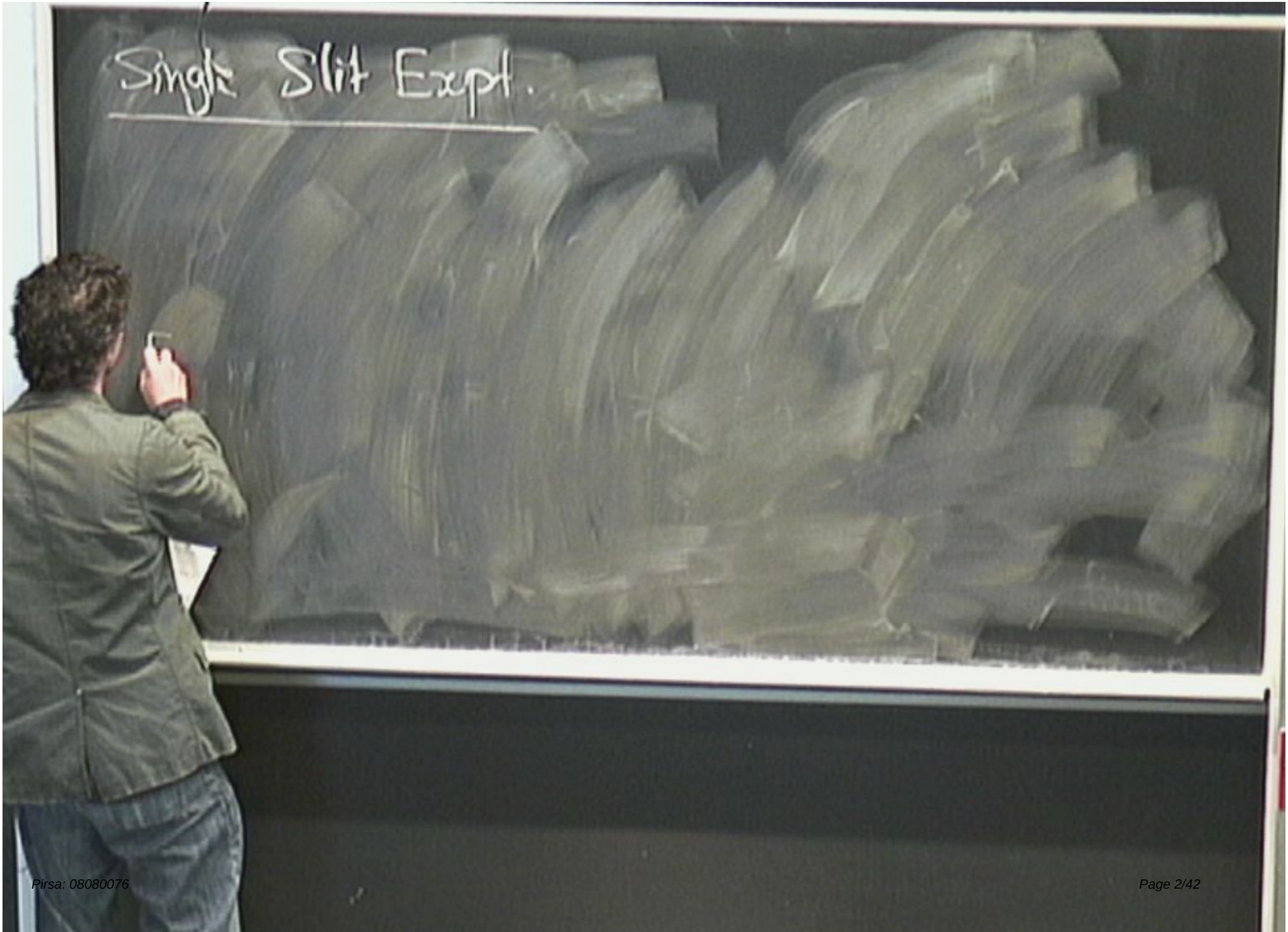
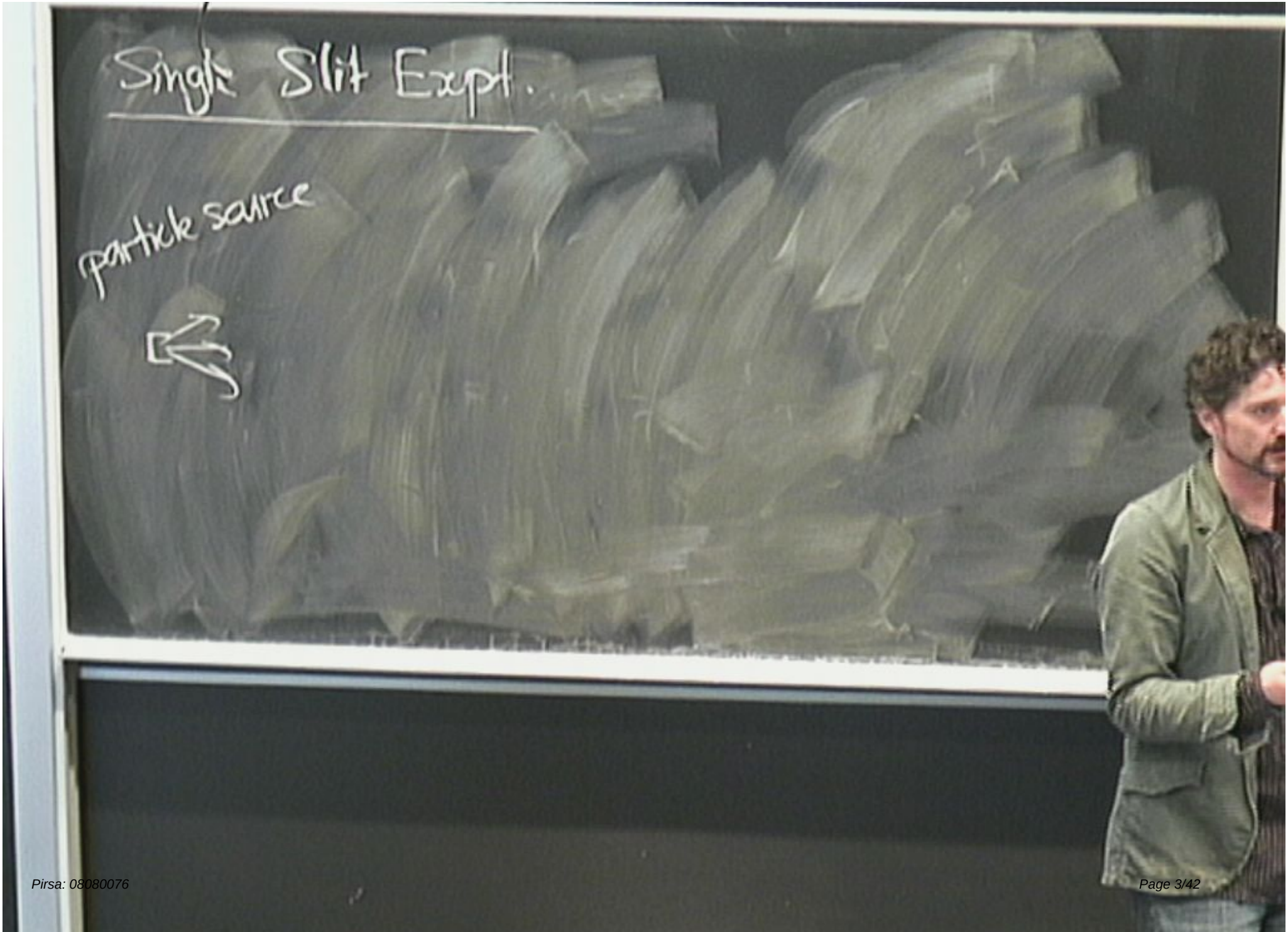
Title: Quantum Mechanics 1: An Experimental Introduction to Quantum Mechanics

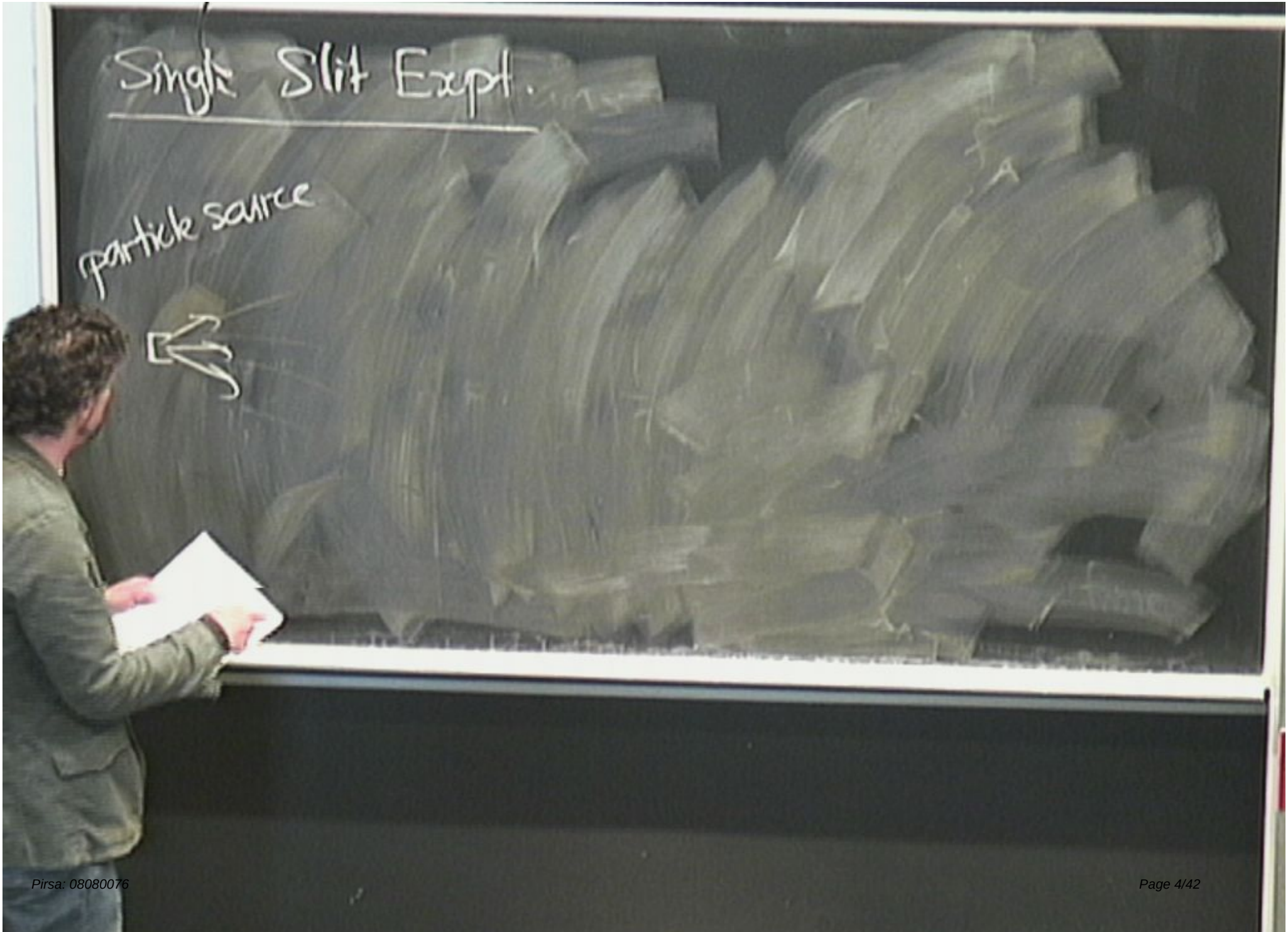
Date: Aug 10, 2008 10:30 AM

URL: http://pirsa.org/08080076

Abstract: A discussion of the surprising results of the single slit and double slit experiments.
Learning Outcomes:
â€¢ How the single slit experiment suggests that chance is at the heart of nature, and that the behaviour of particles might need to be described by something different from Newtonâ€™s laws.
â€¢ How the double slit experiment suggests that understanding the behaviour of particles will require a radically new way of thinking about how nature works at a fundamental level.
â€¢ A video of an actual double slit experiment done with a beam of electrons (in case you donâ€™t believe it).


Single Slit Expt.


Single Slit Expt.
particle source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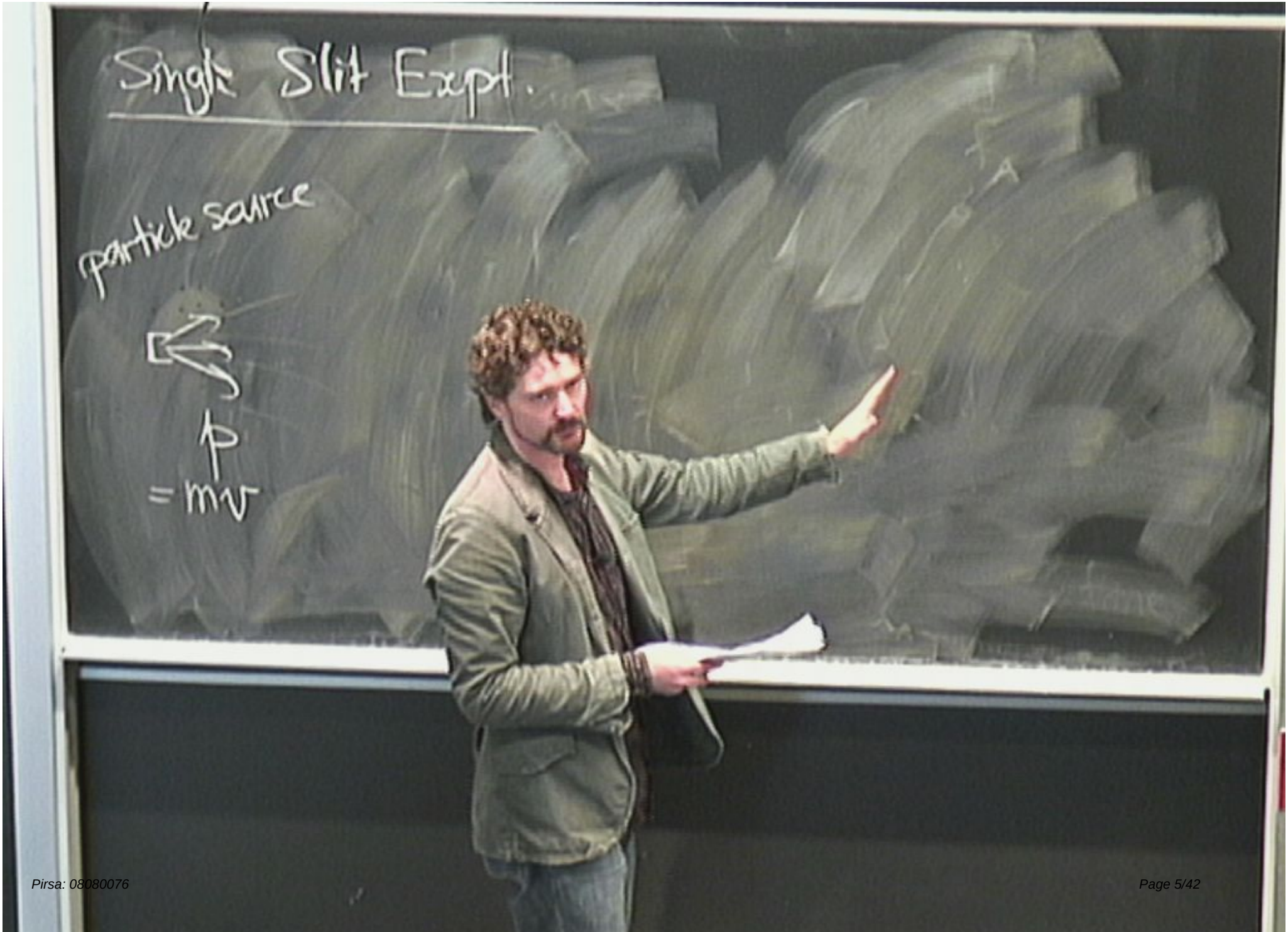
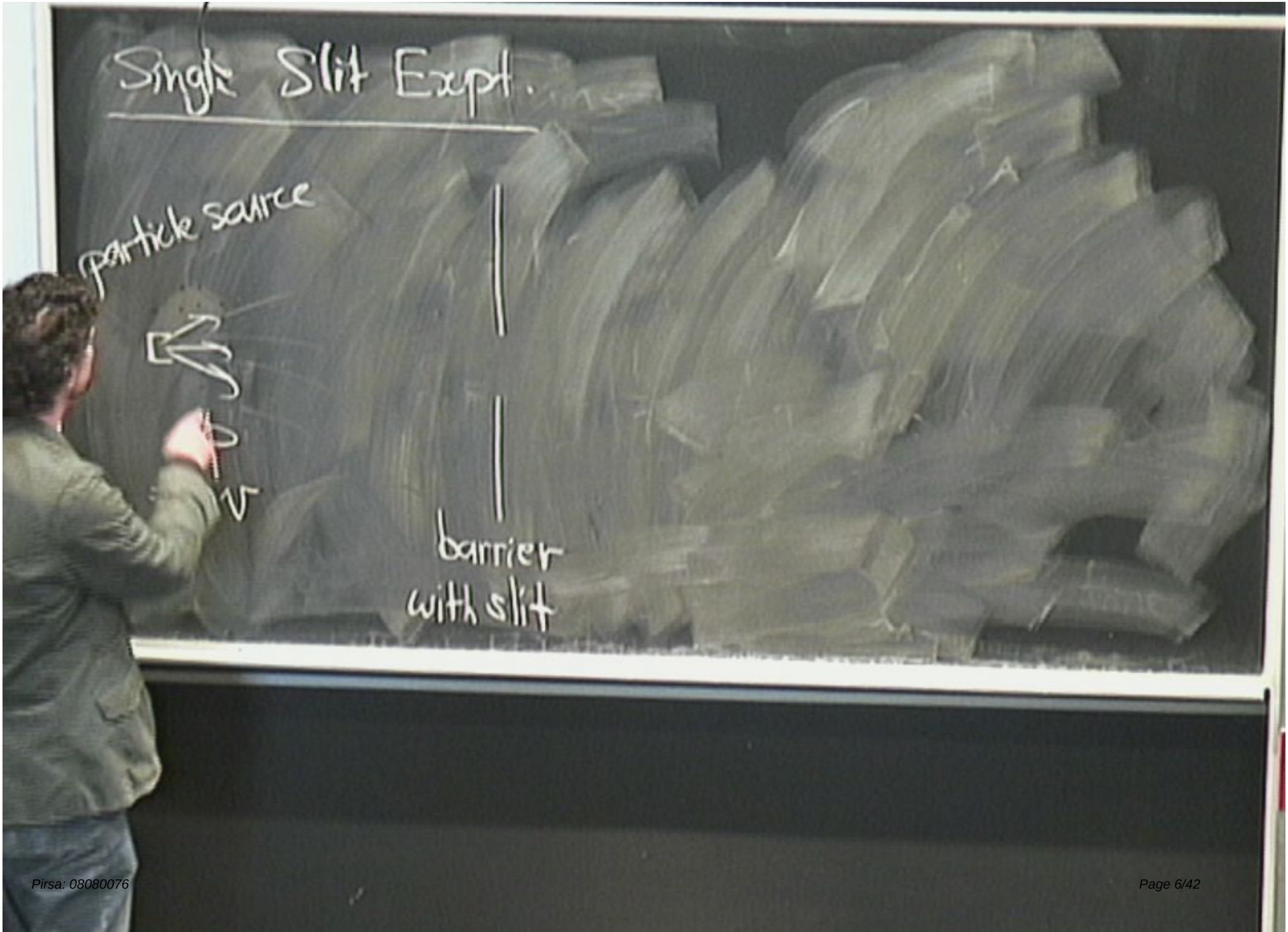
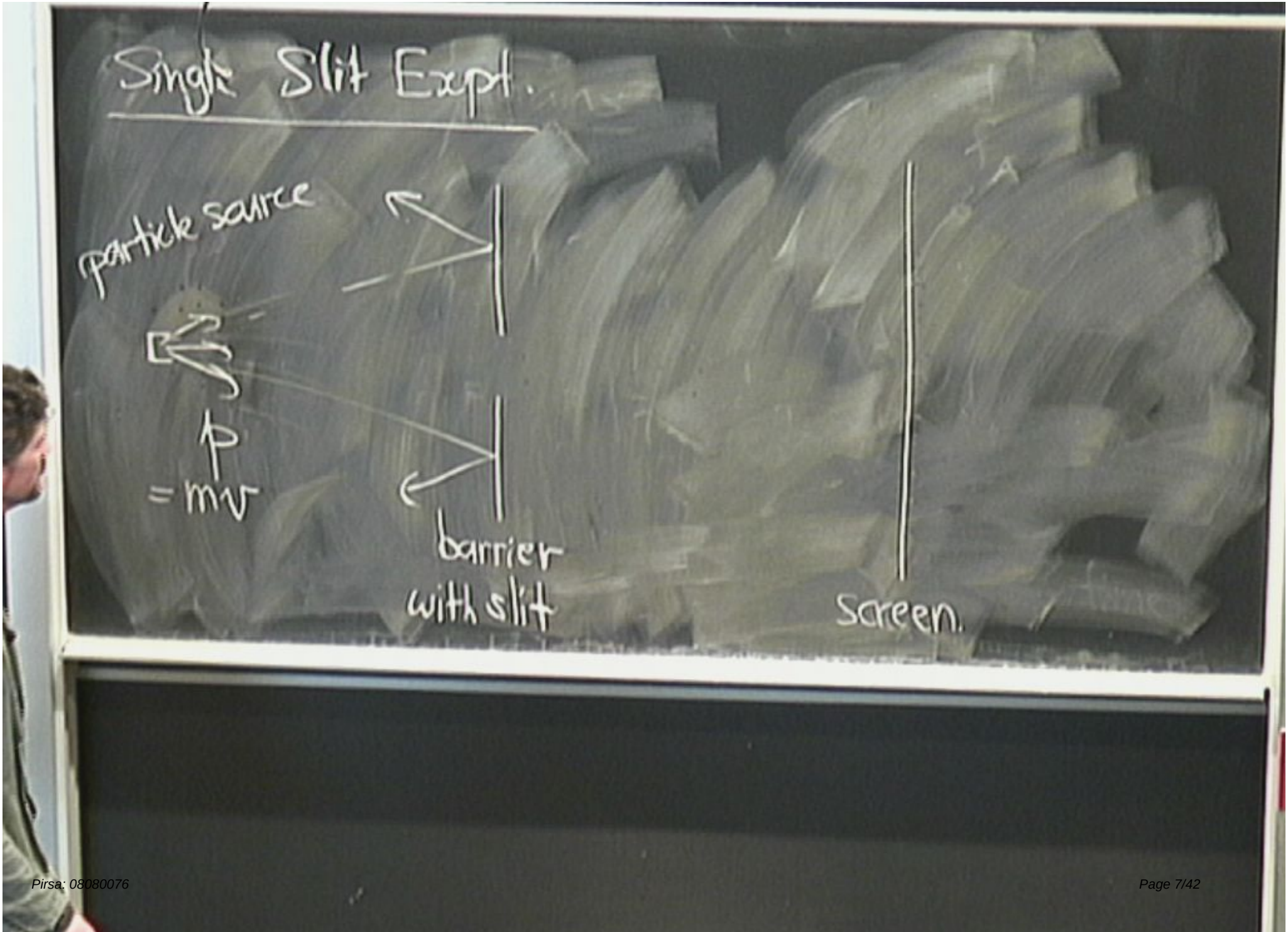
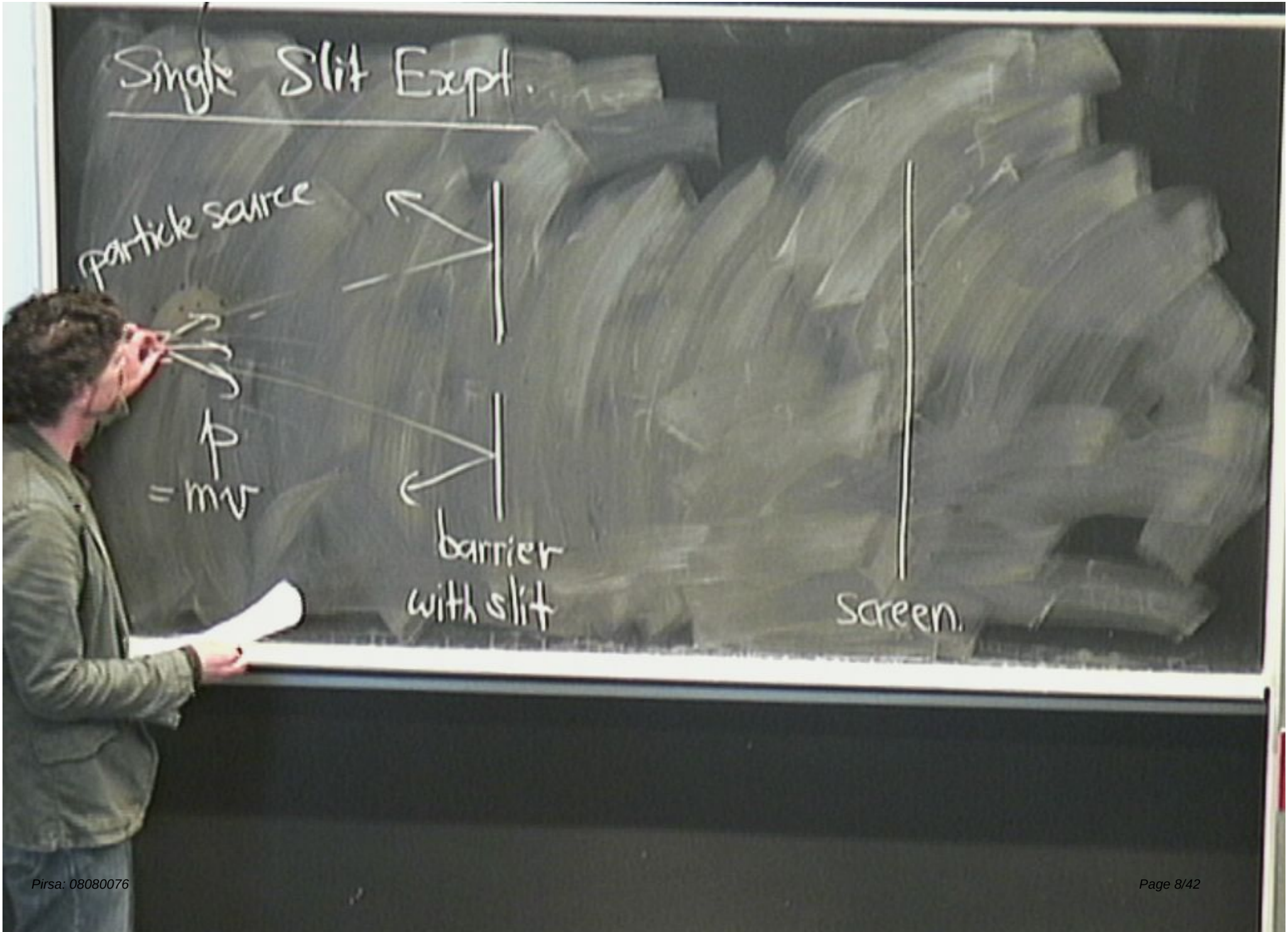
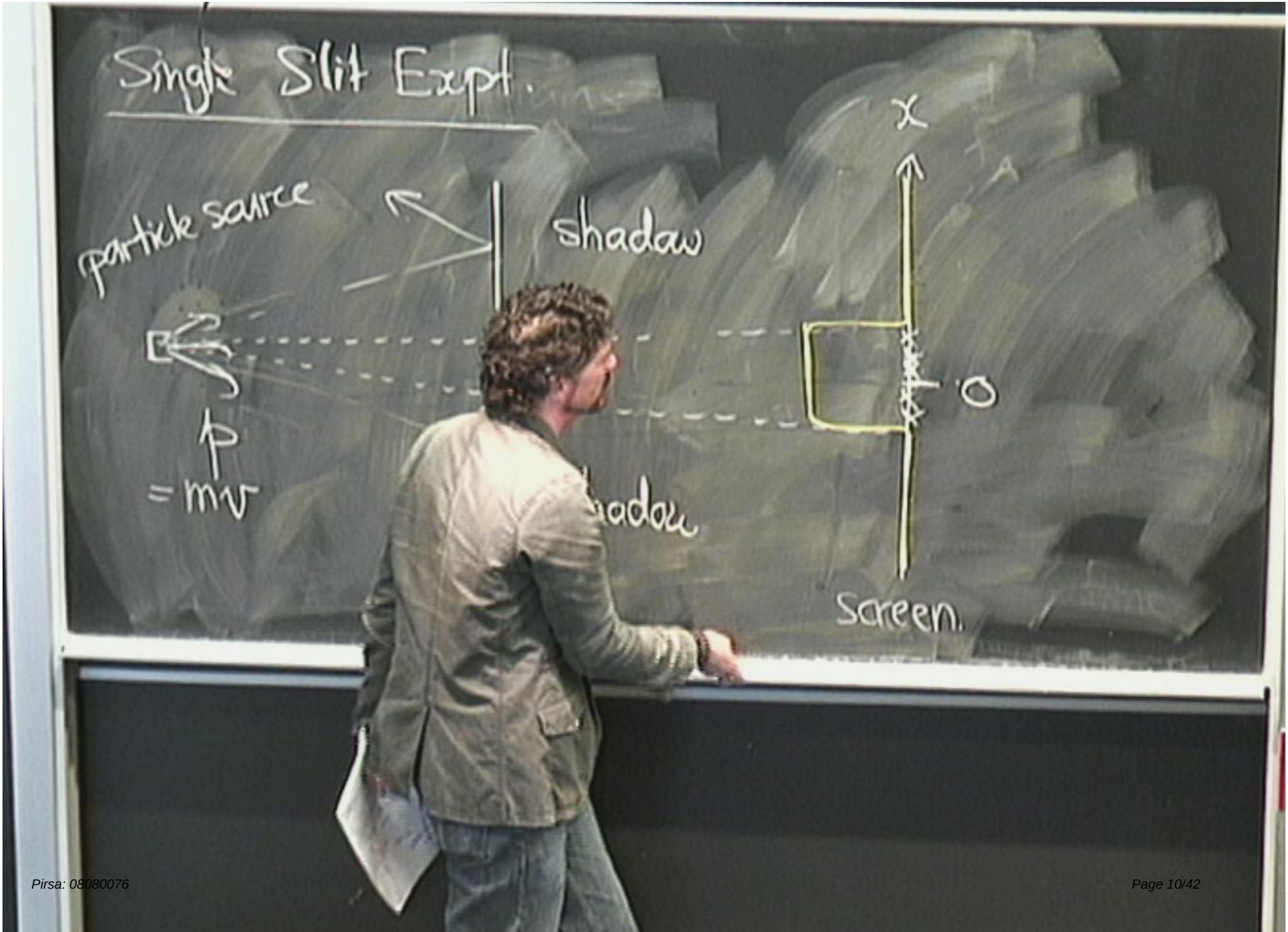

Single Slit Expt.
particle source
p
= mv

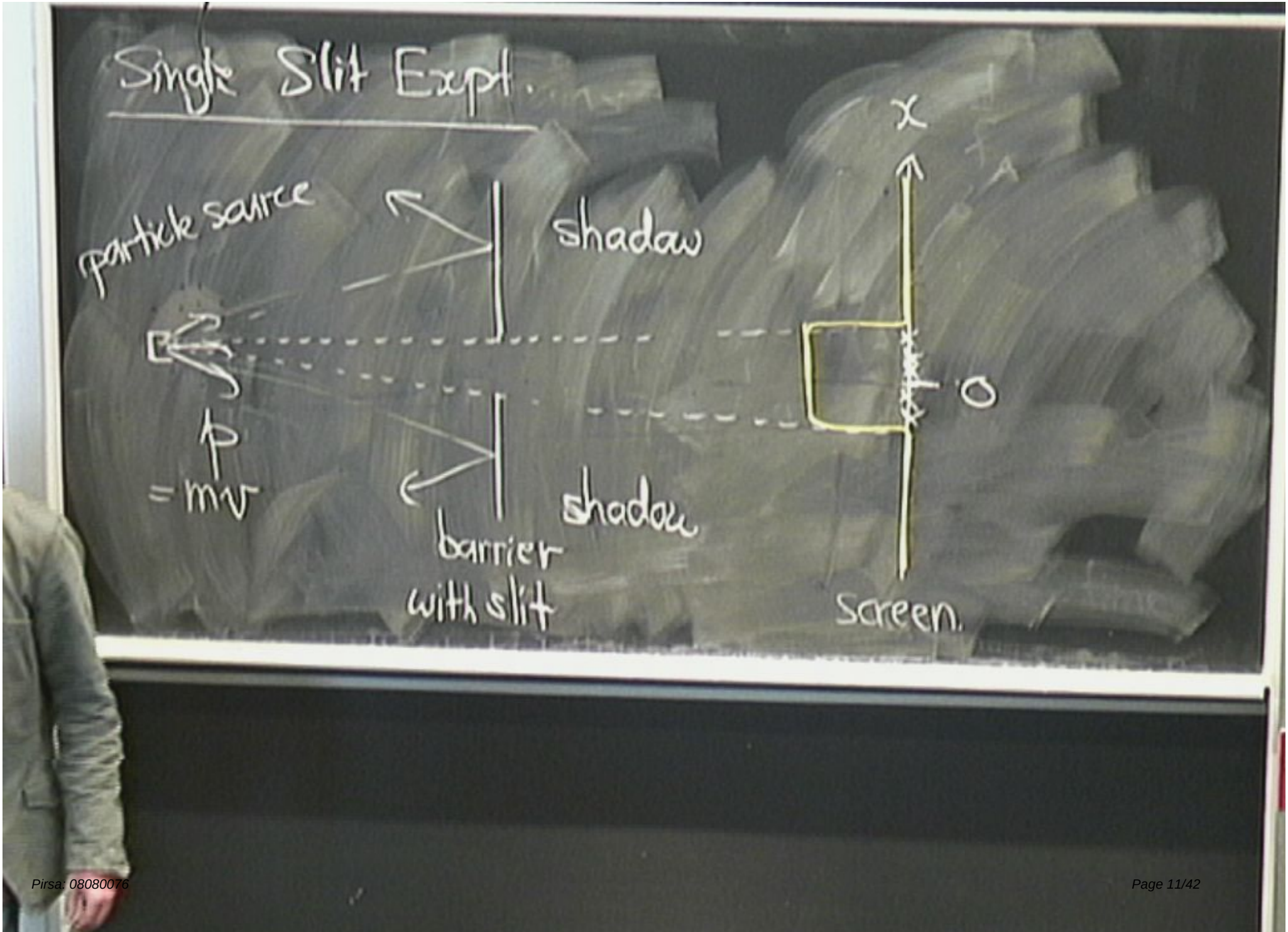

Single Slit Expt.
particle source
barrier
with slit

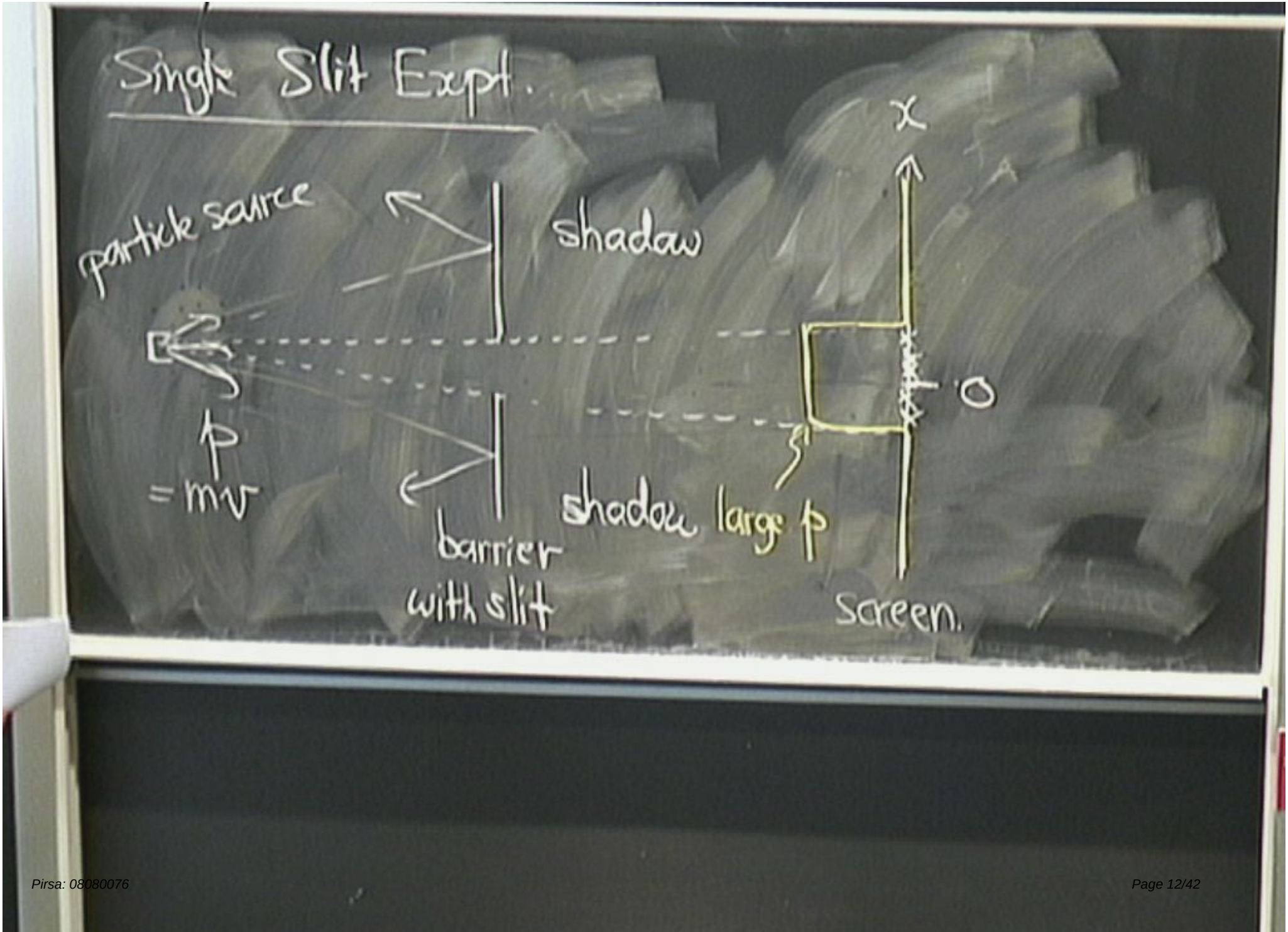

Single Slit Expt.
particle source
p
= mv
barrier
with slit
Screen.

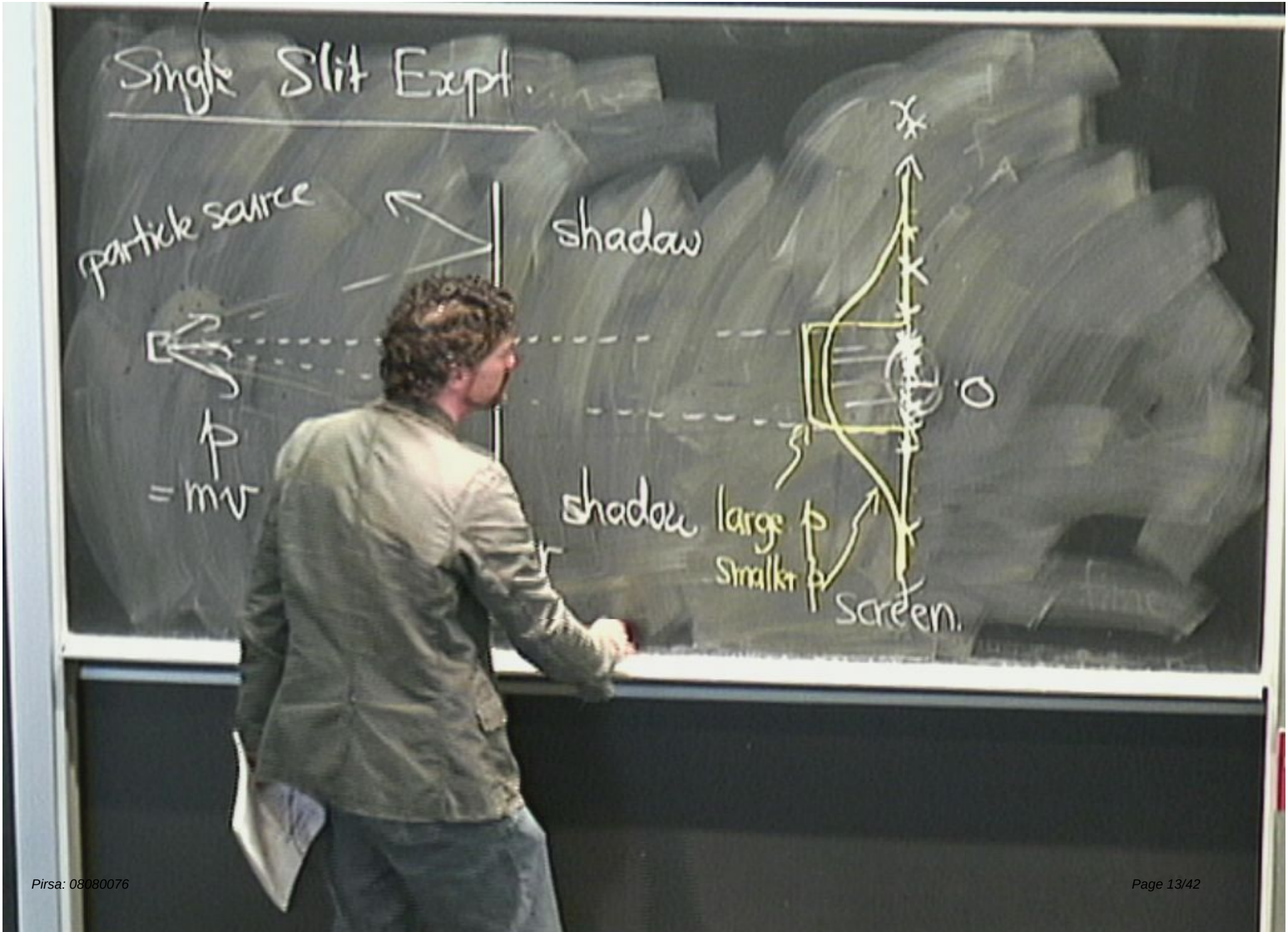

Single Slit Expt.
particle source
p
= mv
barrier
with slit
Screen.

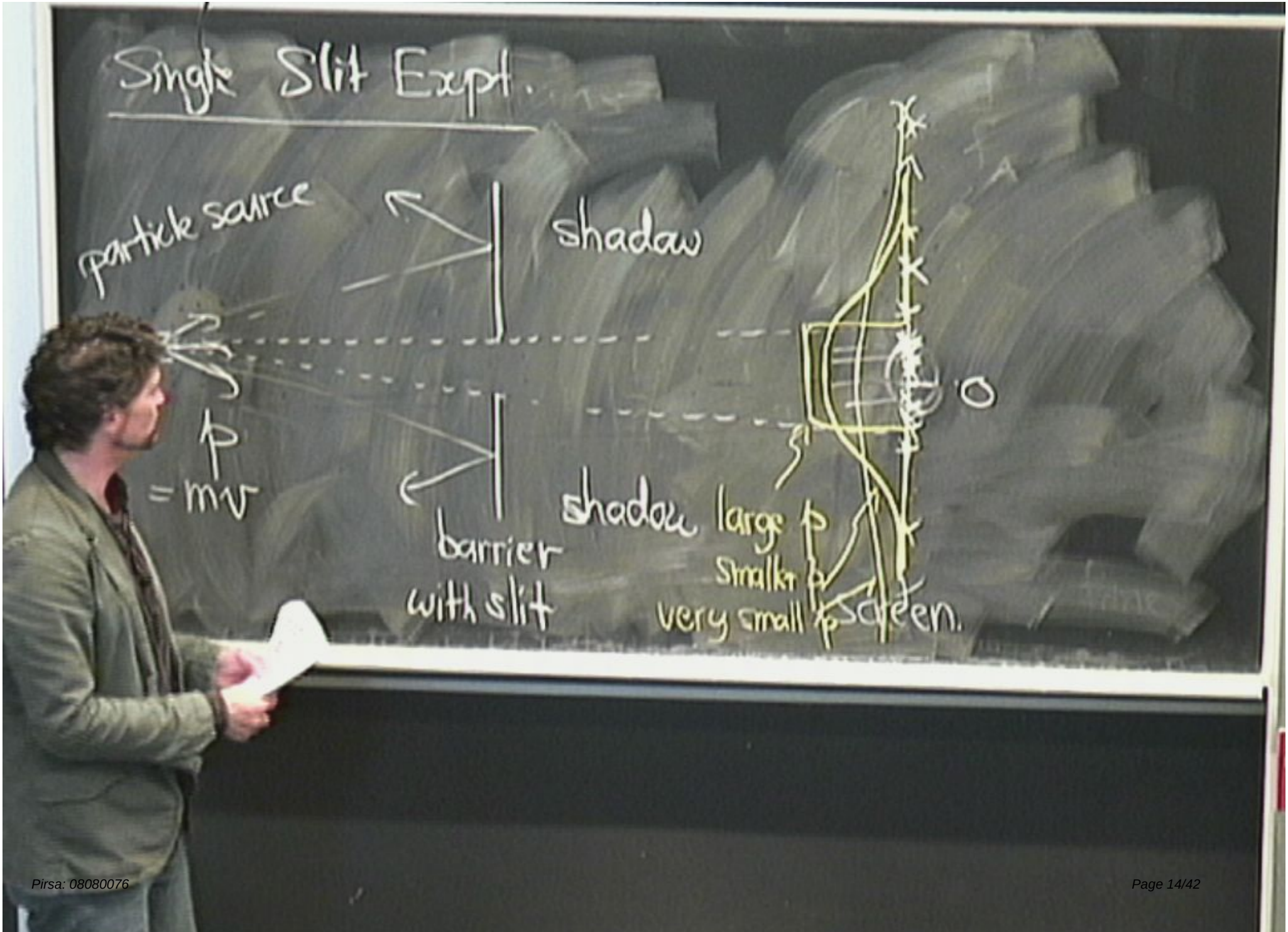

Single Slit Expt.
particle source
shadow
x
A
O
Screen.

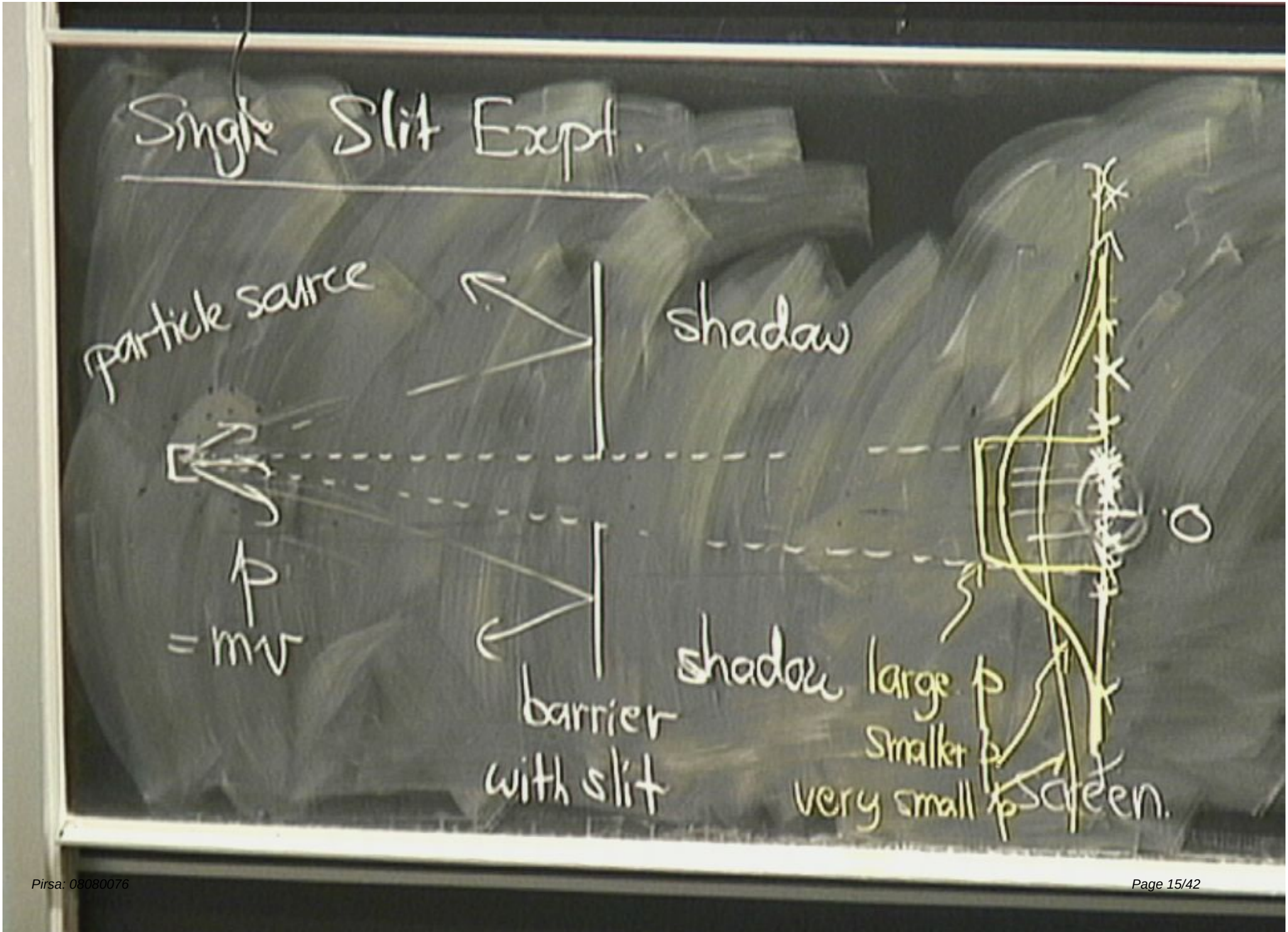

Single Slit Expt.
particle source
shadow
x
A
O
p
= mv
Screen.

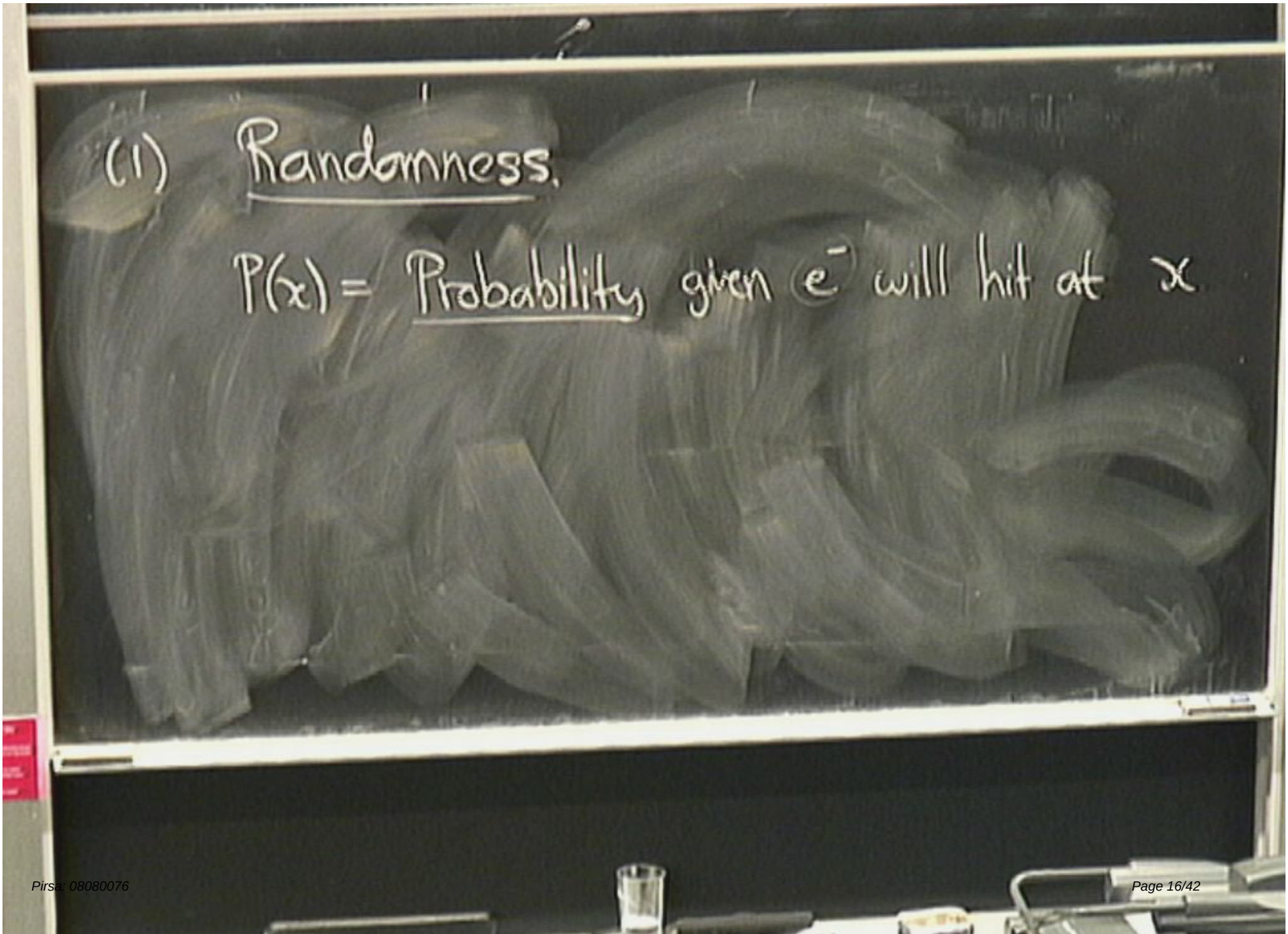

Single Slit Expt.
particle source
shadow
x
A
O
p
= mv
shadow
barrier
with slit
Screen.

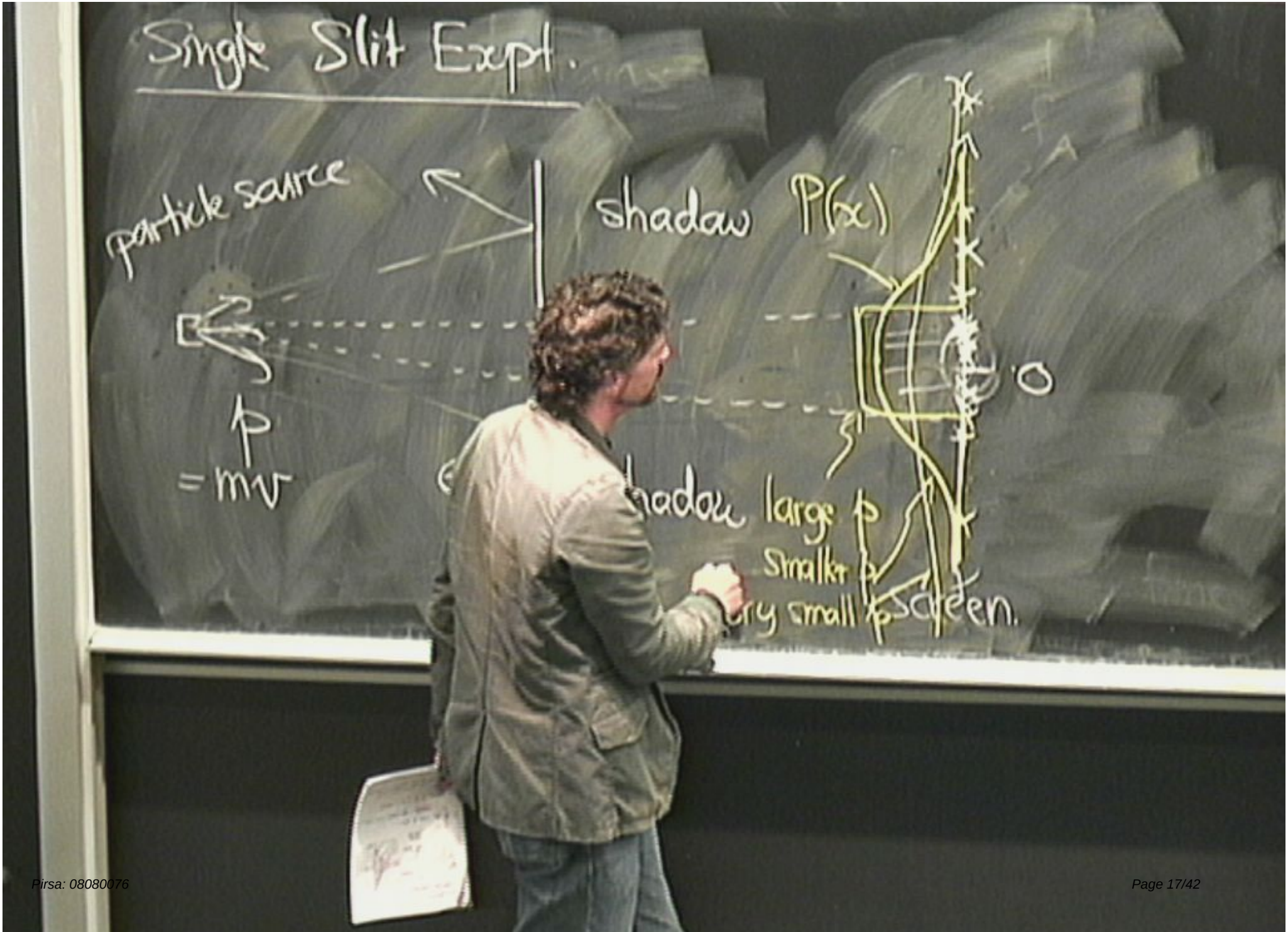

Single Slit Expt.
particle source
shadow
x
O
p
= mv
barrier
with slit
shadow
large p
Screen.


Single Slit Expt.
particle source
shadow
p
= mv
shadow large
smaller
Screen.
O


Single Slit Expt.
particle source
shadow
p
= mv
barrier
with slit
shadow
large p
Smaller p
very small p
screen.
O


Single Slit Expt.
particle source
shadow
p
= mv
barrier
with slit
shadow
large p
smaller p
very small p
screen.
O

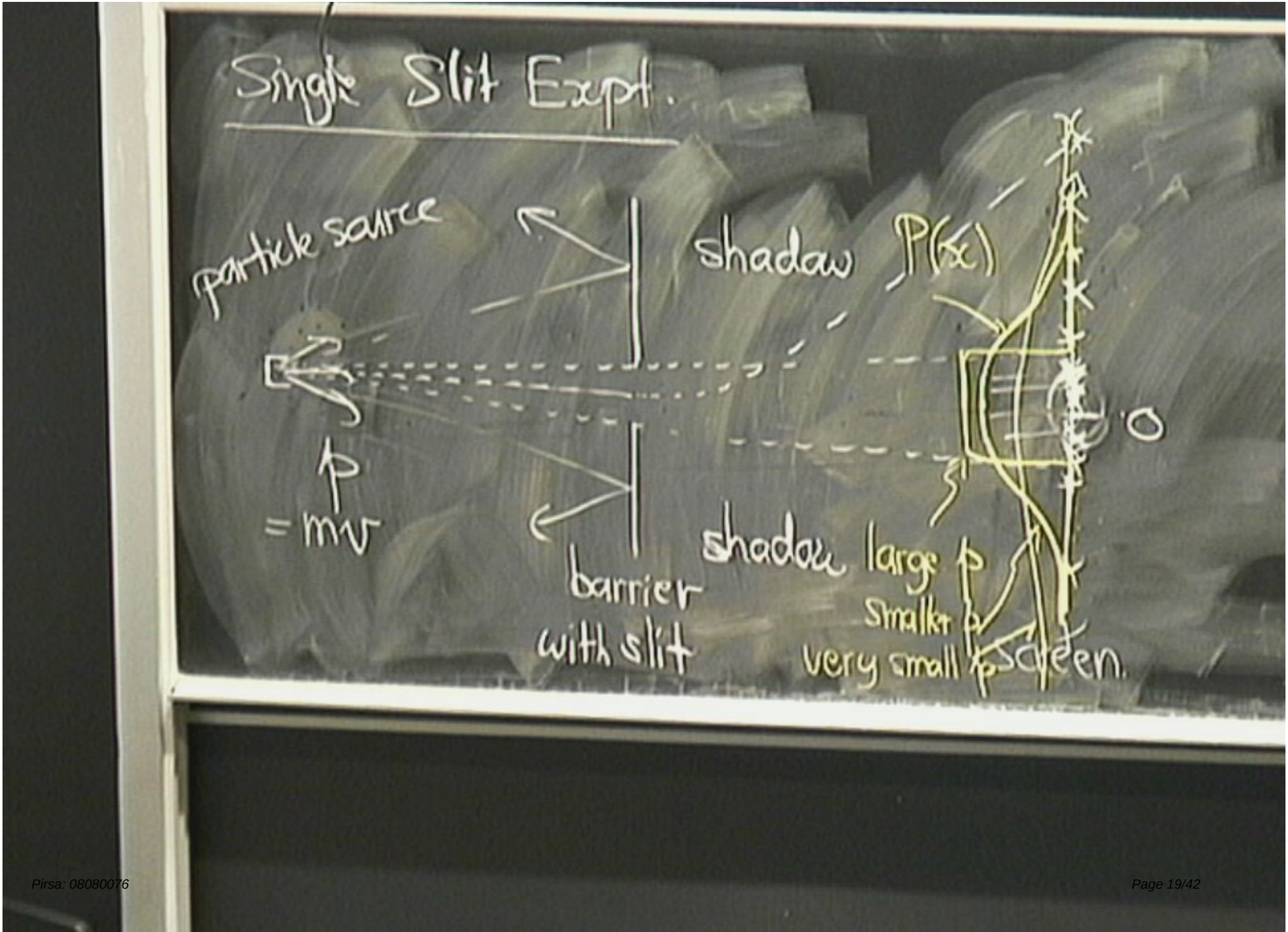

(1) Randomness.
P(x) = Probability given e⁻ will hit at x


Single Slit Expt.
particle source
shadow
P(x)
p
= mv
shadow large p
Smaller p
very small p
screen.

(1) Randomness.

$P(x)$ = Probability given e^- will hit at x

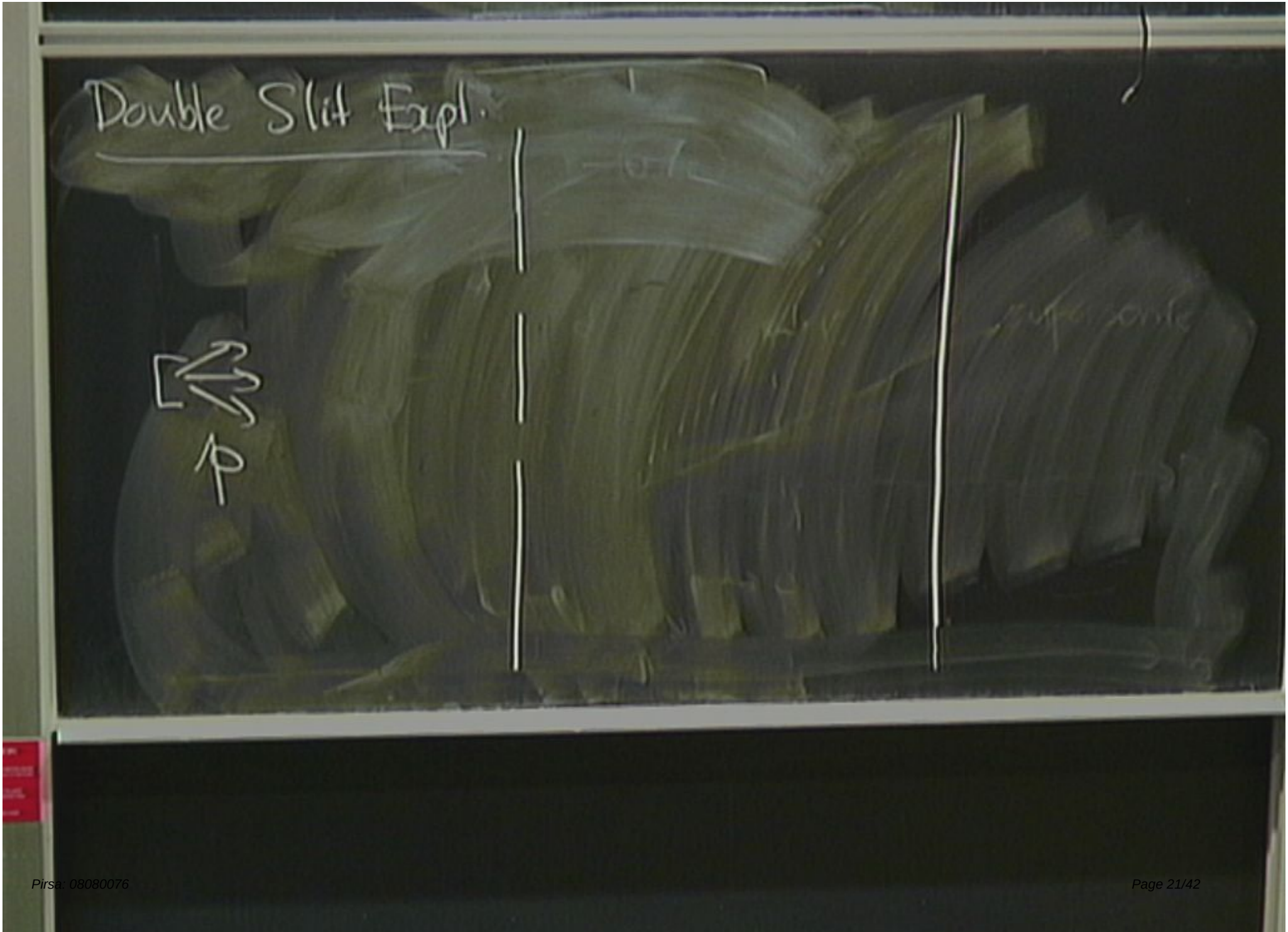
(2) Spreading (as ϕ is reduced)

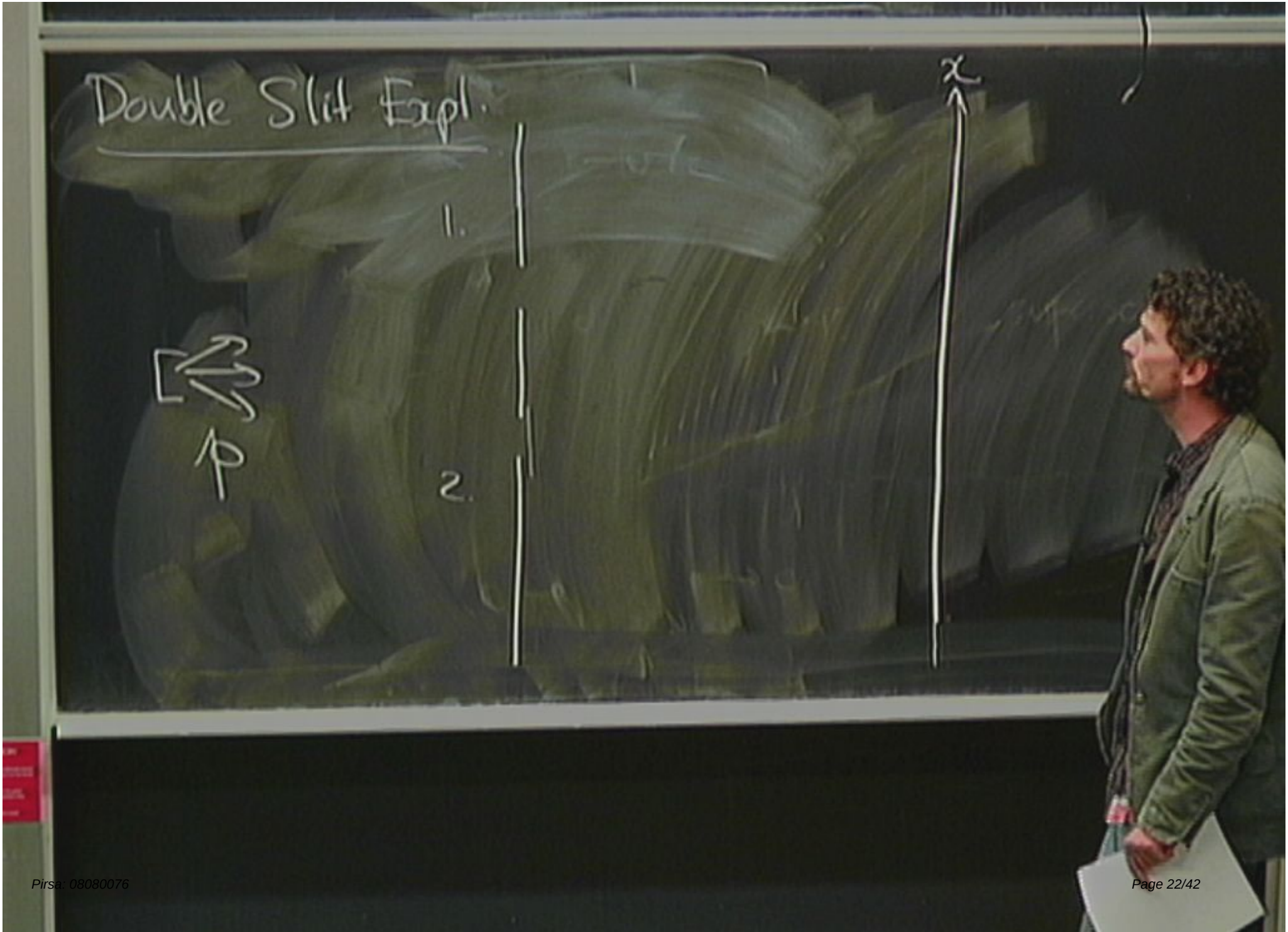

Single Slit Expt.
particle source
shadow
P(x)
0
= mv
barrier
with slit
shadow
large p
Smaller p
very small p
screen.

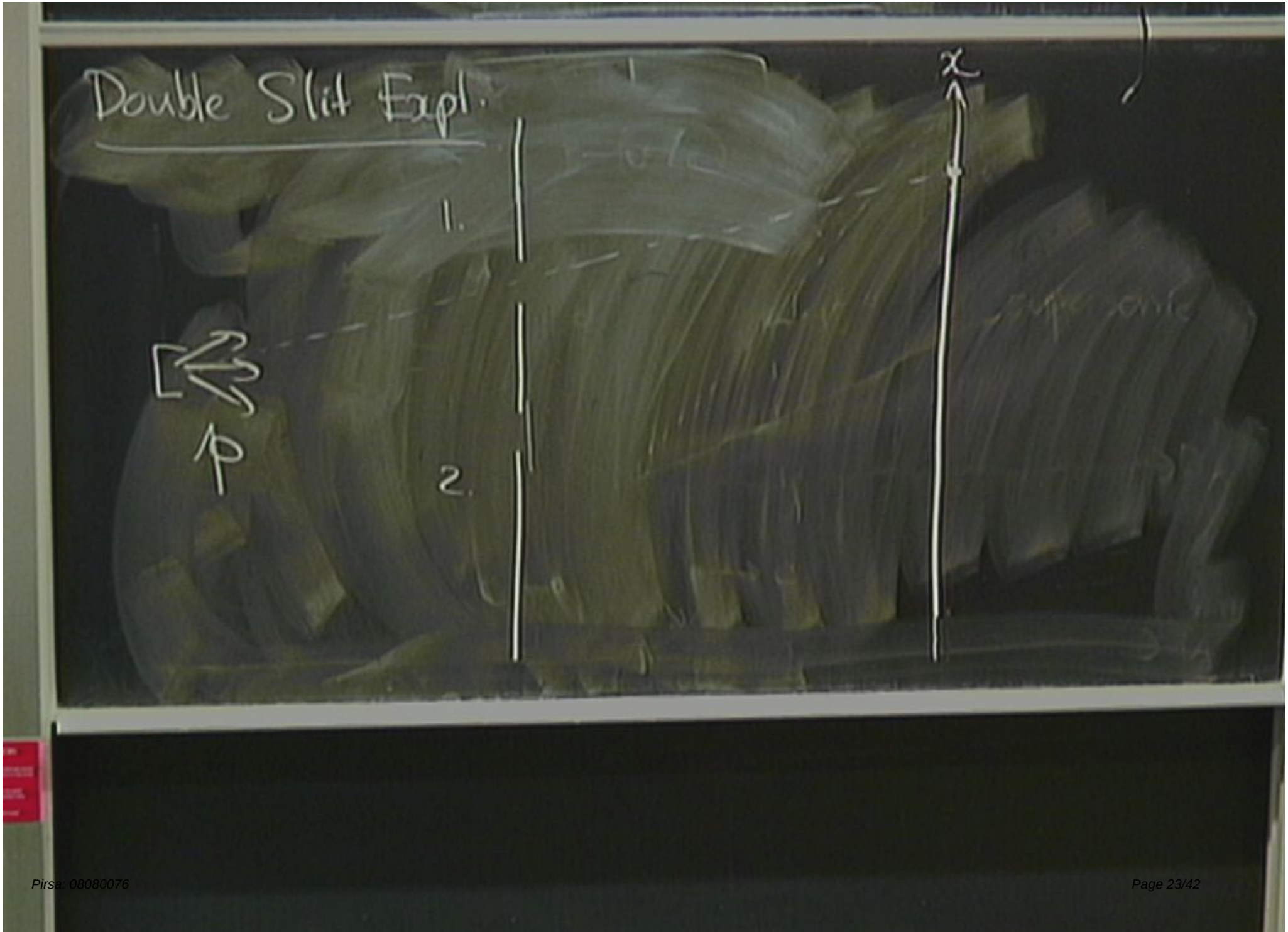
(1) Randomness.

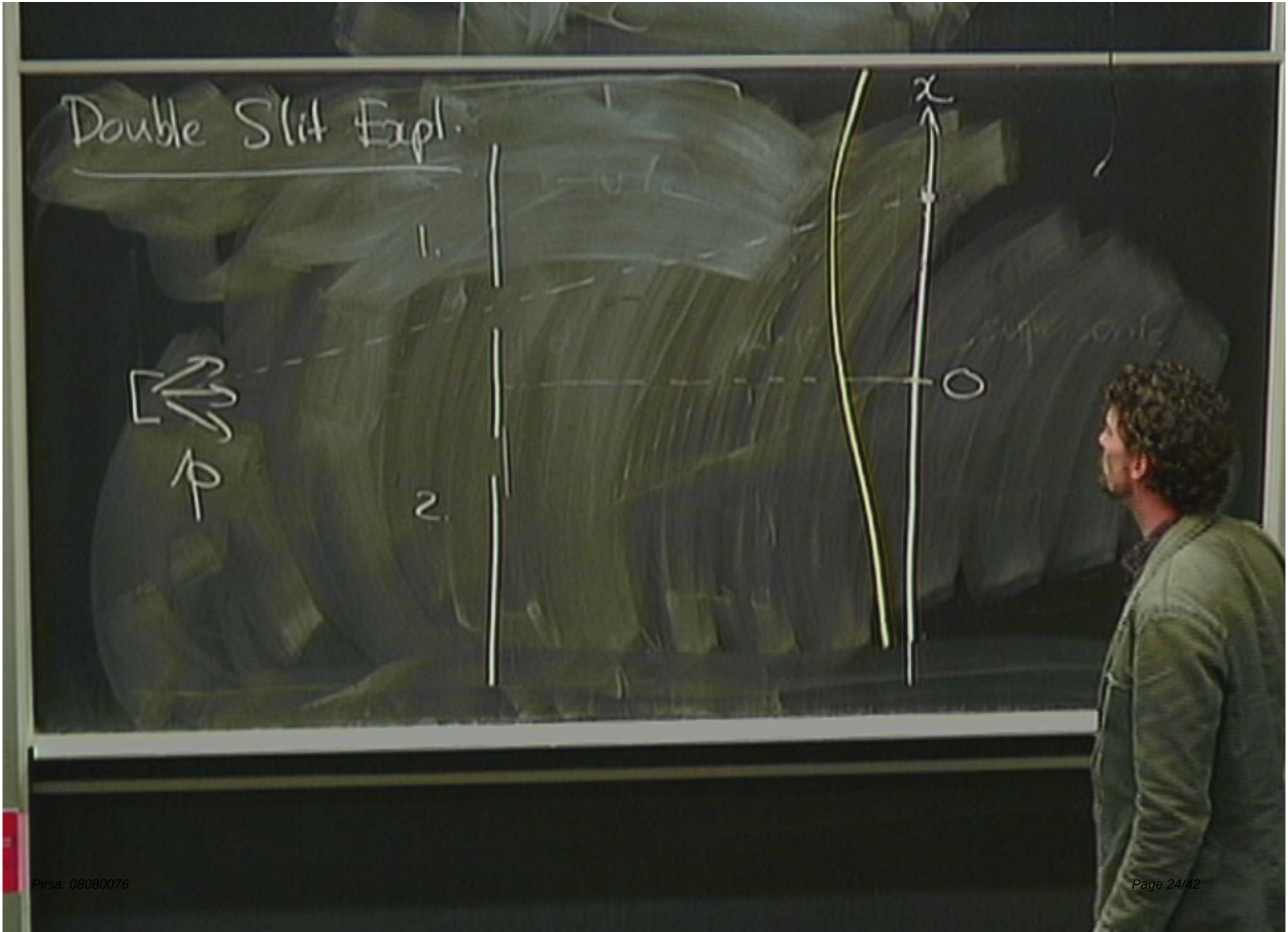
$P(x)$ = Probability given e^- will hit at x

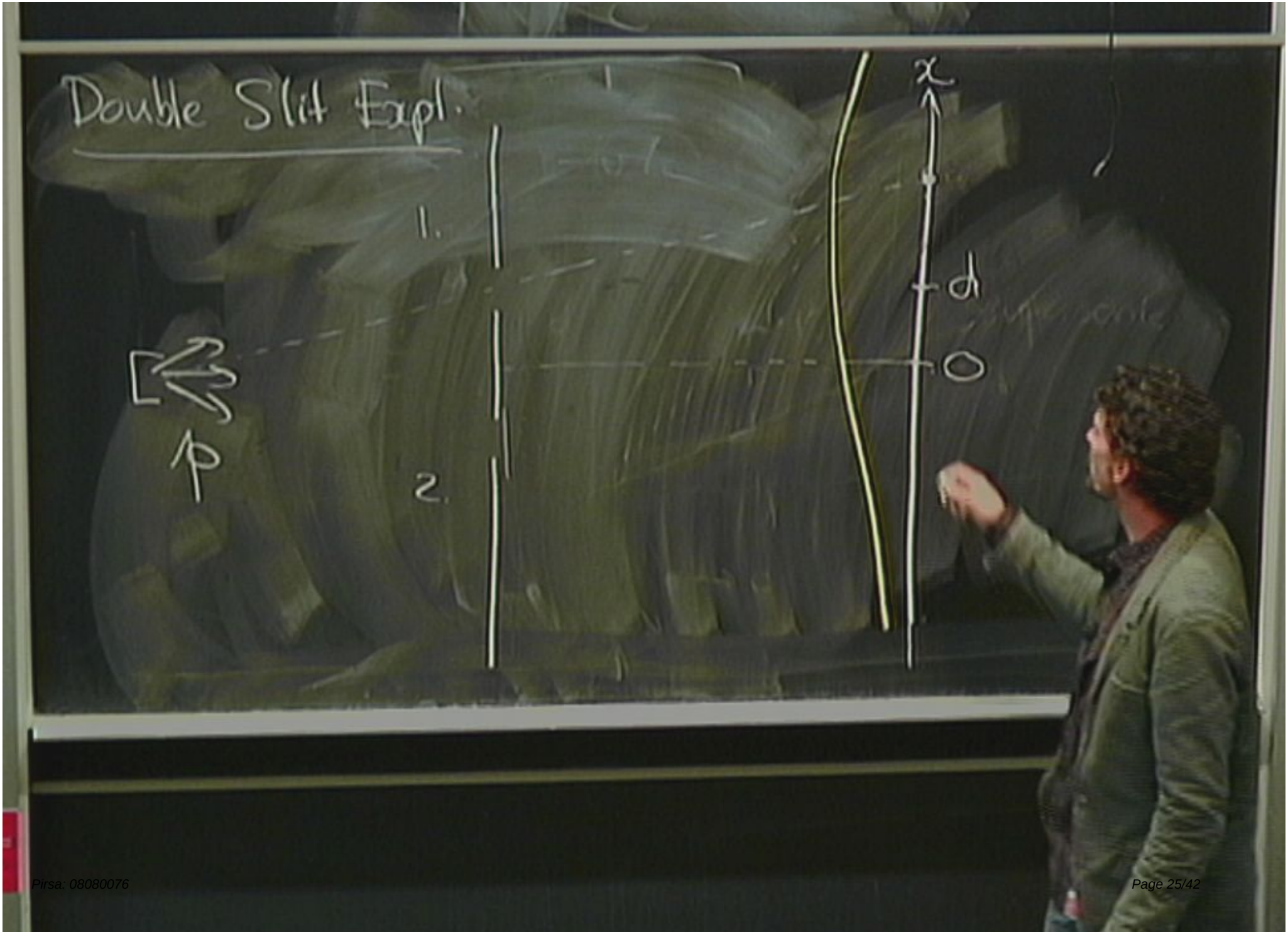
(2) Spreading (as ϕ is reduced)

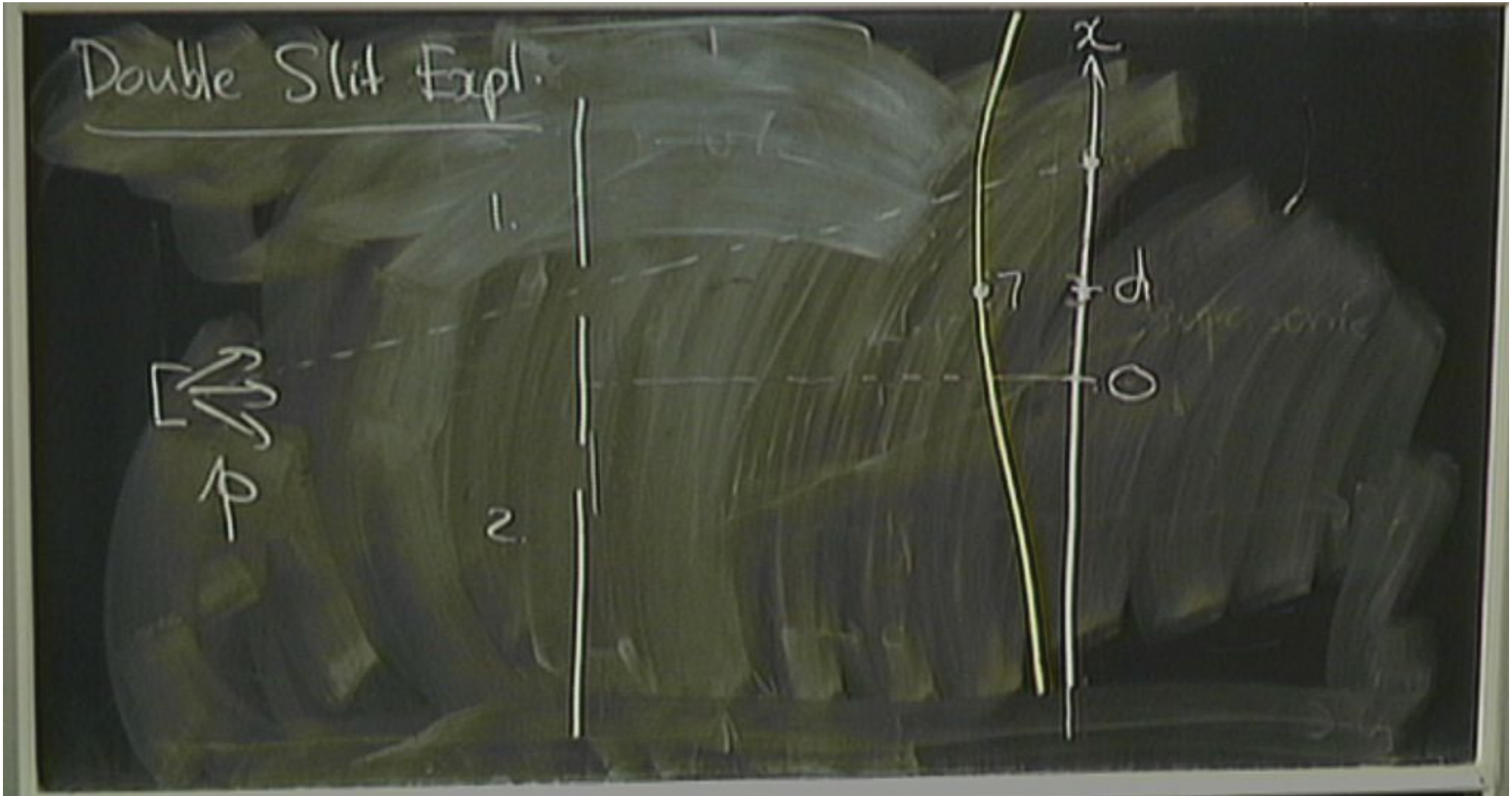

Double Slit Expl.
p

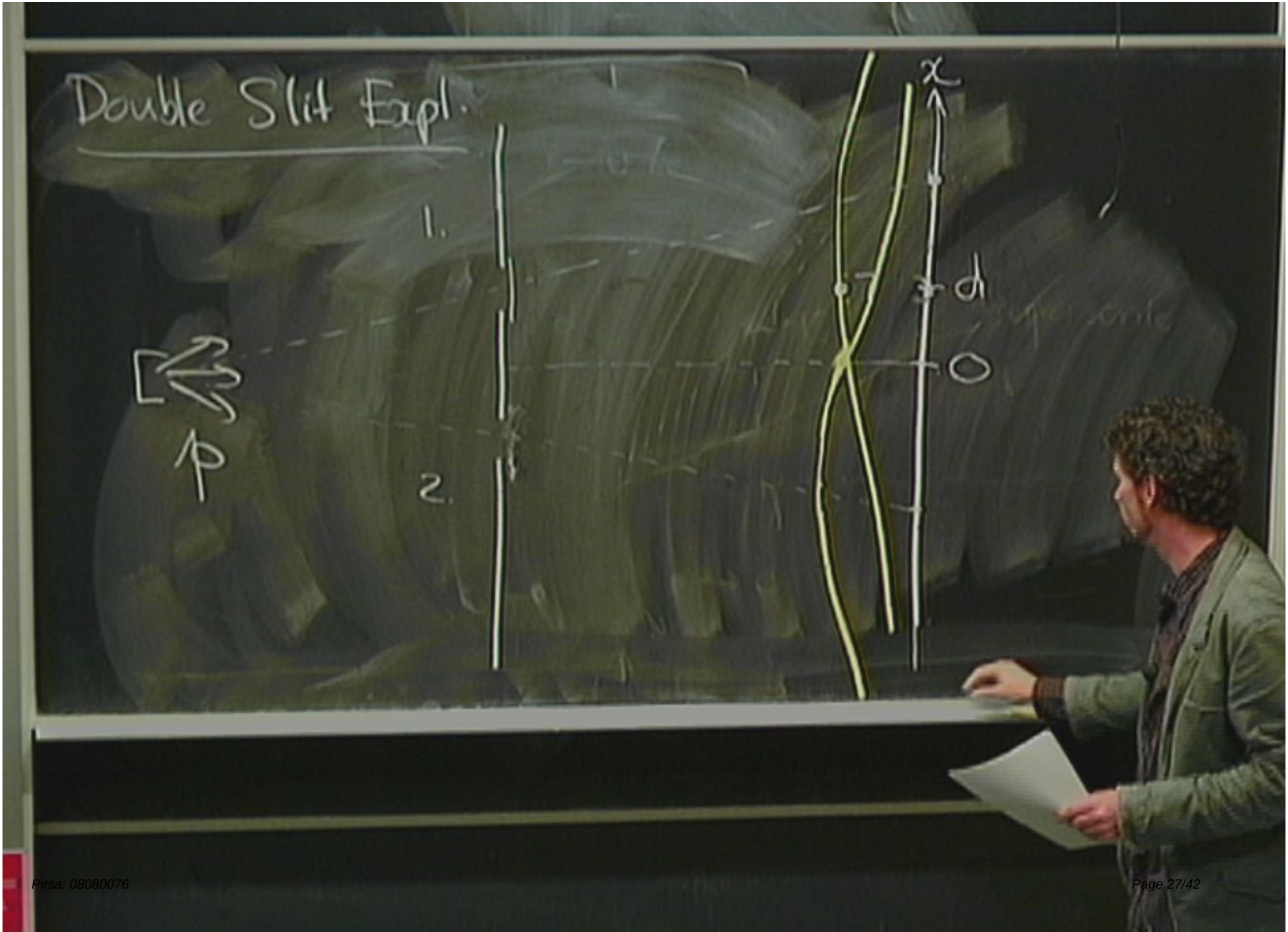

Double Slit Expl.
1.
2.
p
x

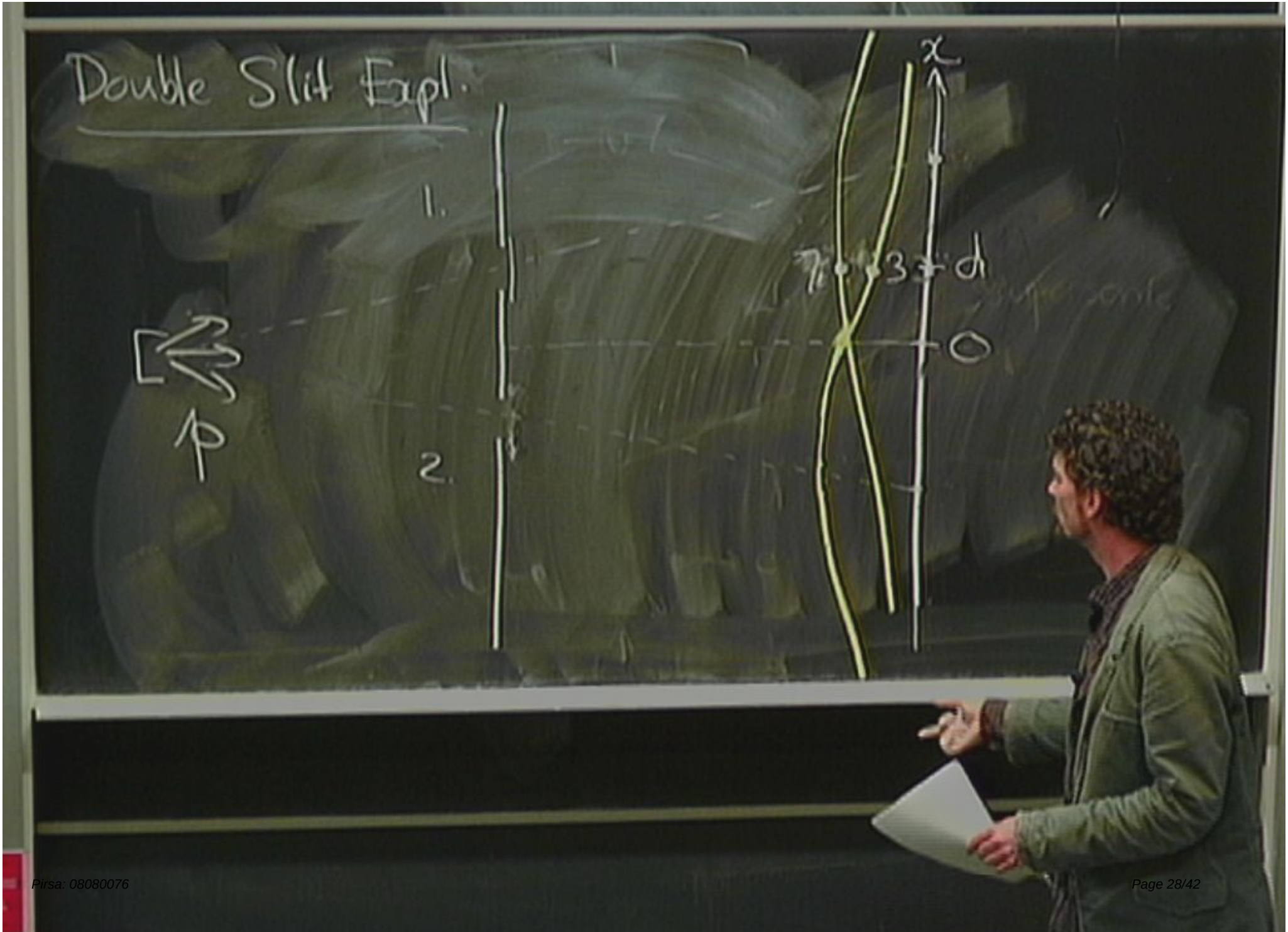

Double Slit Expl.
x
1.
2.
p

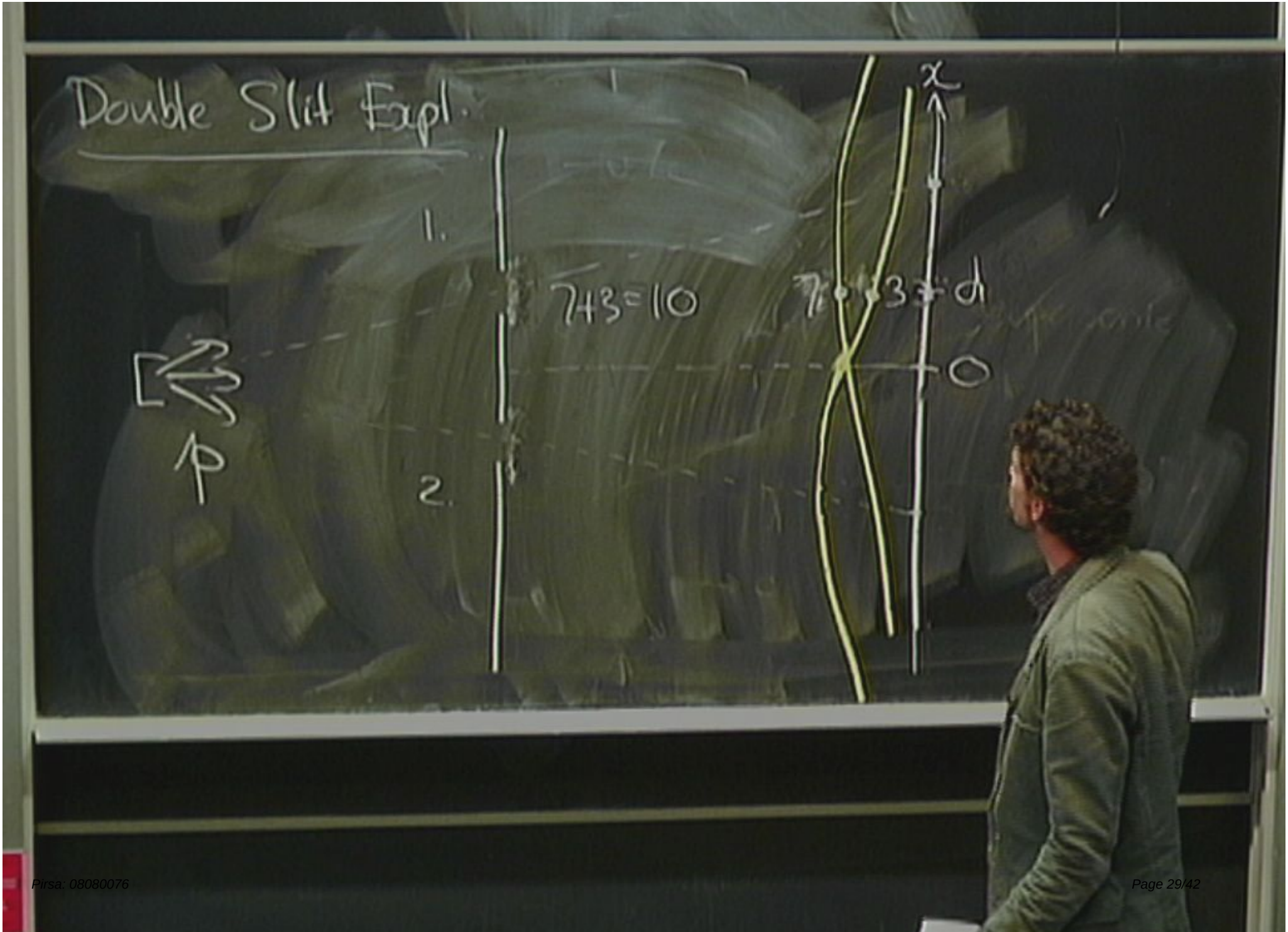

Double Slit Expl.
1.
2.
x
0
p

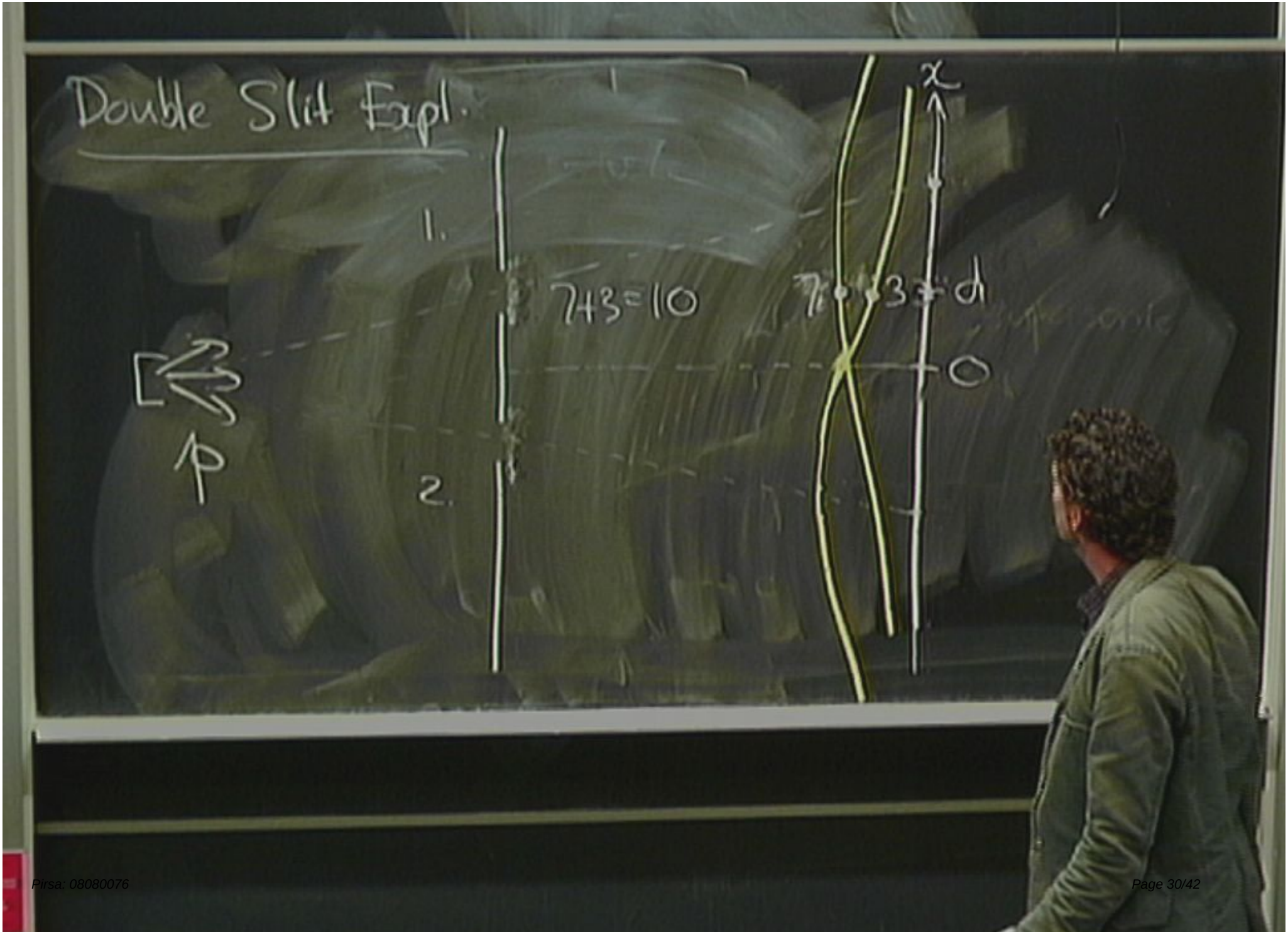

Double Slit Expl.
1.
2.
x
d
0
p

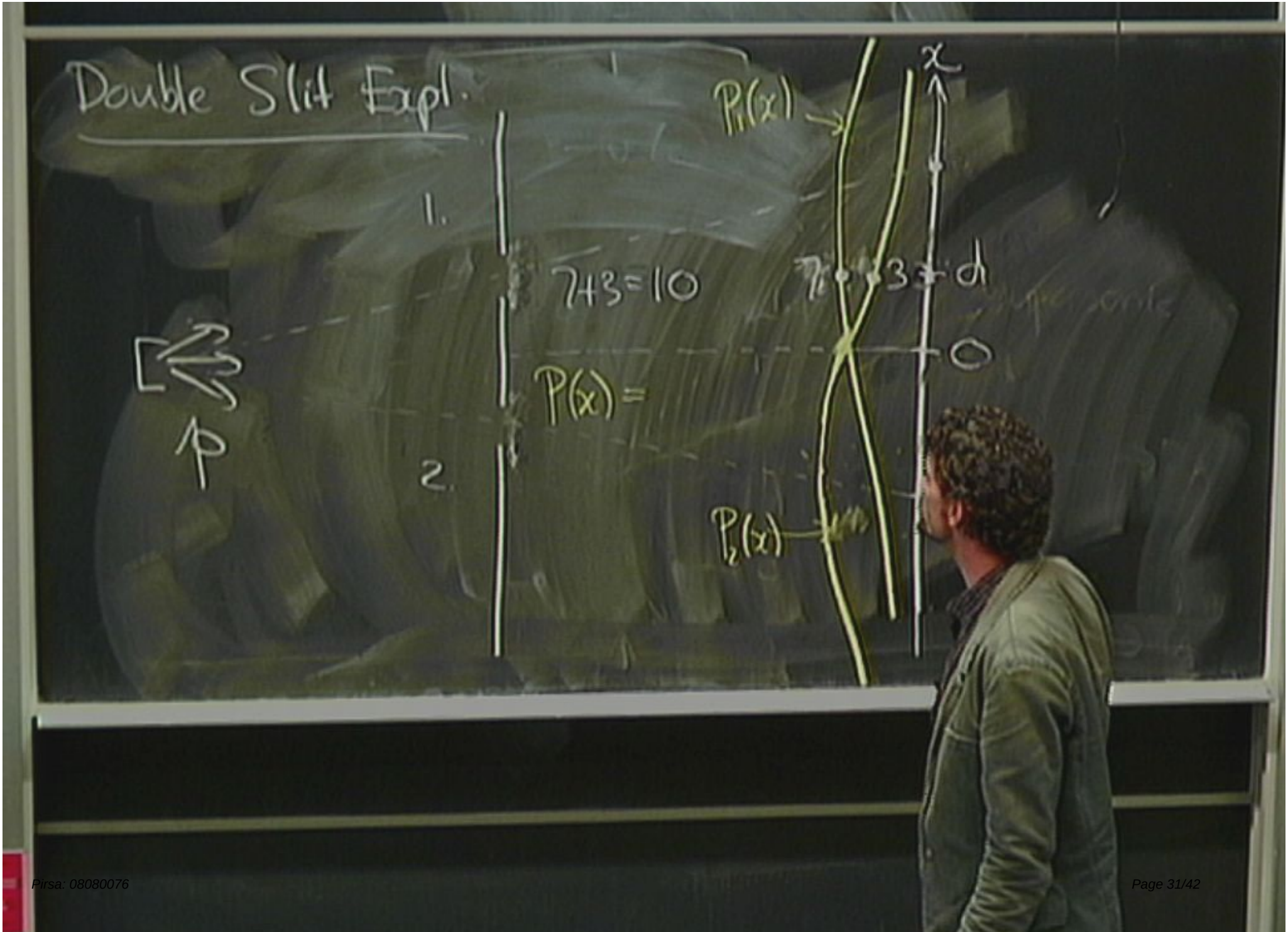

Double Slit Expl.
1.
2.
x
L
d
0
p

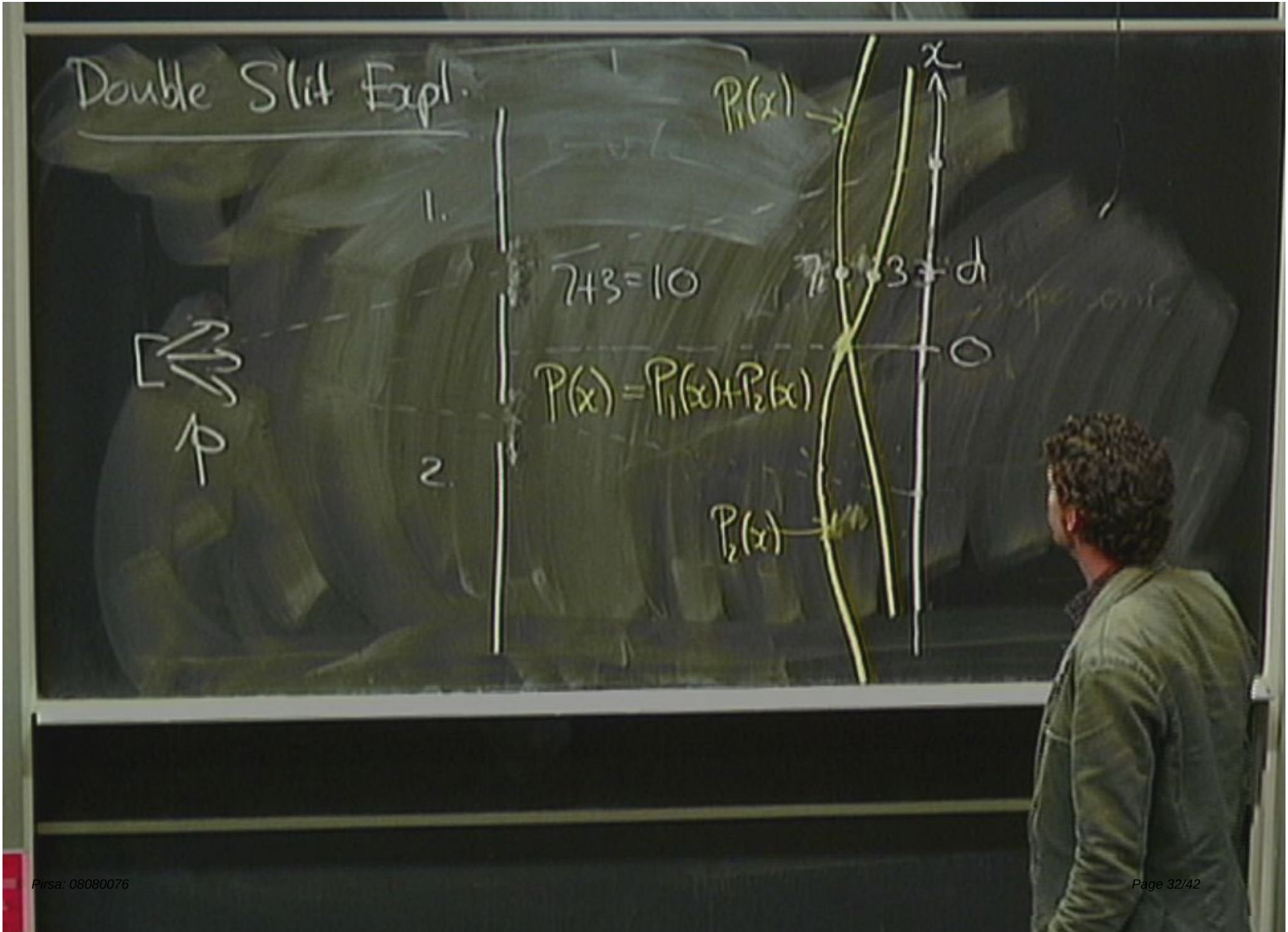

Double Slit Expl.
1.
2.
x
d
0

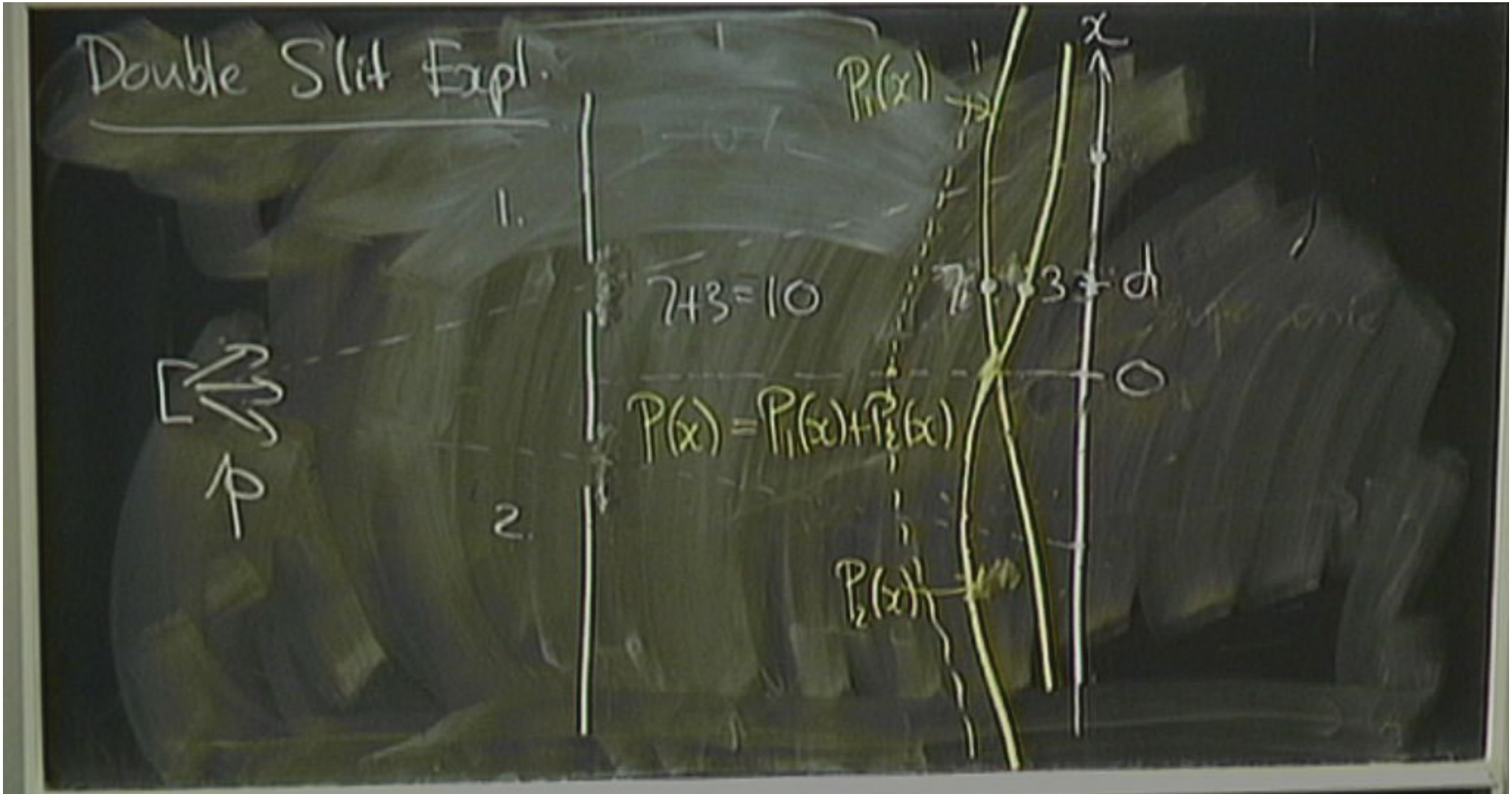

Double Slit Expl.
1.
2.
x
0

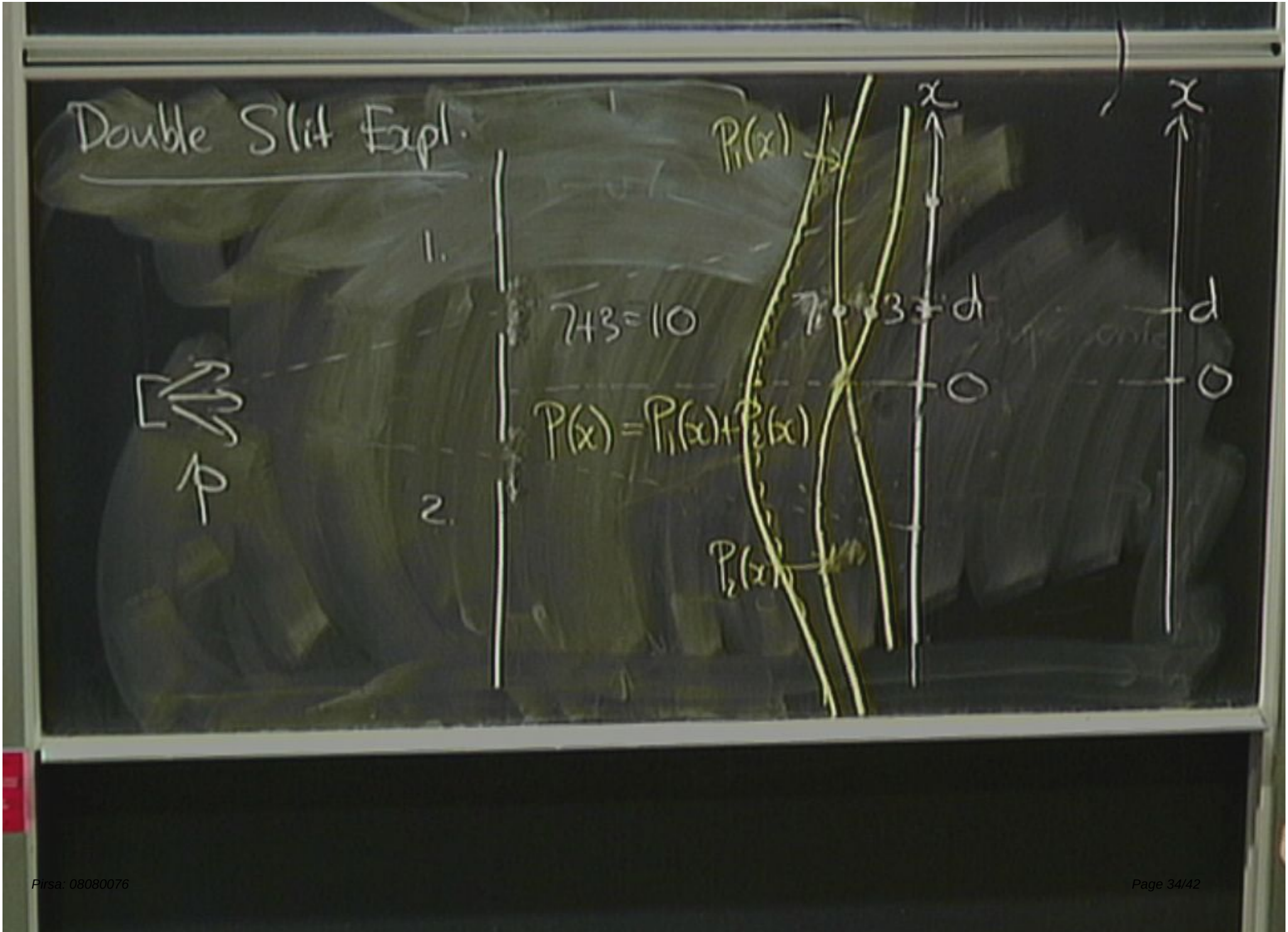

Double Slit Expl.
1.
2.
x
0

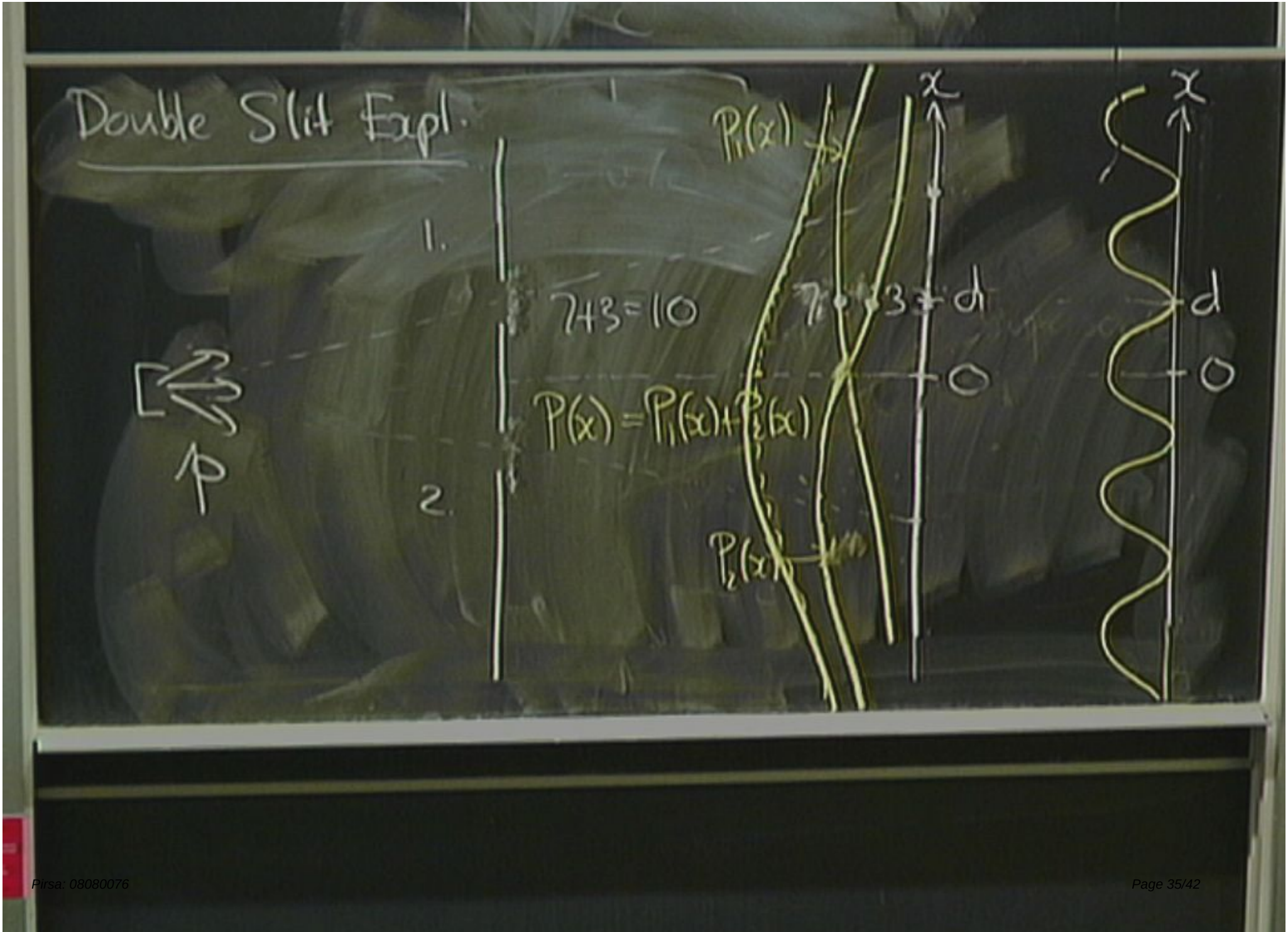

Double Slit Expl.
1.
2.
P
O
x

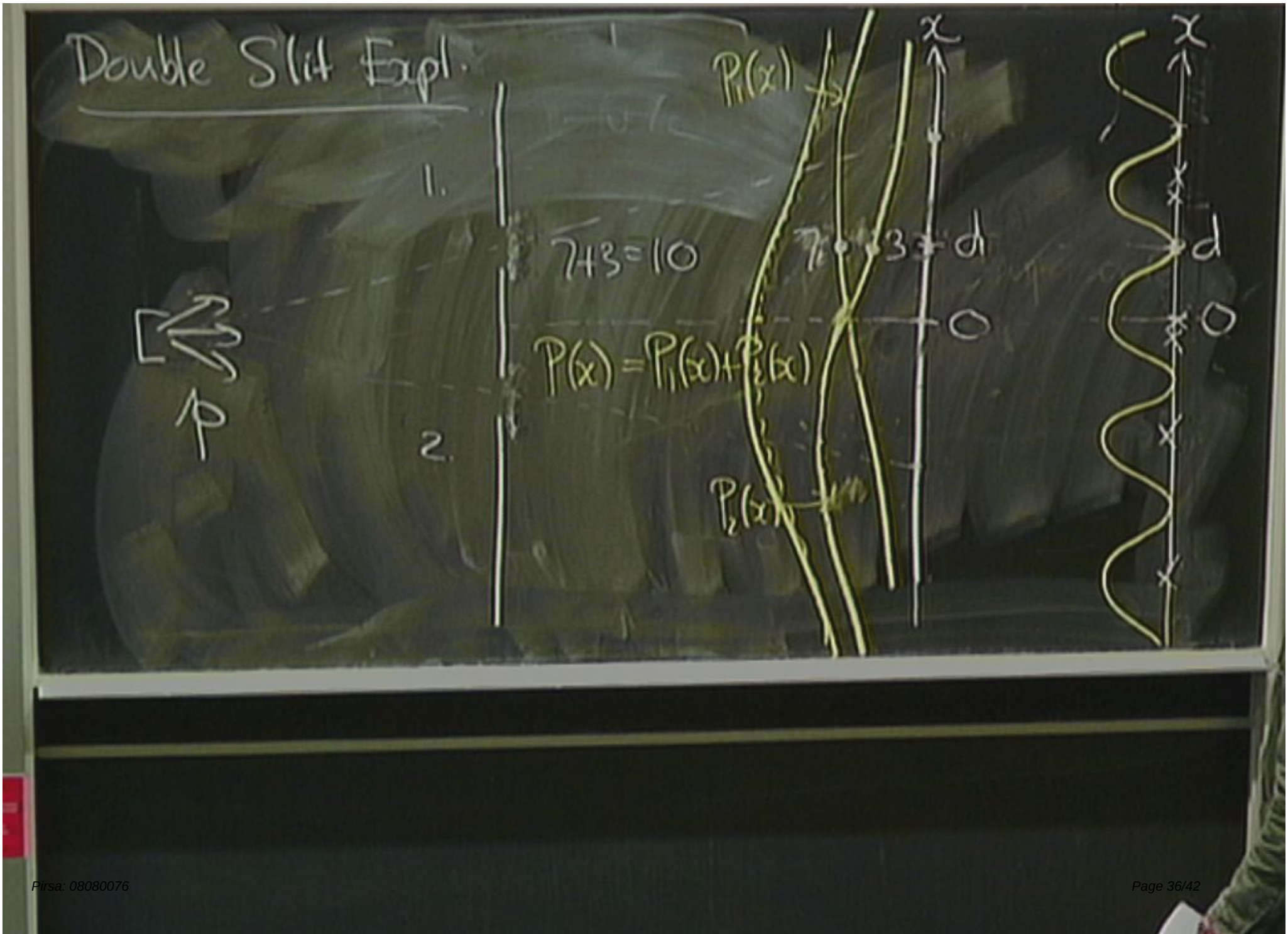

Double Slit Expl.
1.
2.
P(x) =
x
0

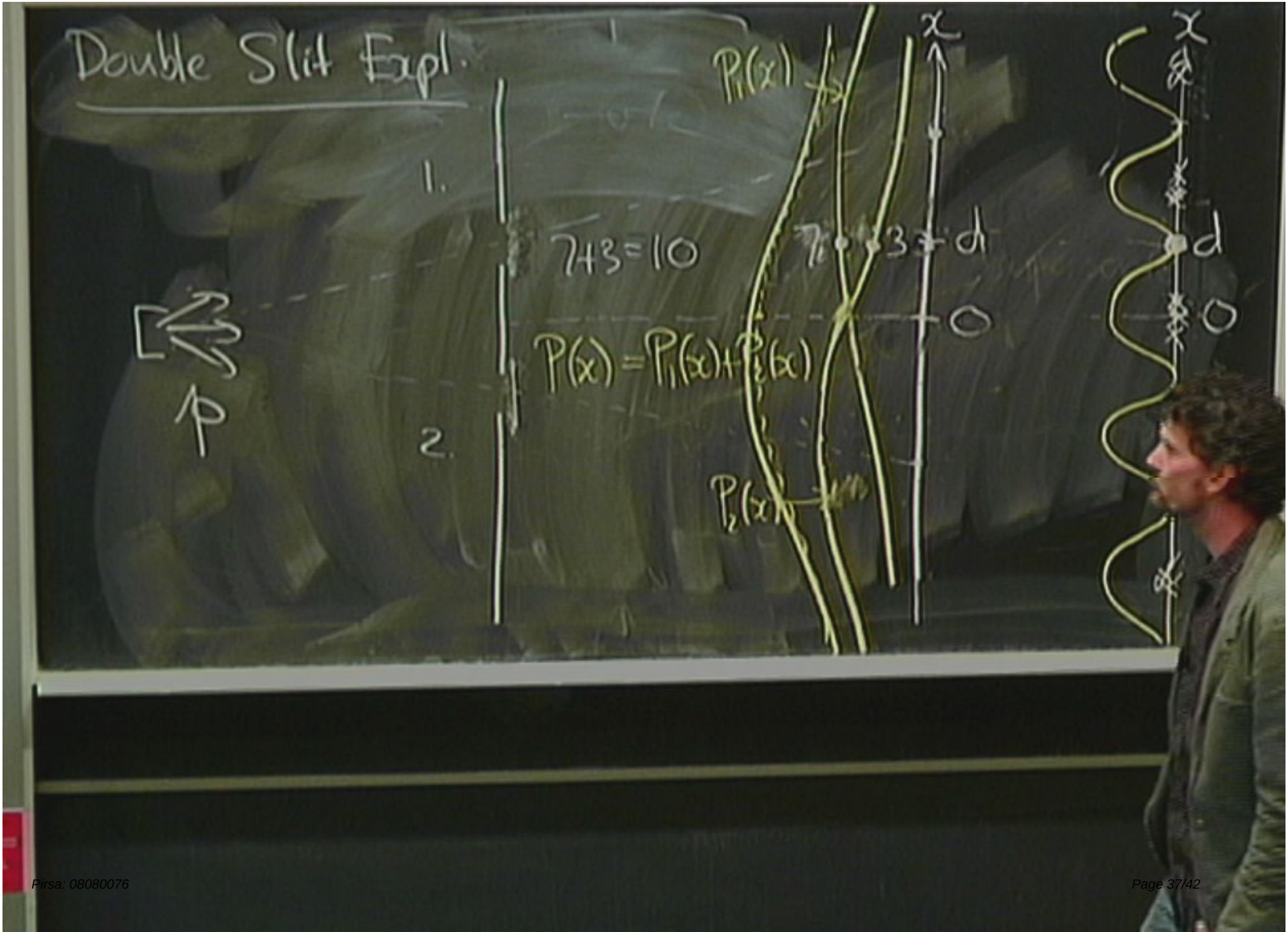

Double Slit Expl.
1.
2.
7+3=10
7+3=d
P(x)=P1(x)+P2(x)
P1(x)
P2(x)
x
0
P

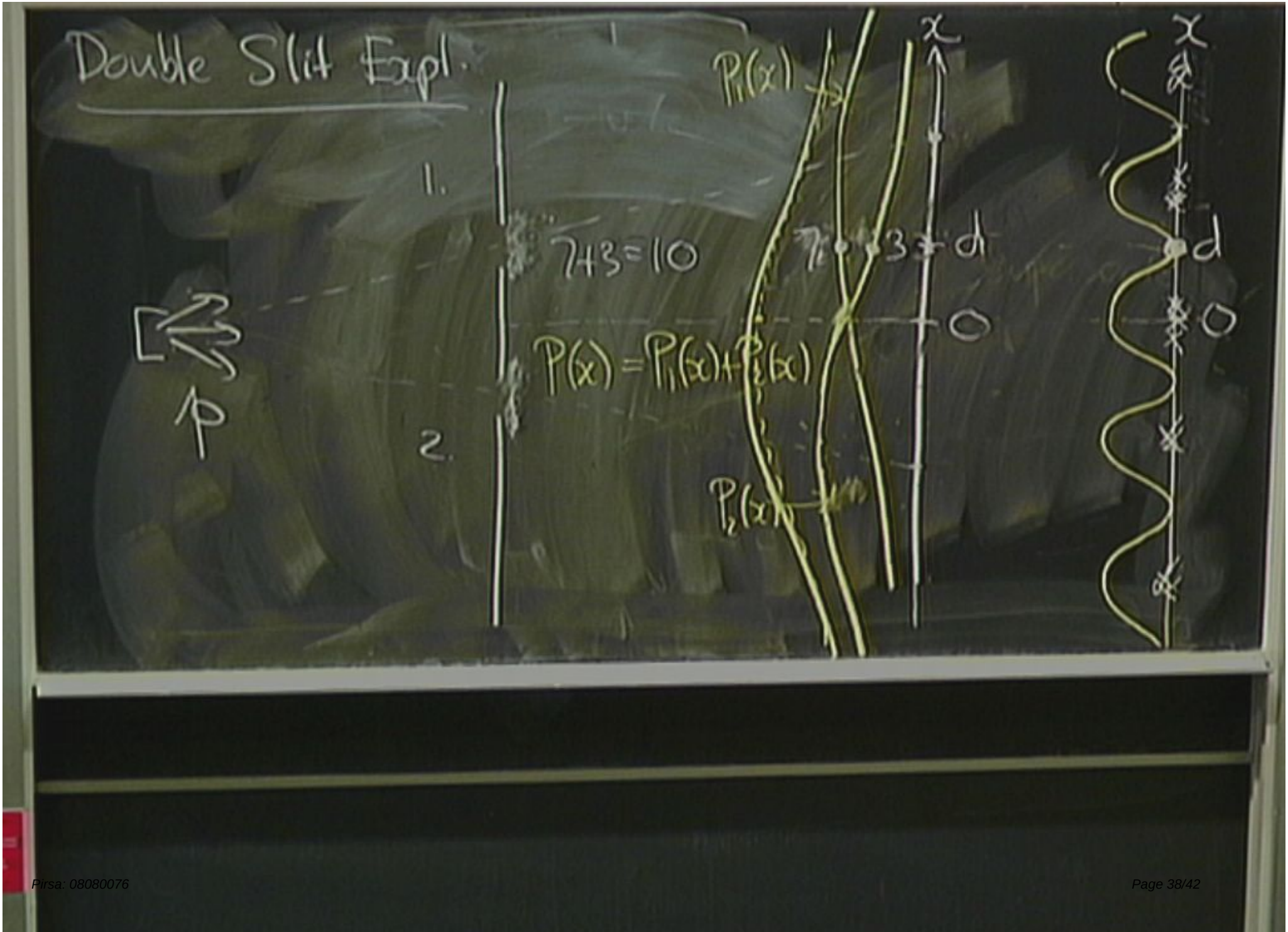

Double Slit Expl.
1.
2.
7+3=10
7+3=d
P(x) = P1(x) + P2(x)
P1(x)
P2(x)
x
0
P

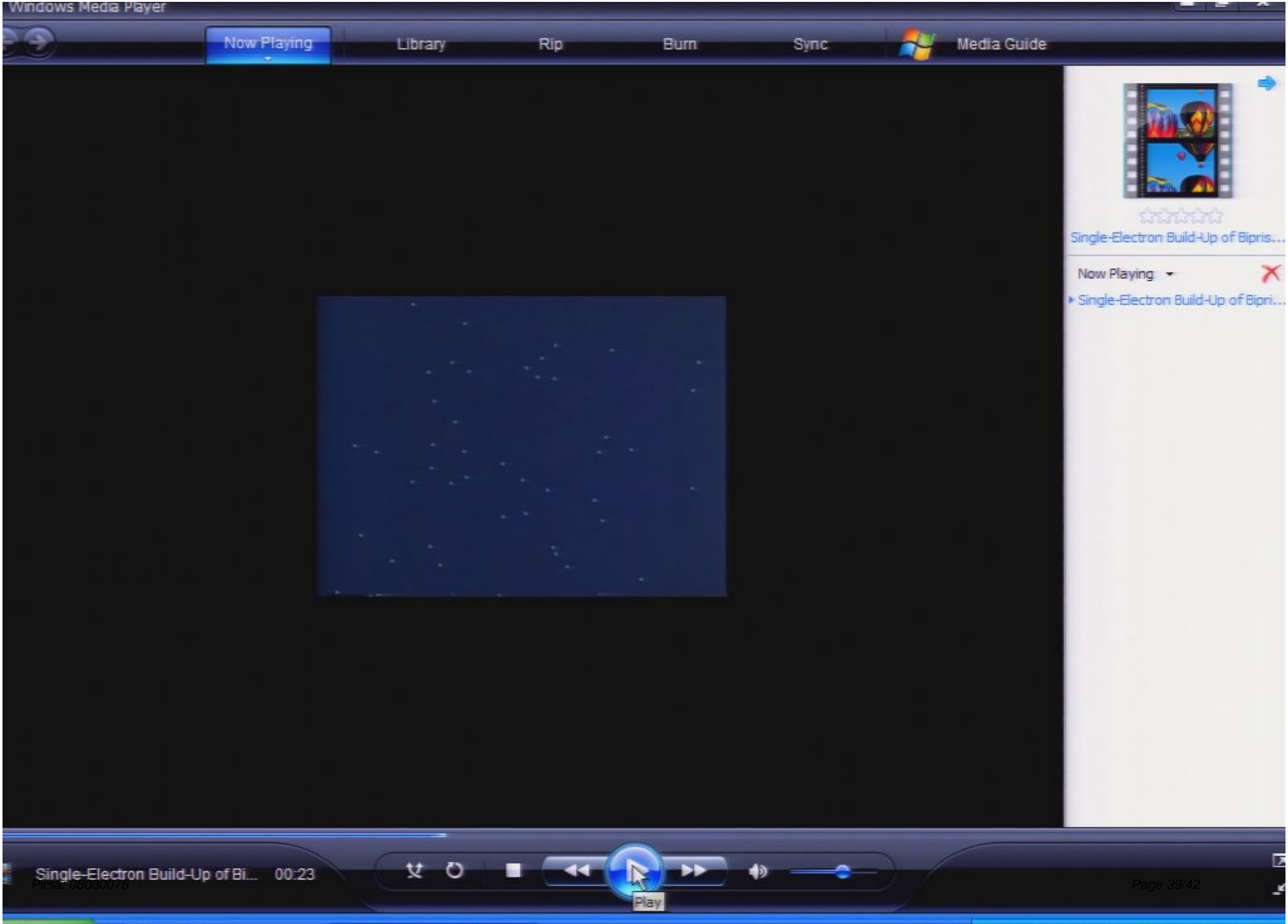

Double Slit Expl.
1.
2.
P
$P_1(x)$
$P_2(x)$
$P(x) = P_1(x) + P_2(x)$
x
x
d
0
d
0

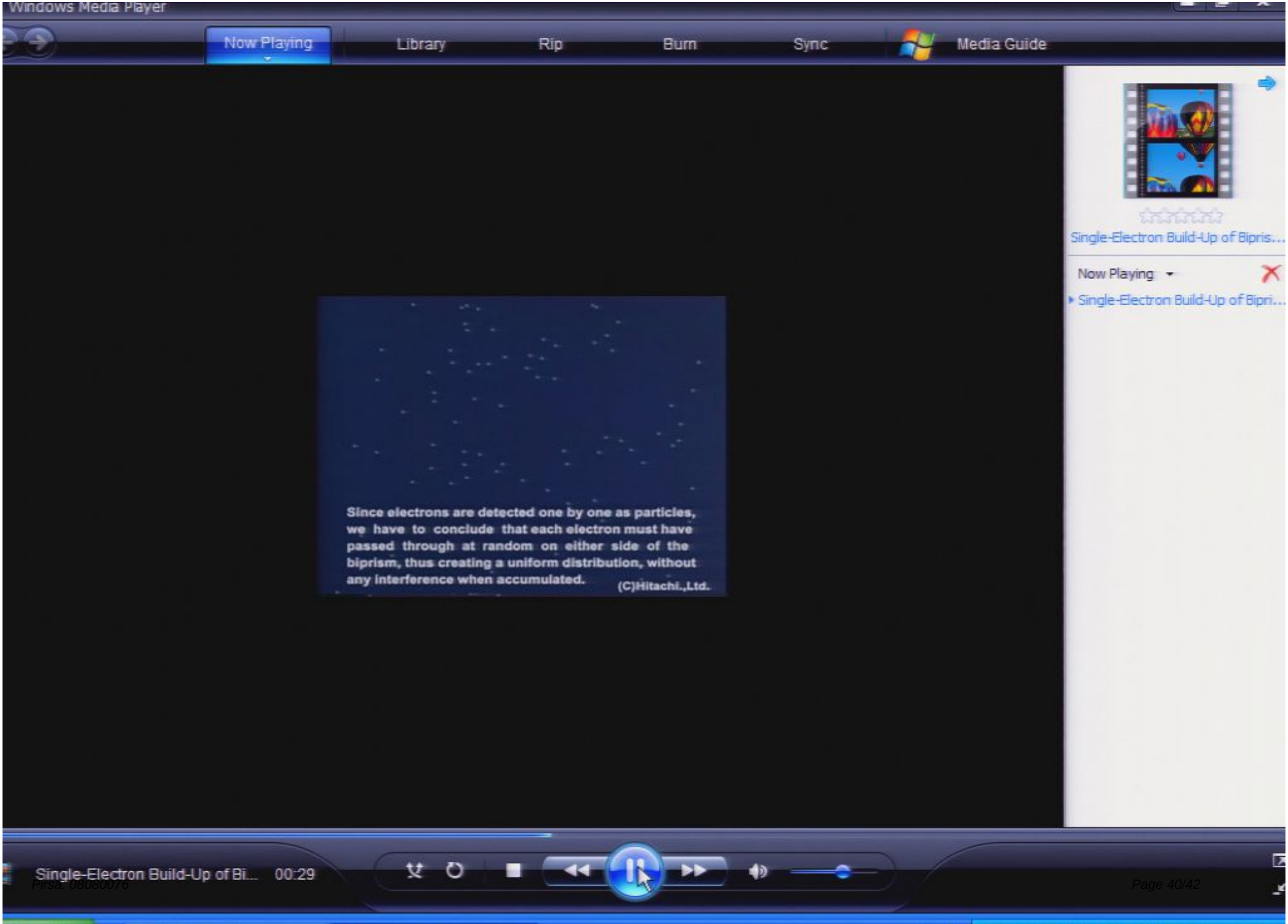

Double Slit Expl.
1.
2.
7+3=10
P(x)=P1(x)+P2(x)
P1(x)
P2(x)
x
x
7+3=d
d
0
d
0

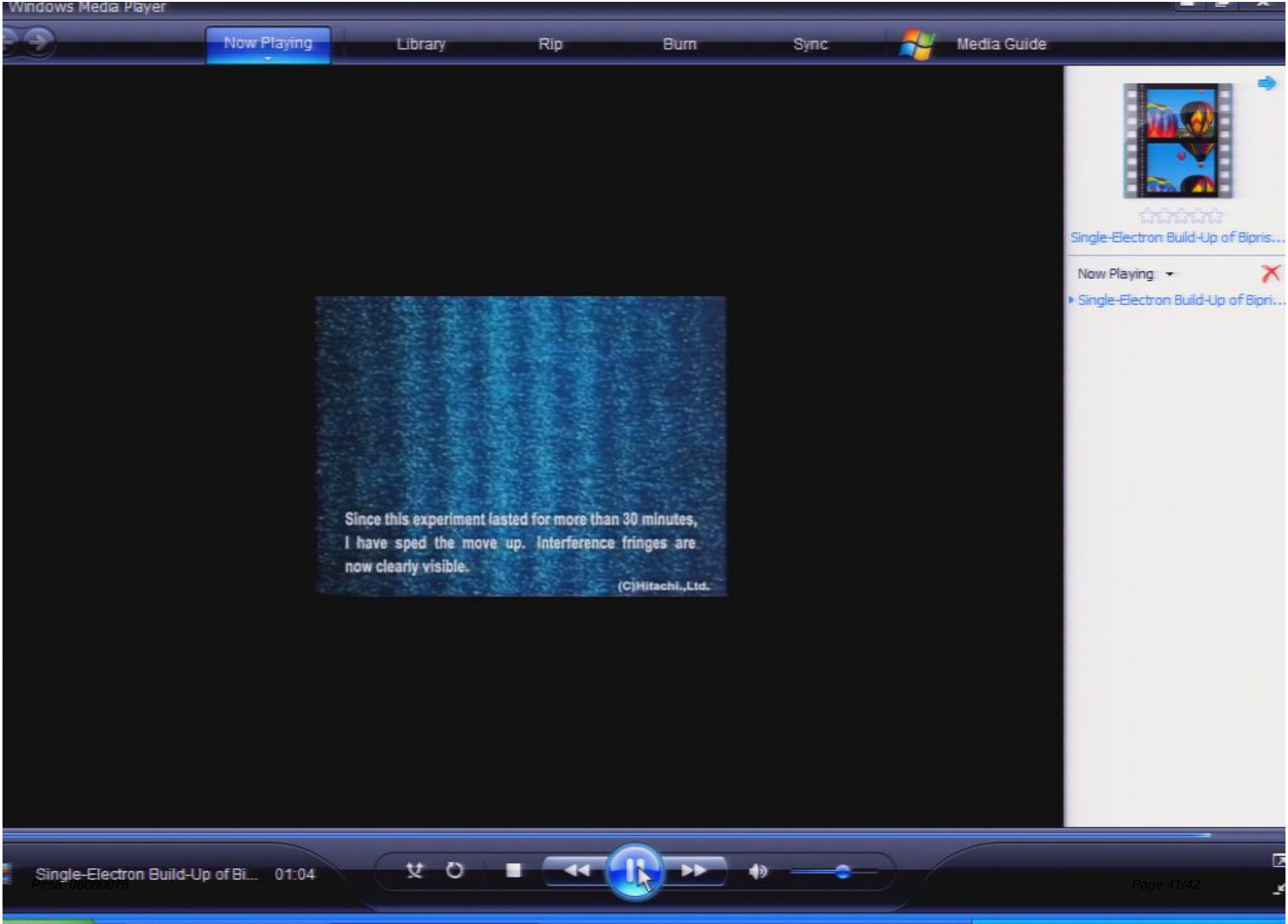

Double Slit Expl.
1.
2.
P
$P_1(x)$
$P_2(x)$
7+3=10
7+3=d
0
$P(x) = P_1(x) + P_2(x)$
x
x
d
0


Double Slit Expl.
1.
2.
P
$P_1(x)$
$P_2(x)$
x
x
d
0
0
$P(x) = P_1(x) + P_2(x)$


Double Slit Expl.
1.
2.
7+3=10
P(x)=P1(x)+P2(x)
P1(x)
P2(x)
x
x
d
0
d
0


Windows Media Player
Now Playing
Library
Rip
Burn
Sync
Media Guide
Single-Electron Build-Up of Bipris...
Now Playing
Single-Electron Build-Up of Bipri...
Single-Electron Build-Up of Bi...
00:23
Play


Windows Media Player
Now Playing
Library
Rip
Burn
Sync
Media Guide
Single-Electron Build-Up of Bipris...
Now Playing
Single-Electron Build-Up of Bipri...
Since electrons are detected one by one as particles, we have to conclude that each electron must have passed through at random on either side of the biprism, thus creating a uniform distribution, without any interference when accumulated.
(C)Hitachi.,Ltd.
Single-Electron Build-Up of Bi... 00:29


Windows Media Player
Now Playing
Library
Rip
Burn
Sync
Media Guide
Single-Electron Build-Up of Bipris...
Now Playing
Single-Electron Build-Up of Bipri...
Since this experiment lasted for more than 30 minutes,
I have sped the move up. Interference fringes are
now clearly visible.
(C)Hitachi.,Ltd.
Single-Electron Build-Up of Bi... 01:04


Windows Media Player
Now Playing
Library
Rip
Burn
Sync
Media Guide
1 item
1 minute
Now Playing
Single-Electron Build-Up of Bipri...