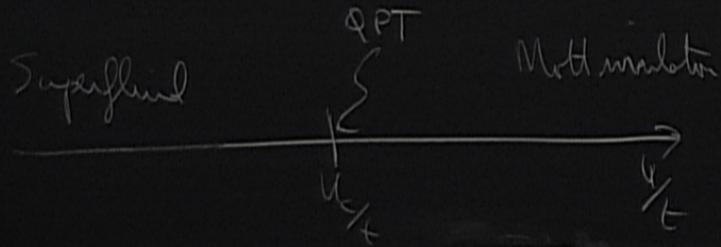
$$|0\rangle = \left(\sum_i b_i^+ \right)^N |0\rangle$$

$$|M\rangle = \prod_{i=1}^N b_i^+ |0\rangle$$

$$= b_1^{+3} + b_2^{+3} + b_3^{+3} + b_1^{+2} b_2 + \dots + b_1^+ b_2^+ b_3^+ |0\rangle$$



density of bosons = 1



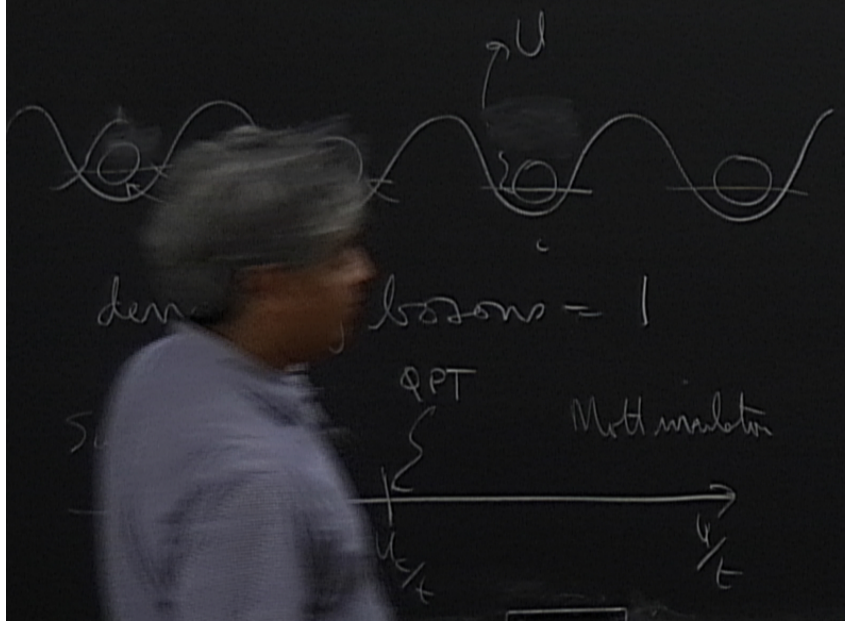
b_i

$$b_k = \sum_i b_i e^{ik \cdot \lambda_i}$$

$$|SF\rangle = \left(\prod_{k=0}^+ b_k \right)^N |0\rangle = \left(\sum_i b_i^+ \right)^N |0\rangle$$

$$|MI\rangle = \prod_{i=1}^N b_i^+ |0\rangle$$

$$= \left\{ \begin{aligned} & b_1^+ + b_2^+ + b_3^+ \\ & + b_1^+ b_2^+ + \dots \\ & + b_1^+ b_2^+ b_3^+ |0\rangle \end{aligned} \right.$$



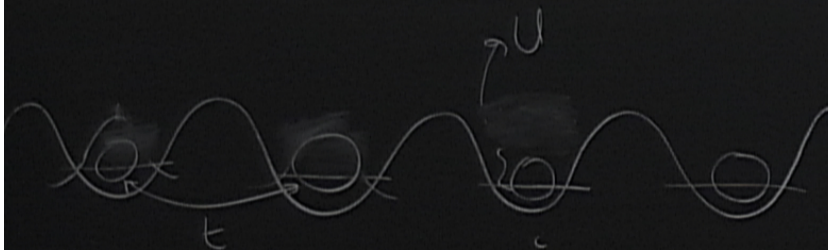
$$b_i \quad b_k = \sum_i b_i e^{ik \cdot \lambda_i}$$

$$|SF\rangle = \left(\prod_{k=0}^+ b_k \right)^N |0\rangle = \left(\sum_i b_i^+ \right)^N |0\rangle$$

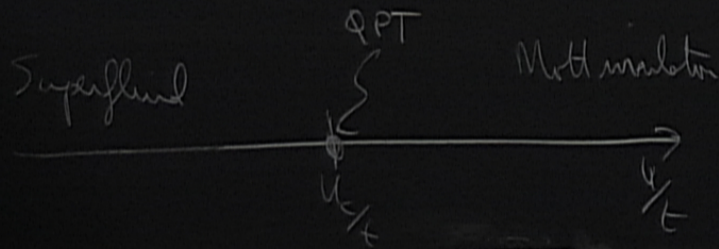
$$|MI\rangle = \prod_{i=1}^N b_i^+ |0\rangle$$

Neither state is "entangled"

$$= b_1^{+3} + b_2^{+3} + b_3^{+3} + b_1^{+2} b_2^+ + \dots + b_1^+ b_2^+ b_3^+ |0\rangle$$



density of bosons = 1



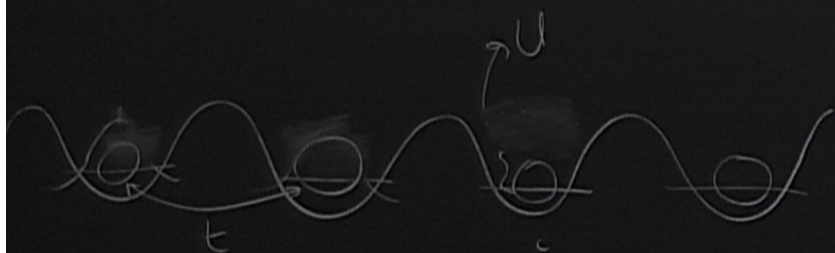
$$b_i \quad b_k = \sum_i b_i e^{ik \cdot \lambda_i}$$

$$|SF\rangle = \left(\prod_{k=0}^+ b_k \right)^N |0\rangle = \left(\sum_i b_i^+ \right)^N |0\rangle$$

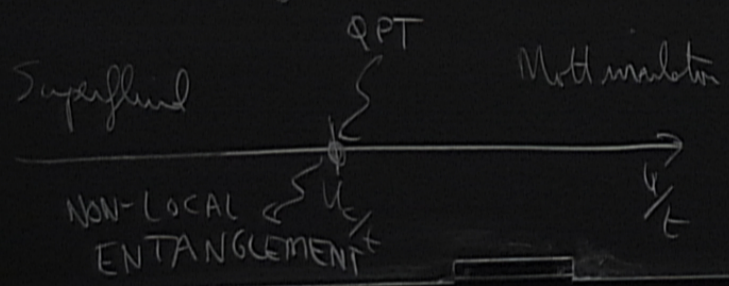
$$|MI\rangle = \prod_{i=1}^N b_i^+ |0\rangle$$

Neither state is "entangled"

$$= \left\{ \begin{aligned} & b_1^+ + b_2^+ + b_3^+ \\ & + b_1^+ b_2^+ + \dots \\ & + b_1^+ b_2^+ b_3^+ |0\rangle \end{aligned} \right.$$



density of bosons = 1



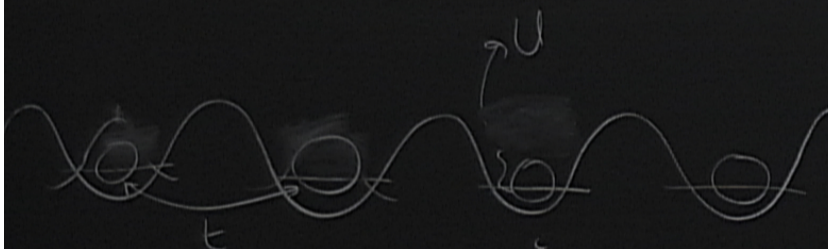
$$b_i \quad b_k = \sum_i b_i e^{ik \cdot \lambda_i}$$

$$|SF\rangle = \left(\prod_{k=0}^+ b_k \right)^N |0\rangle = \left(\sum_i b_i^+ \right)^N |0\rangle$$

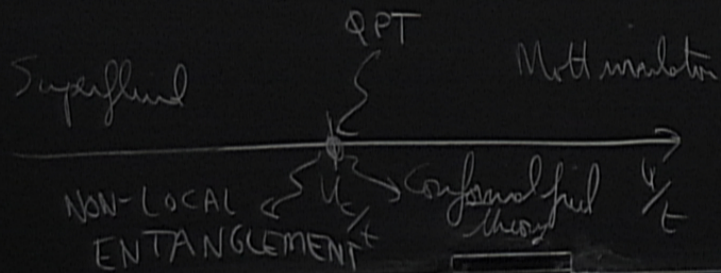
$$|MI\rangle = \prod_{i=1}^N b_i^+ |0\rangle$$

Neither state is "entangled"

$$= b_1^{+3} + b_2^{+3} + b_3^{+3} + b_1^{+2} b_2 + \dots + b_1^+ b_2^+ b_3^+ |0\rangle$$



density of bosons = 1



b_i

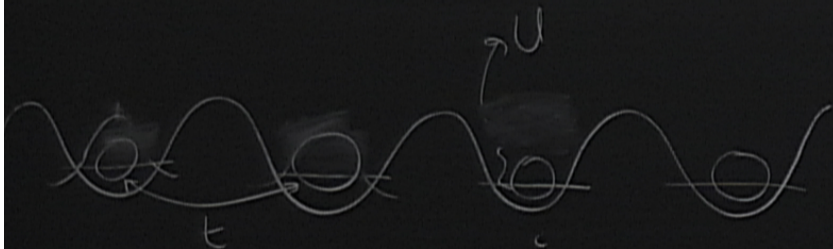
$$b_k = \sum_i b_i e^{ik \cdot \lambda_i}$$

$$|SF\rangle = \left(\prod_{k=0}^+ b_k \right)^N |0\rangle = \left(\sum_i b_i^+ \right)^N |0\rangle$$

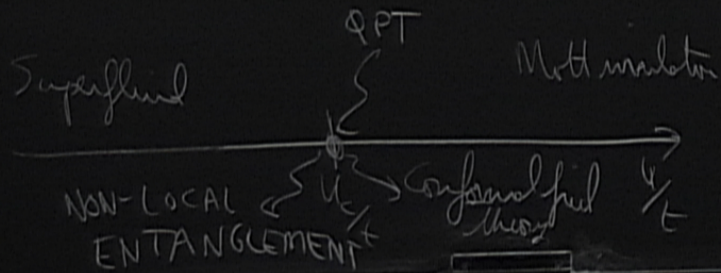
$$|MI\rangle = \prod_{i=1}^N b_i^+ |0\rangle$$

Neither state is "entangled"

$$= \left\{ \begin{aligned} & b_1^{+3} + b_2^{+3} + b_3^{+3} \\ & + b_1^{+2} b_2 + \dots \\ & + b_1^+ b_2^+ b_3^+ |0\rangle \end{aligned} \right.$$



density of bosons = 1



b_i

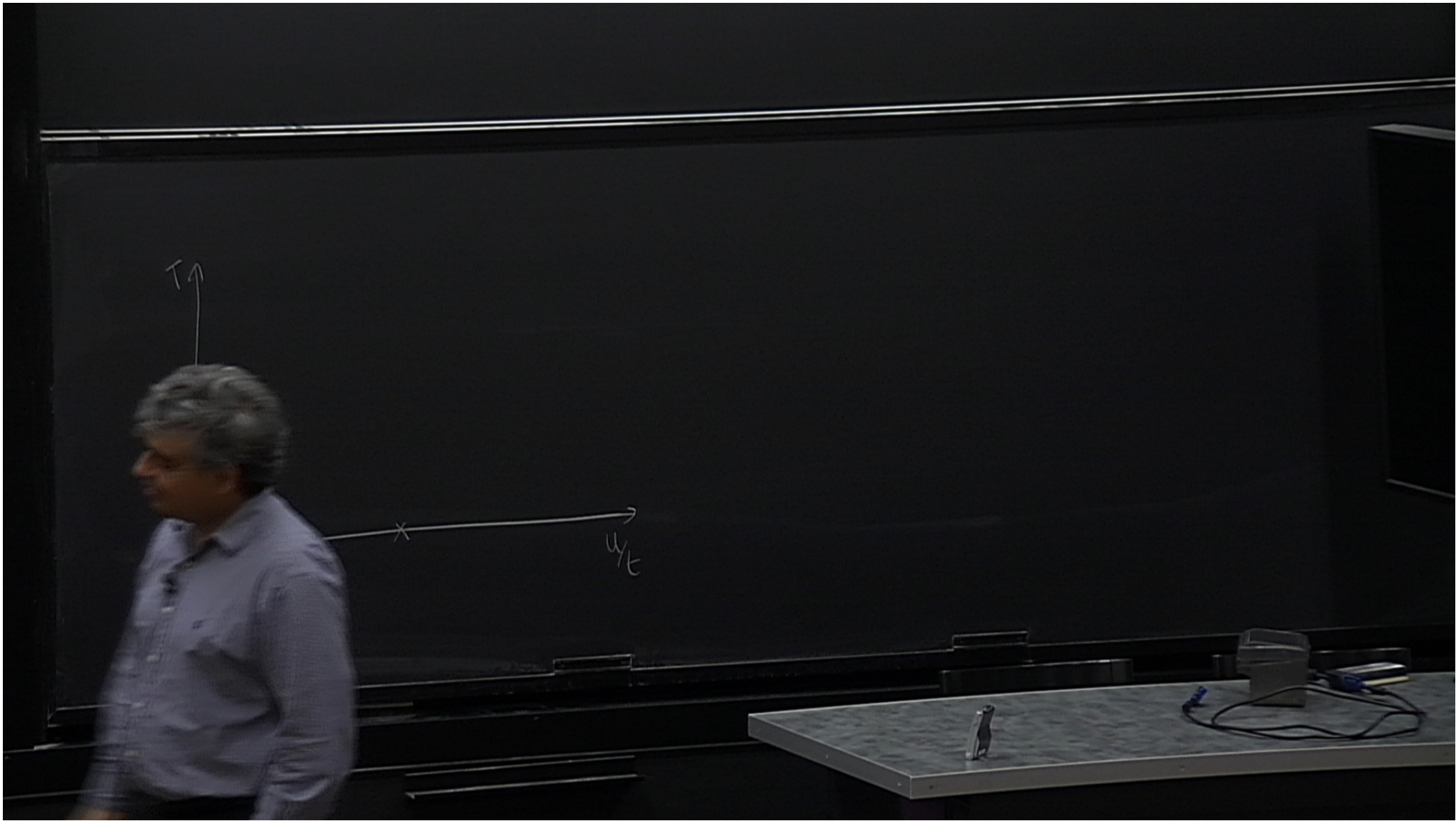
$$b_k = \sum_i b_i e^{ik \cdot \lambda_i}$$

$$|SF\rangle = \left(\prod_{k=0}^+ b_k \right)^N |0\rangle = \left(\sum_i b_i^+ \right)^N |0\rangle$$

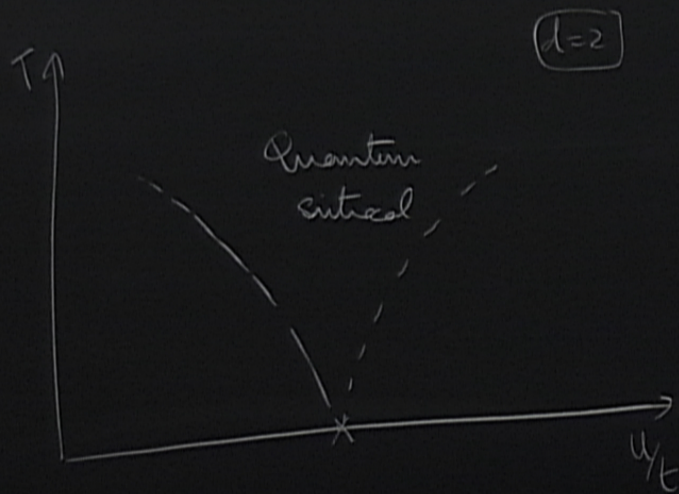
$$|MI\rangle = \prod_{i=1}^N b_i^+ |0\rangle$$

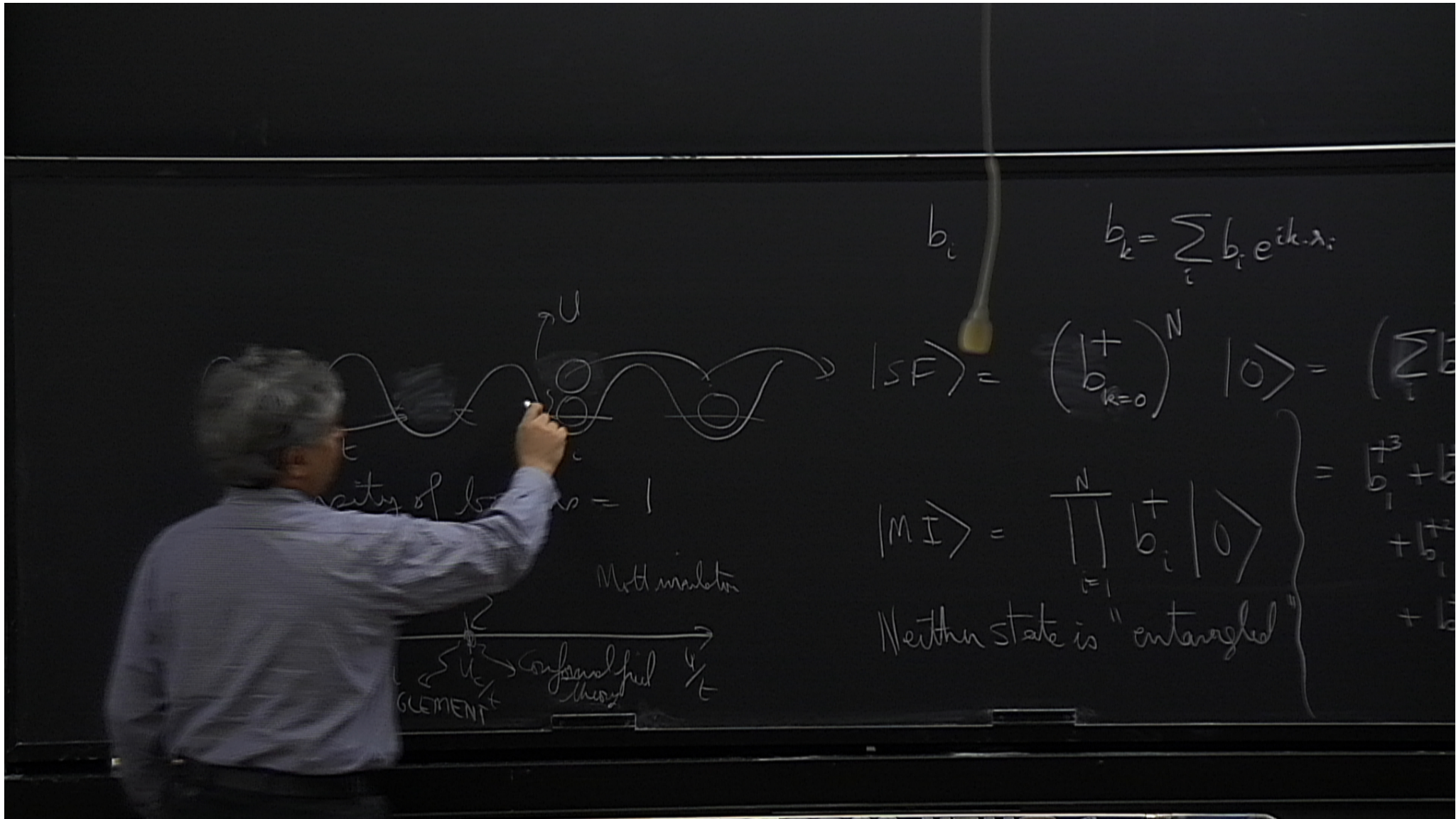
Neither state is "entangled"

$$= \left\{ \begin{aligned} & b_1^+ + b_2^+ + b_3^+ \\ & + b_1^+ b_2^+ + \dots \\ & + b_1^+ b_2^+ b_3^+ |0\rangle \end{aligned} \right.$$

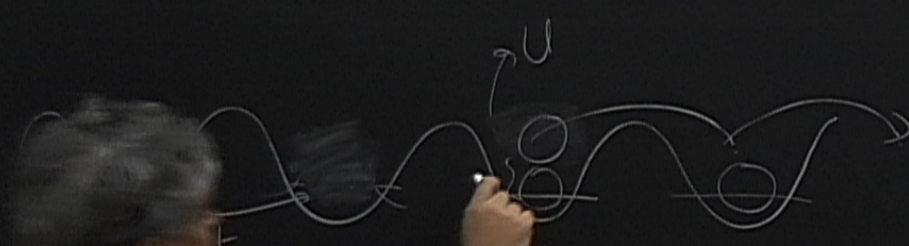






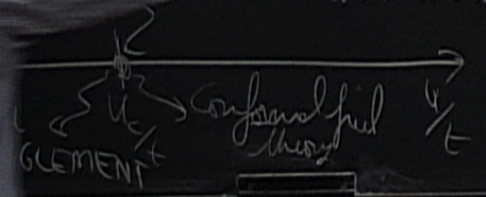


$$b_i \quad b_k = \sum_i b_i e^{ik \cdot r_i}$$



velocity of bosons = 1

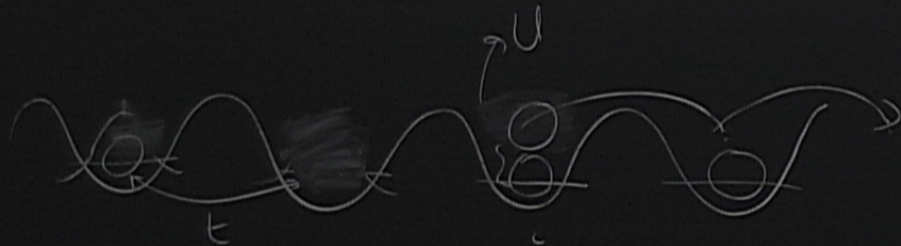
Mott insulator



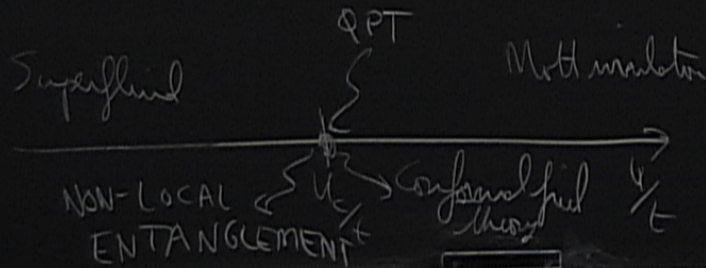
$$|SF\rangle = \left(\prod_{k=0}^+ b_k \right)^N |0\rangle = \left(\sum_i b_i \right)^N$$

$$|MI\rangle = \prod_{i=1}^N b_i^+ |0\rangle = b_1^+ + b_2^+ + \dots + b_N^+$$

Neither state is "entangled"



density of bosons = 1



b_i

$$b_k = \sum_i b_i e^{ik \cdot x_i}$$

$$|SF\rangle = \left(\prod_{k=0}^+ b_k \right)^N |0\rangle = \left(\sum_i b_i \right)^N$$

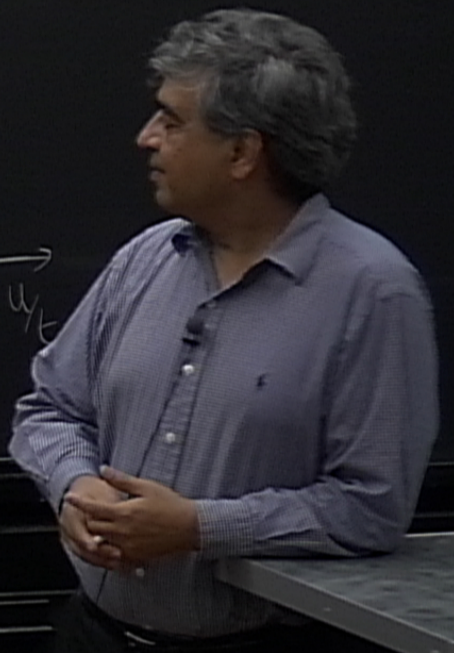
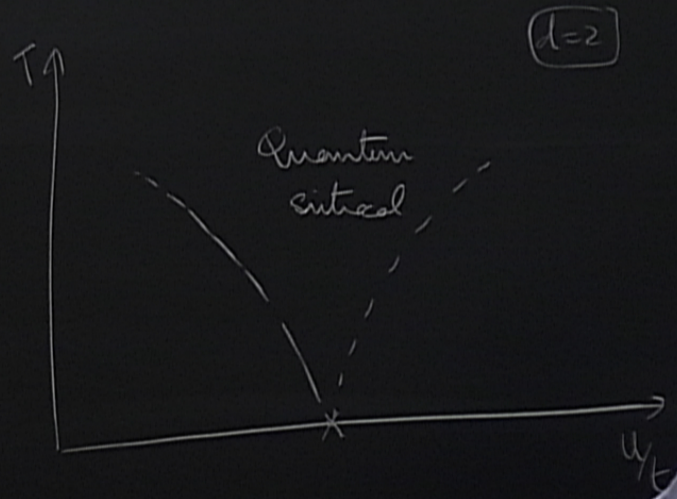
$$|MI\rangle = \prod_{i=1}^N b_i^+ |0\rangle = b_1^+ + b_2^+ + b_3^+ + \dots$$

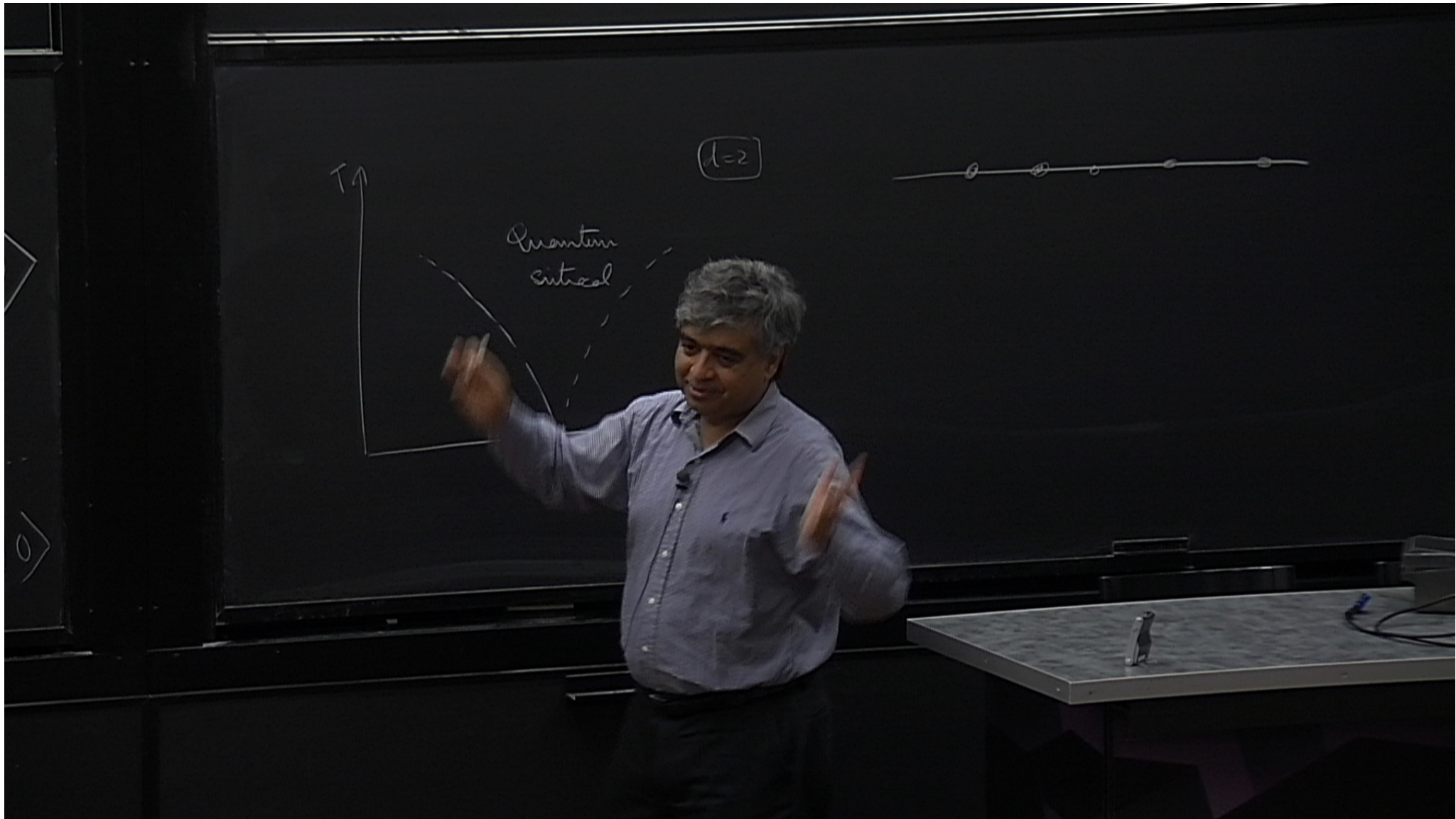
Neither state is "entangled"

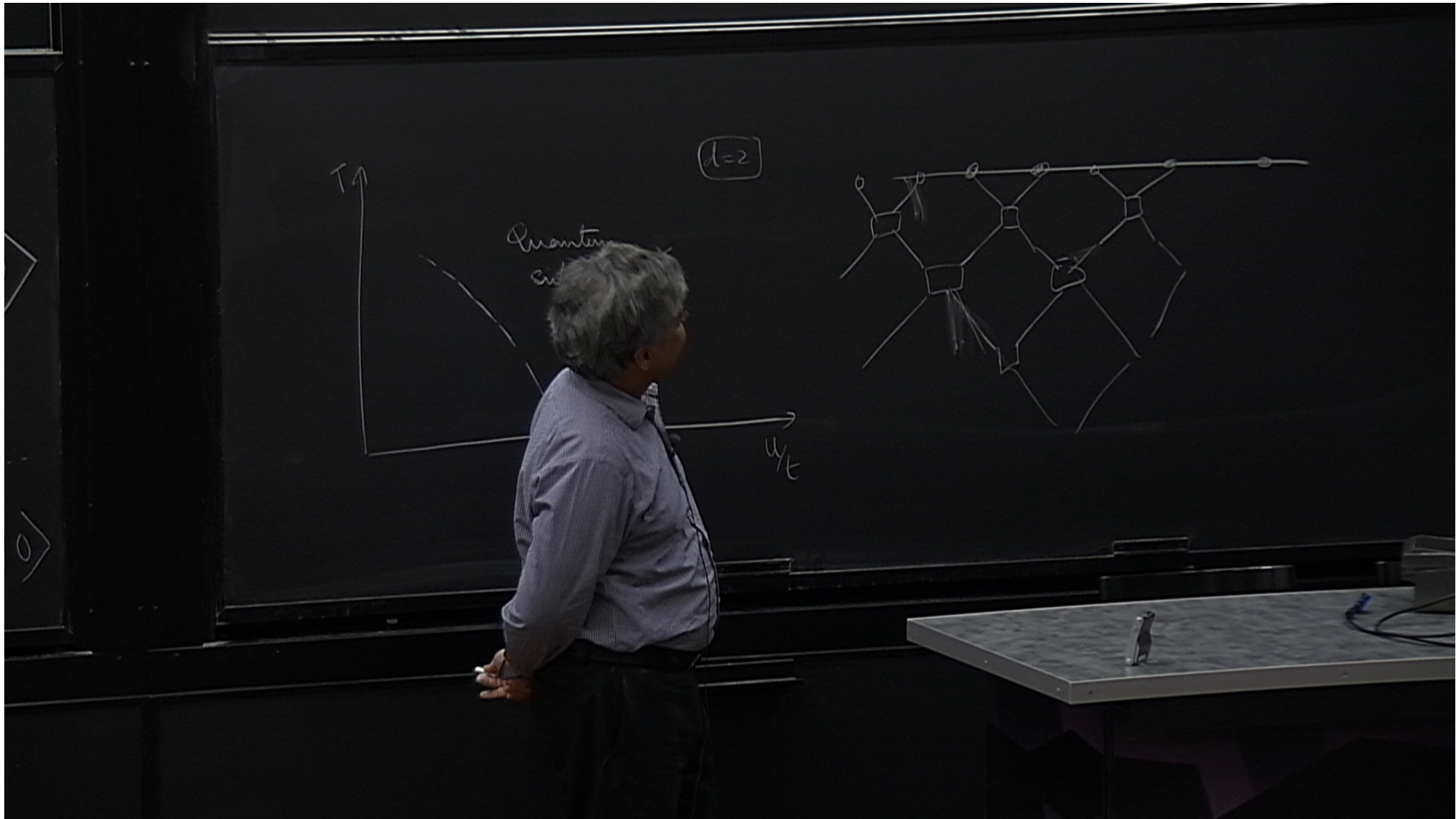
$$\sum b_i e^{ik \cdot x_i}$$

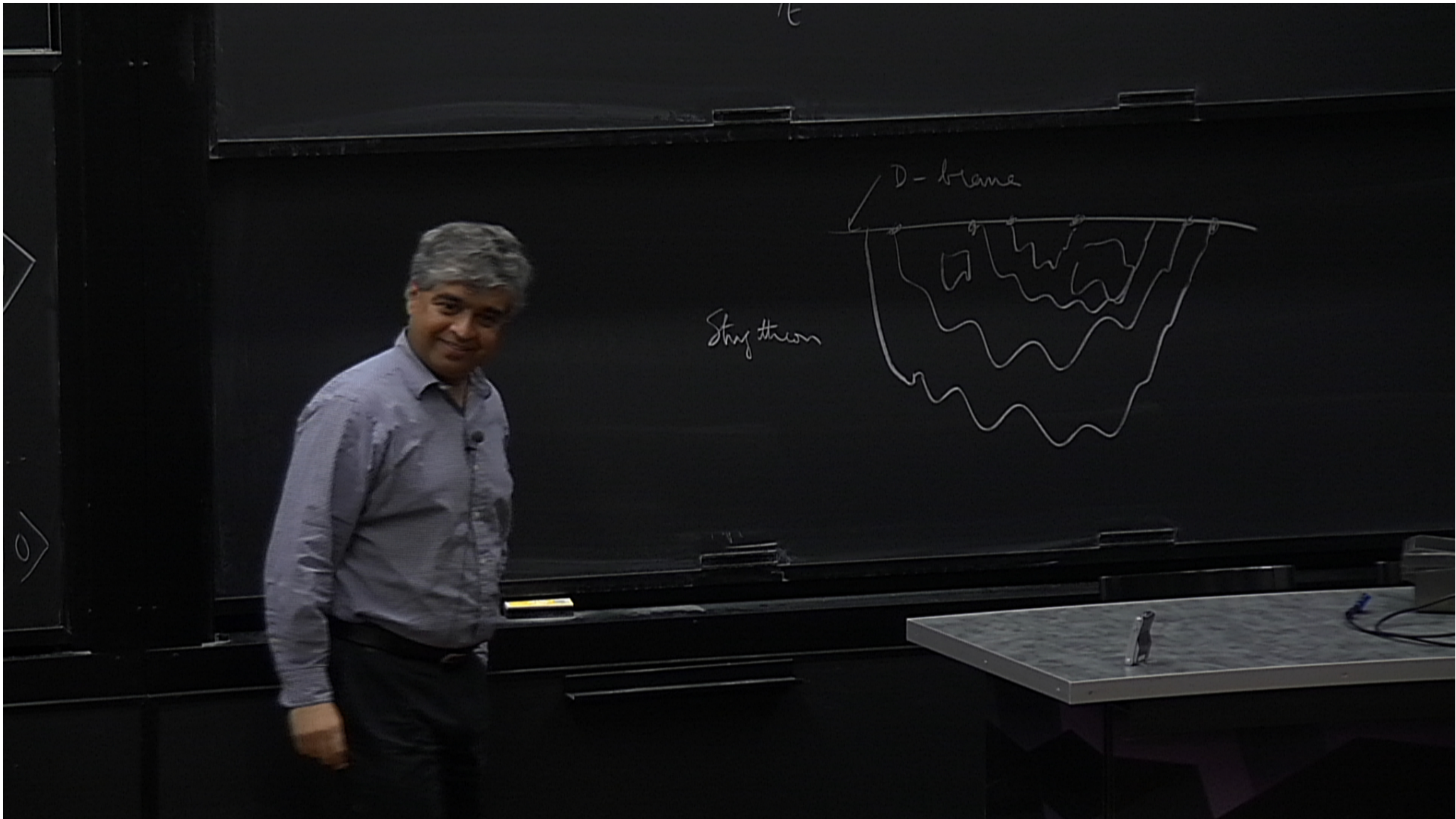
$$|0\rangle = \left(\sum_i b_i^\dagger \right)^N |0\rangle$$

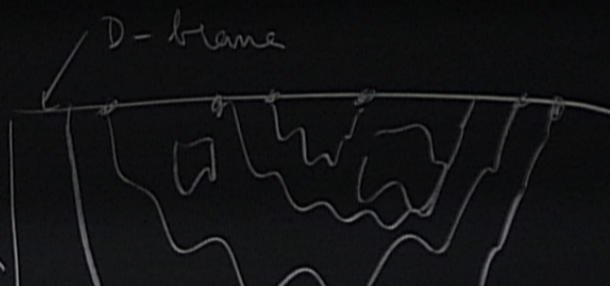
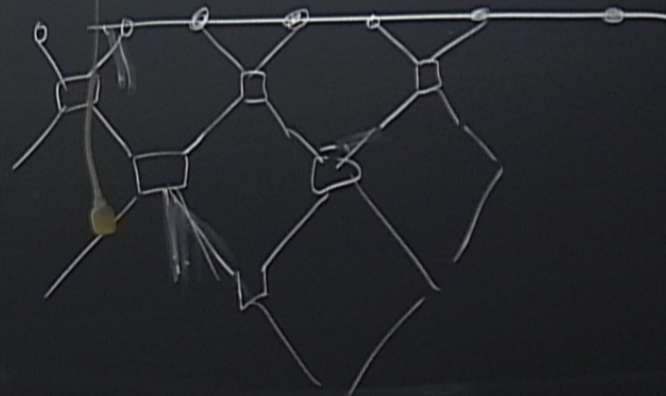
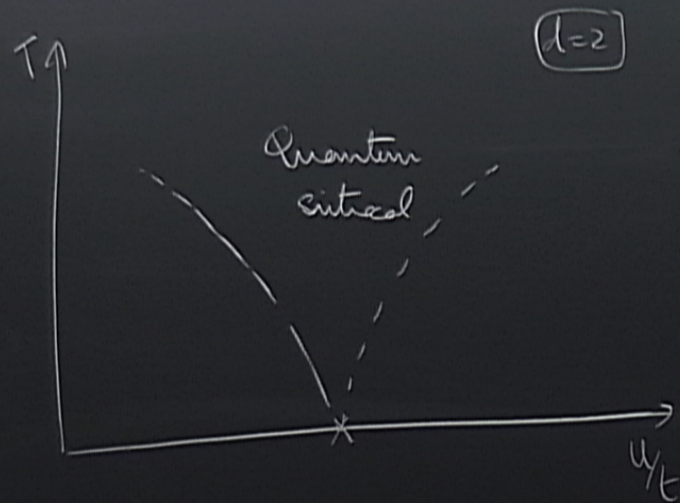
$$= \left. \begin{aligned} & b_1^{\dagger 3} + b_2^{\dagger 3} + b_3^{\dagger 3} \\ & + b_1^{\dagger 2} b_2 + \dots \\ & + b_1^\dagger b_2^\dagger b_3^\dagger |0\rangle \end{aligned} \right\} \text{ "neglected"}$$

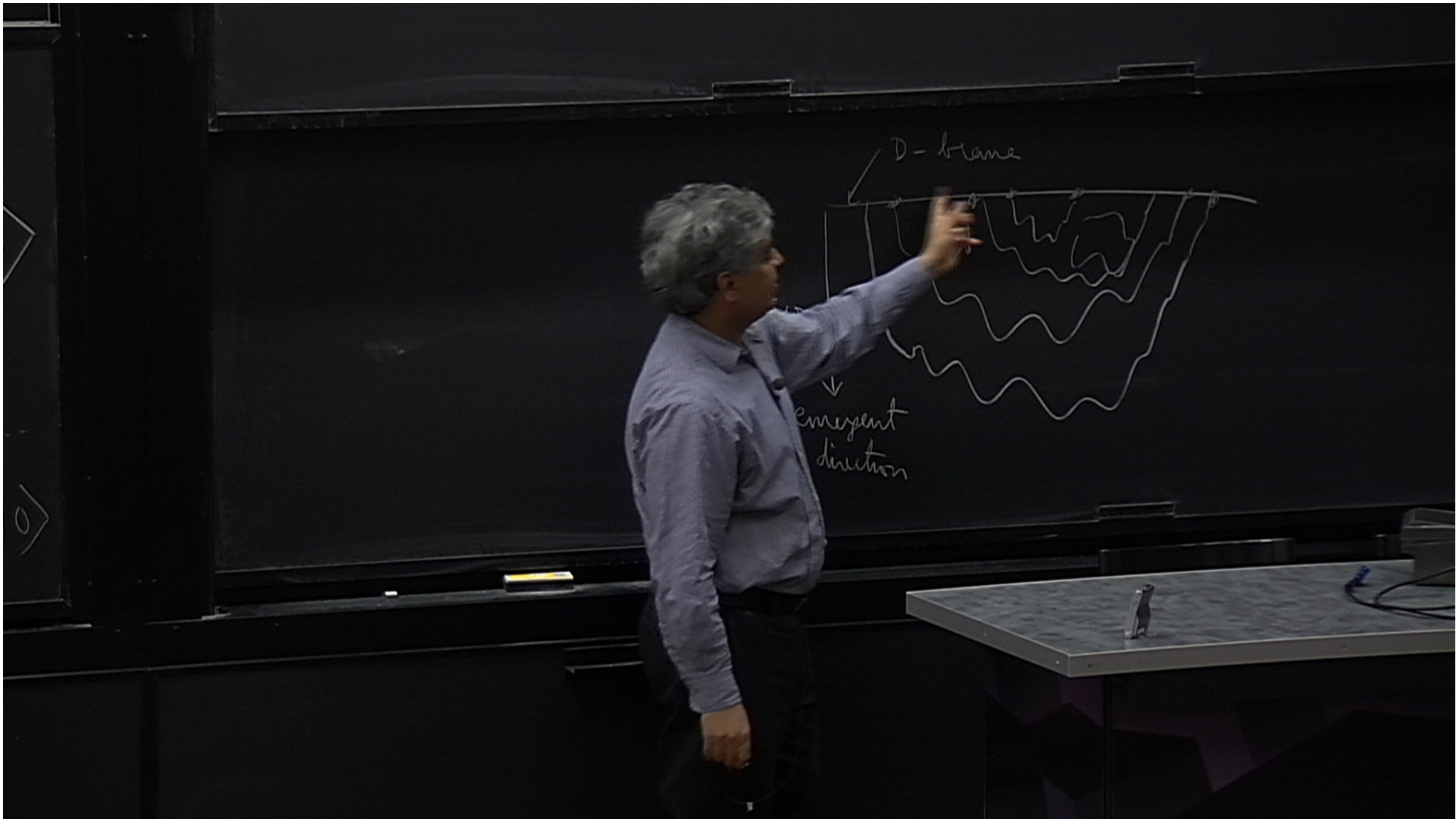












CFT in D dimensions



String theory in $D+1$ dimensions

String theory

emergent direction

