Title: Topology in crystalline lattices

Date: Mar 20, 2018 03:30 PM

URL: http://pirsa.org/18030072

Abstract: Topology has in the past decades become an organizing principle in the classification and characterization of phases of matter. While all possible topological phases of free fermions in the presence of external symmetries have been fully worked out, the inclusion of lattice symmetries relevant to any real-life material provides for an active research area.

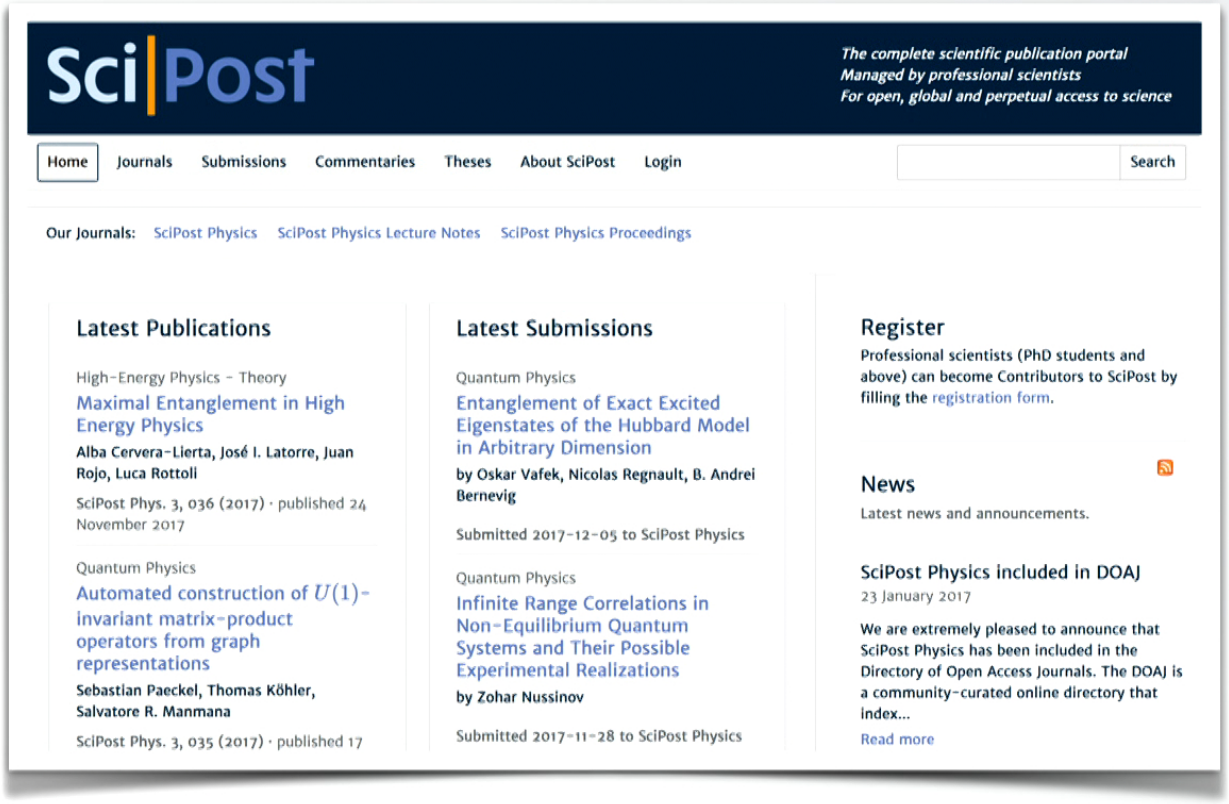
In this seminar, I will present a classification of all possible gapped topological phases of non-interacting insulators with lattice symmetries, both in the absence and presence of time-reversal symmetry. This is done using a very simple counting scheme based on the electronic band structure of the materials. Despite the simplicity of the procedure, it is based on (and matches all known predictions of) the far more involved mathematical framework known as K-theory, which establishes the correctness and completeness of the counting scheme. The same straightforward counting can also be used to study transitions between crystalline topological phases. This allows us to list all possible types of such transitions for any given crystal structure, and accordingly stipulate whether or not they give rise to intermediate Weyl semimetallic phases. The presented procedure is ideally suited for the analysis of real, known materials, as well as the prediction of new, experimentally relevant, topological materials.

References:

http://doi.org/10.1103/PhysRevX.7.041069

http://arxiv.org/pdf/1711.04769

SciPost



SciPost

The complete scientific publication portal
Managed by professional scientists
For open, global and perpetual access to science

Home | Journals | Submissions | Commentaries | Theses | About SciPost | Login | Search

Our Journals: SciPost Physics | SciPost Physics Lecture Notes | SciPost Physics Proceedings

Latest Publications

High-Energy Physics - Theory

Maximal Entanglement in High Energy Physics

Alba Cervera-Lierta, José I. Latorre, Juan Rojo, Luca Rottoli

SciPost Phys. 3, 036 (2017) · published 24 November 2017

Quantum Physics

Automated construction of $U(1)$-invariant matrix-product operators from graph representations

Sebastian Paeckel, Thomas Köhler, Salvatore R. Manmana

SciPost Phys. 3, 035 (2017) · published 17

Latest Submissions

Quantum Physics

Entanglement of Exact Excited Eigenstates of the Hubbard Model in Arbitrary Dimension

by Oskar Vafek, Nicolas Regnault, B. Andrei Bernevig

Submitted 2017-12-05 to SciPost Physics

Quantum Physics

Infinite Range Correlations in Non-Equilibrium Quantum Systems and Their Possible Experimental Realizations

by Zohar Nussinov

Submitted 2017-11-28 to SciPost Physics

Register

Professional scientists (PhD students and above) can become Contributors to SciPost by filling the registration form.

News

Latest news and announcements.

SciPost Physics included in DOAJ

23 January 2017

We are extremely pleased to announce that SciPost Physics has been included in the Directory of Open Access Journals. The DOAJ is a community-curated online directory that index...

Read more

SciPost

SciPost

What is it?

A complete scientific publishing portal
(it's a fully-featured publishing entity)

Who runs it?

Professional scientists
(it is and will remain entirely grassroots)

What does it offer?

- Journals
- Commentaries
- Theses links

SciPost

What does it aim to achieve?

- **Implement true-to-spirit Open Access**
  - two-way: free for readers, free for authors
- **Decouple scientific & financial issues**
  - isolate scientists from the latter
  - remove publish-to-cash-in flaw of current APCs
- **Modernise the refereeing procedure**
  - Give more credit to referees
  - Streamline post-publication feedback
- **Reform impact assessment**

SciPost

What you should know:

- Fully professional publishing (not “overlay”)
- ★ Indexed in Google Scholar, Web of Science ESCI
- ★ DOAJ Seal
- No Article Processing Charges
- Open refereeing == top quality required
- Authors preserve copyright
- Cited-by linking (Crossref)
- Full FundRef/Crossmark integration

Check the website scipost.org

SciPost

Our Supporting Partners:

THE UNIVERSITY OF MELBOURNE

UNIVERSITY OF AMSTERDAM

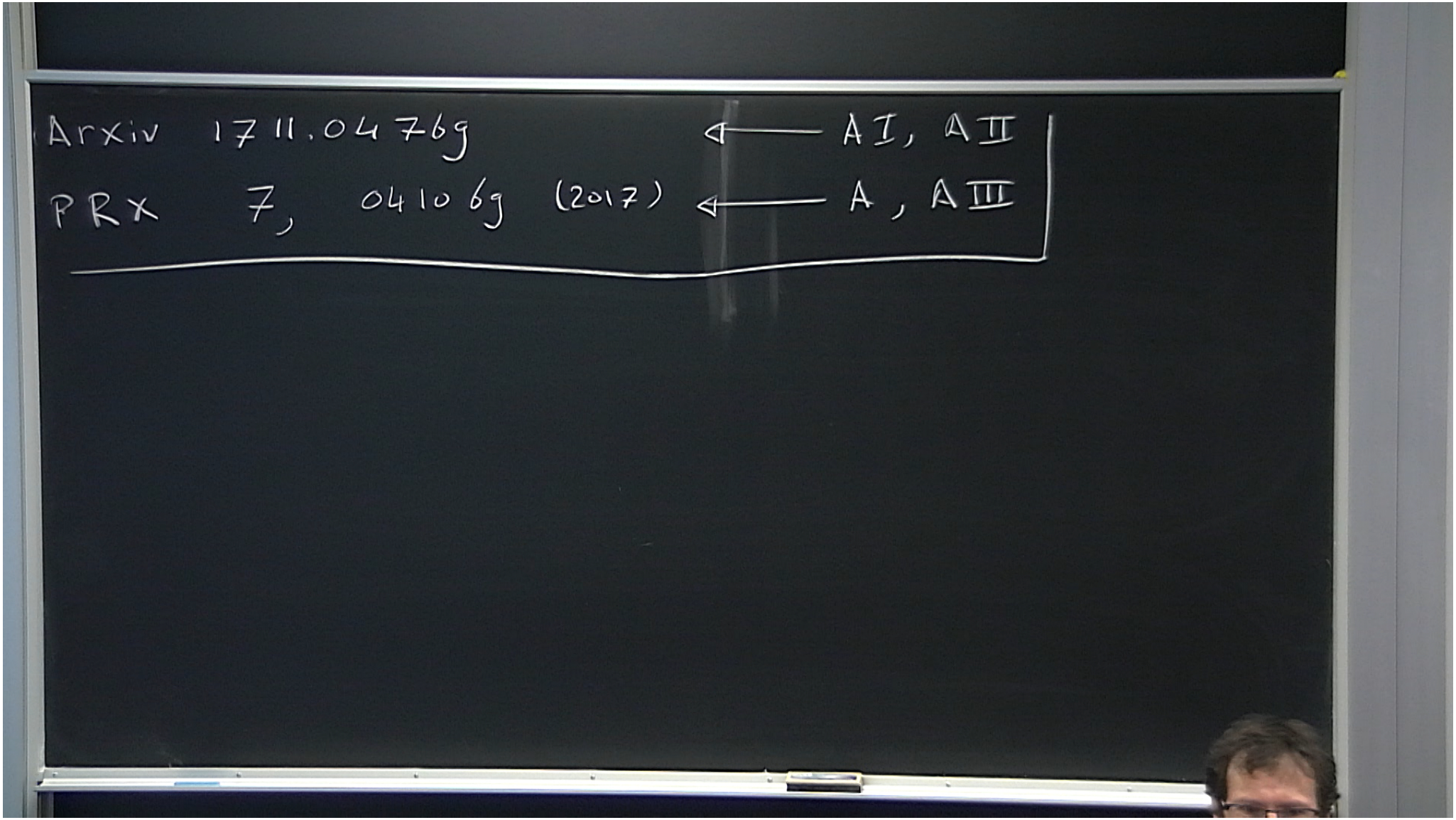
MAX PLANCK digital library

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

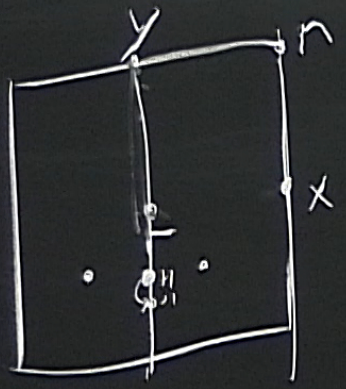
technische universität dortmund

CERN

More underway!


Arxiv 1711.04769 ← AI, AII
PRX 7, 041069 (2017) ← A, AIII

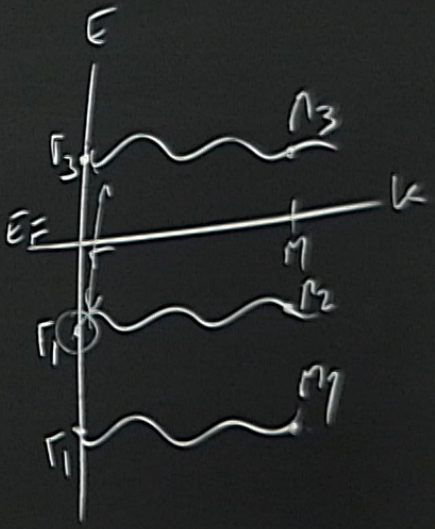
1) Representations



$m : x \to -x$

$k_x \to -k_x$

$[H(k), m] = 0$



Topology

1) Representation

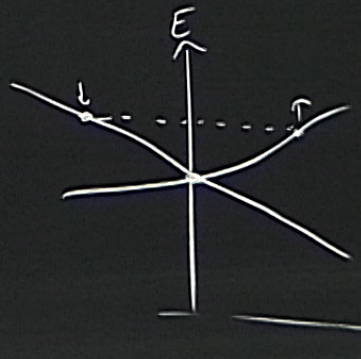
2) torsion

TRS

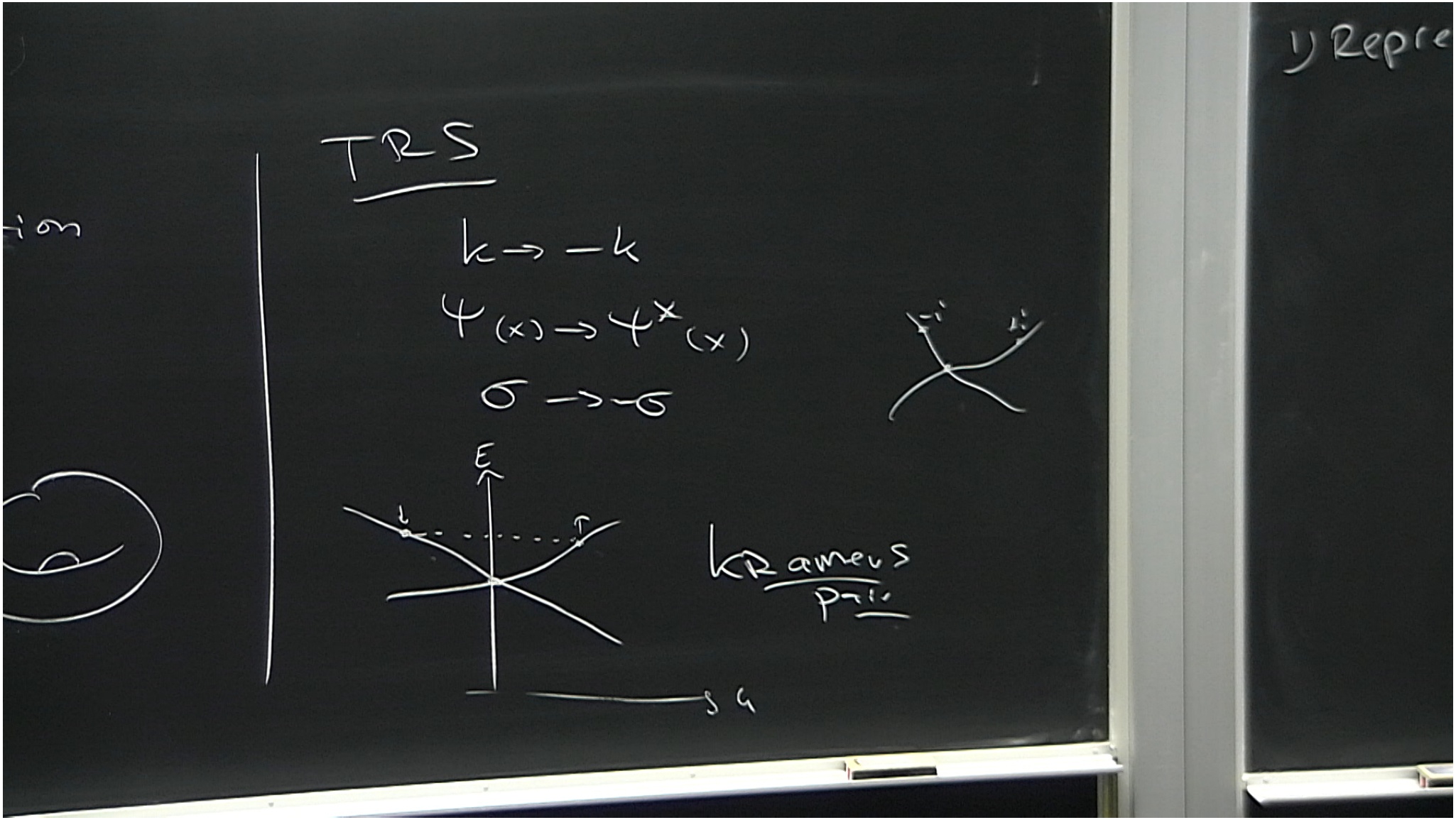
$k \to -k$

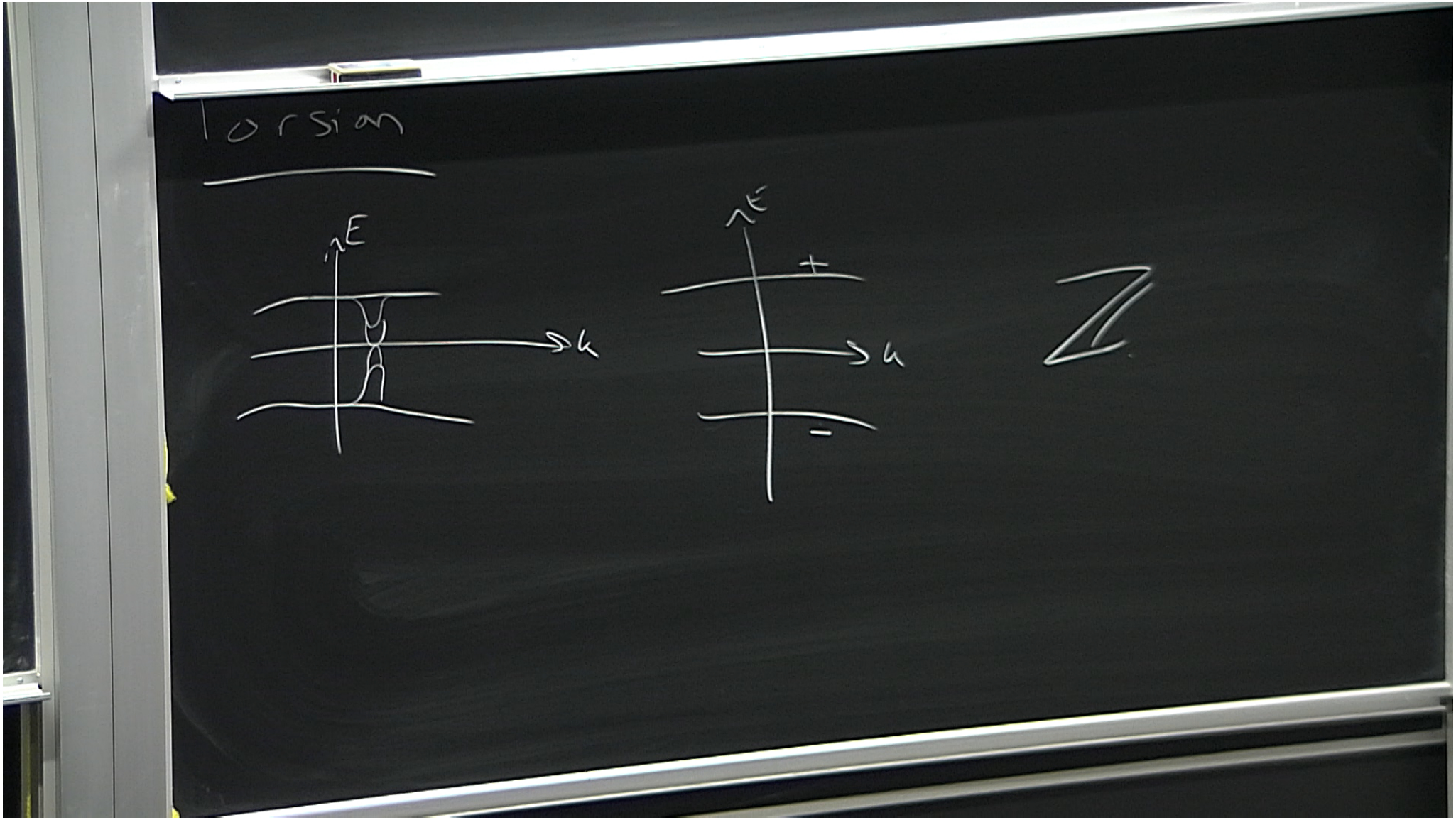
$\Psi(x) \to \Psi^*(x)$

$\sigma \to -\sigma$



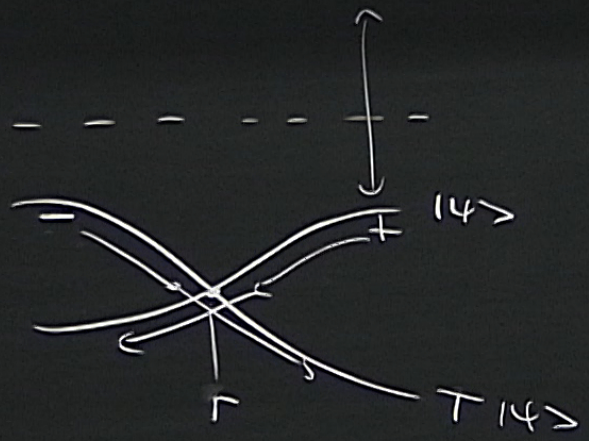
Kramers pair


TRS
$k \to -k$
$\psi(x) \to \psi^*(x)$
$\sigma \to -\sigma$
E
Kramers
pair

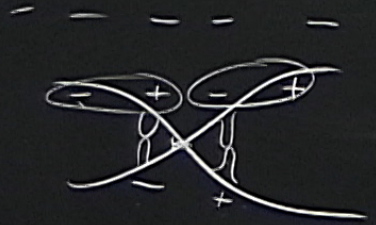

Torsion
E
k
E
+
k
-
Z

TRS

C=0:

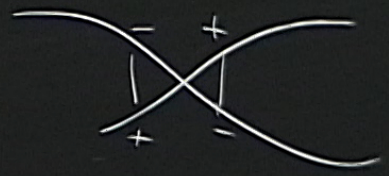


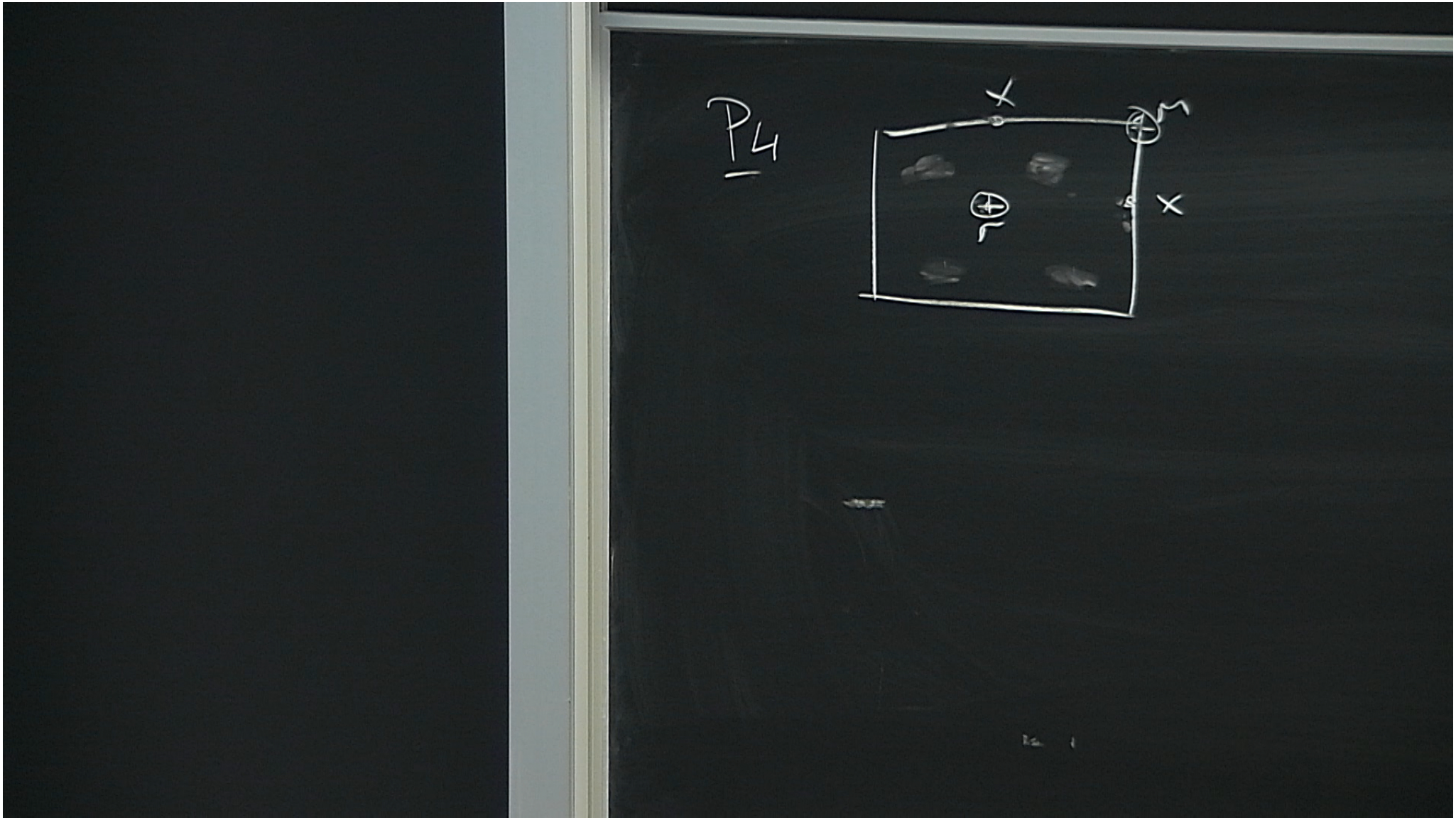
$(-1)^C = FKM_2$

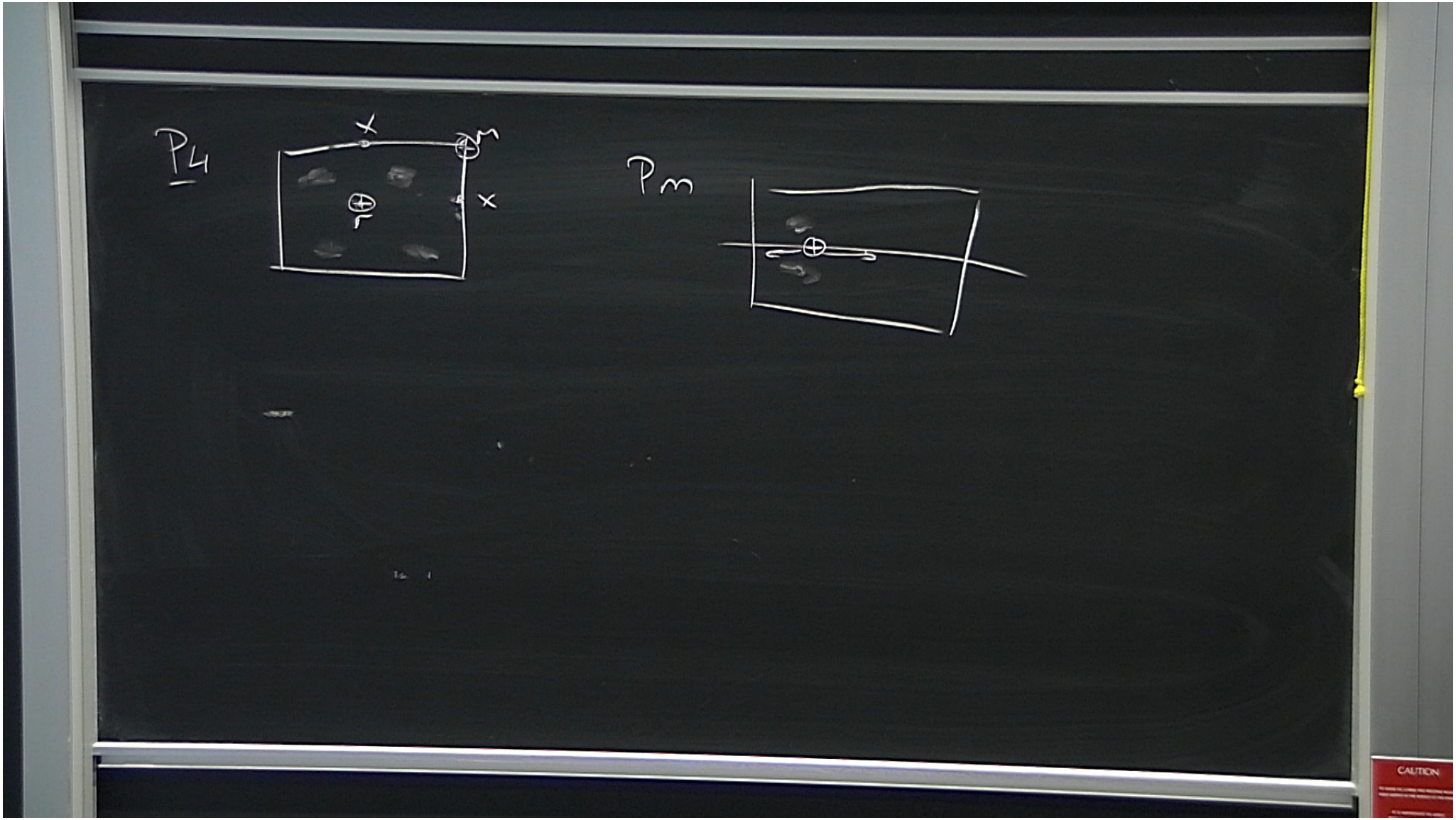


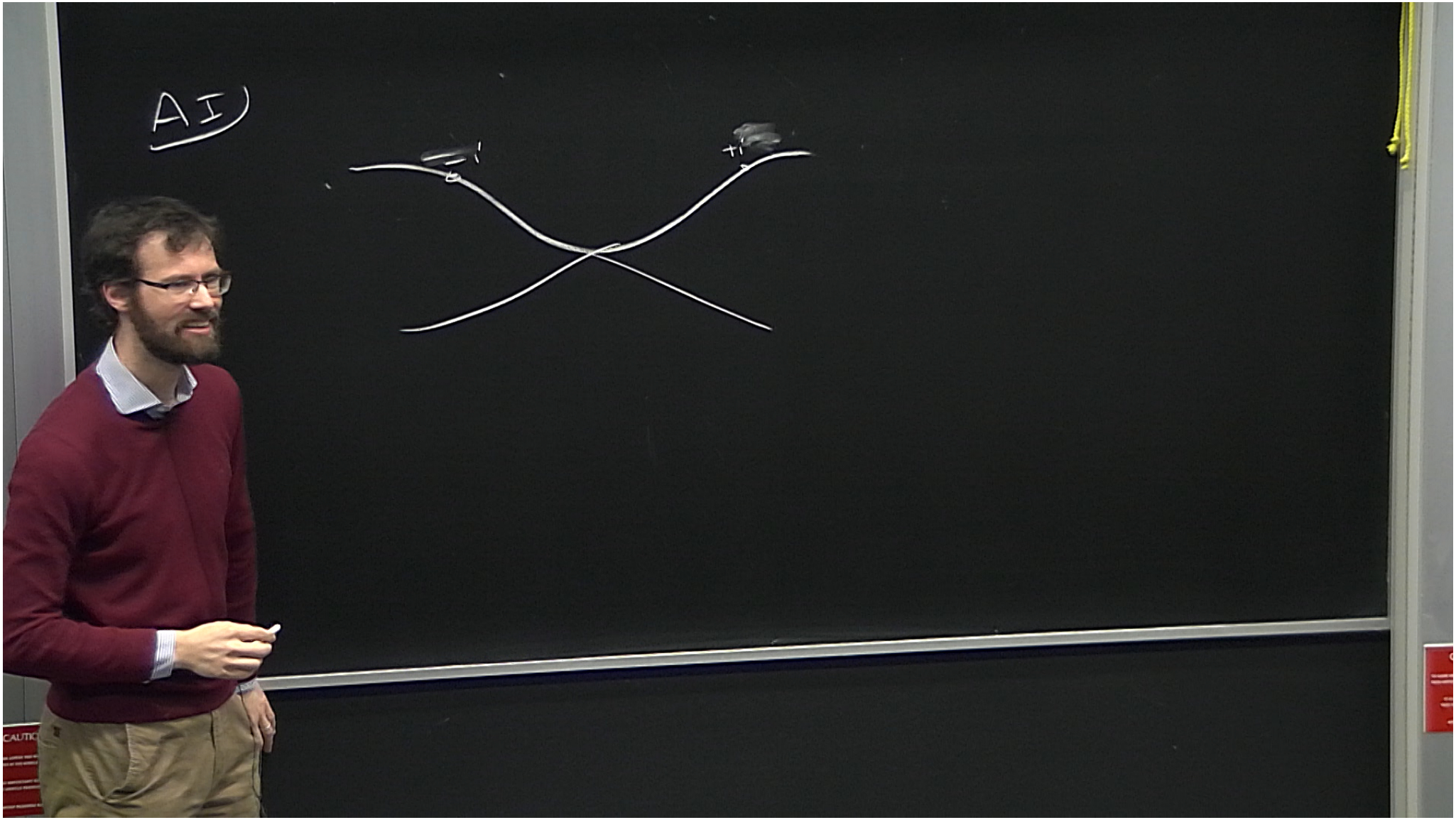
$+1 = -1$

$0 = +2$




P4
x
m
x
F


P4
x
m
x
r
Pm

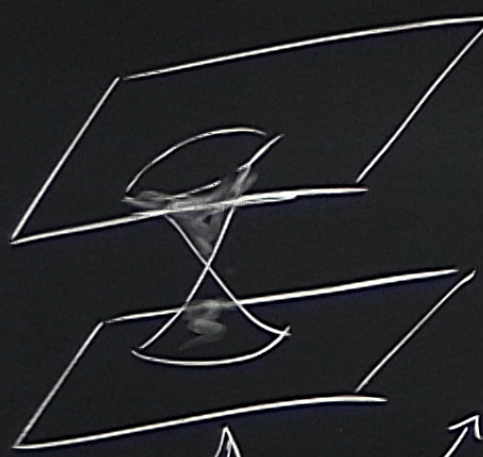

AI

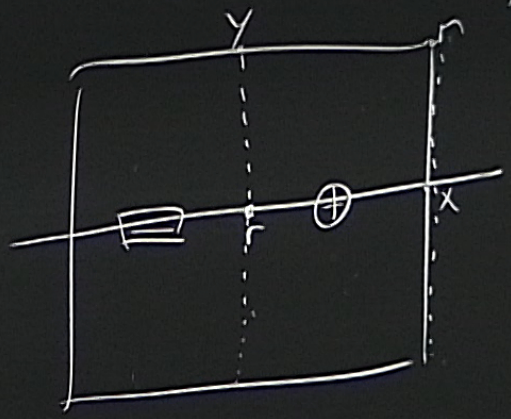
TRS + m in 1D

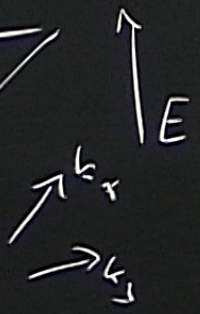
2

Pm

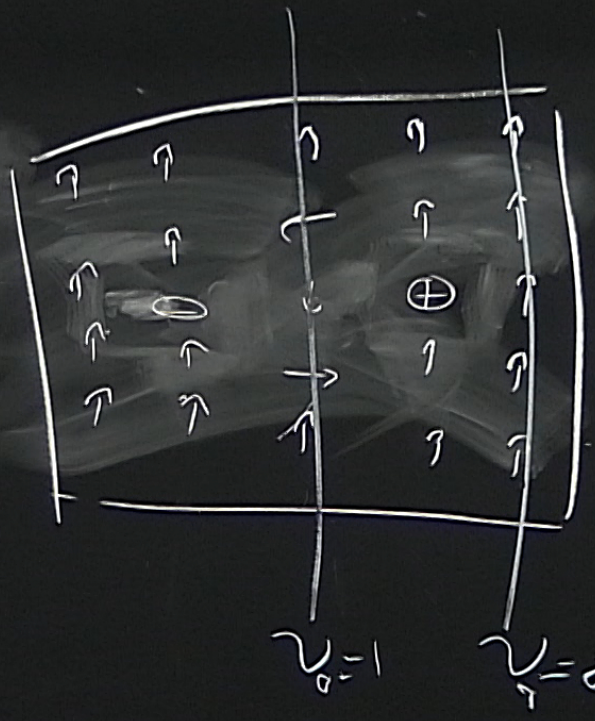
FkM2







$\nu_0 + \nu_1 = FKM$



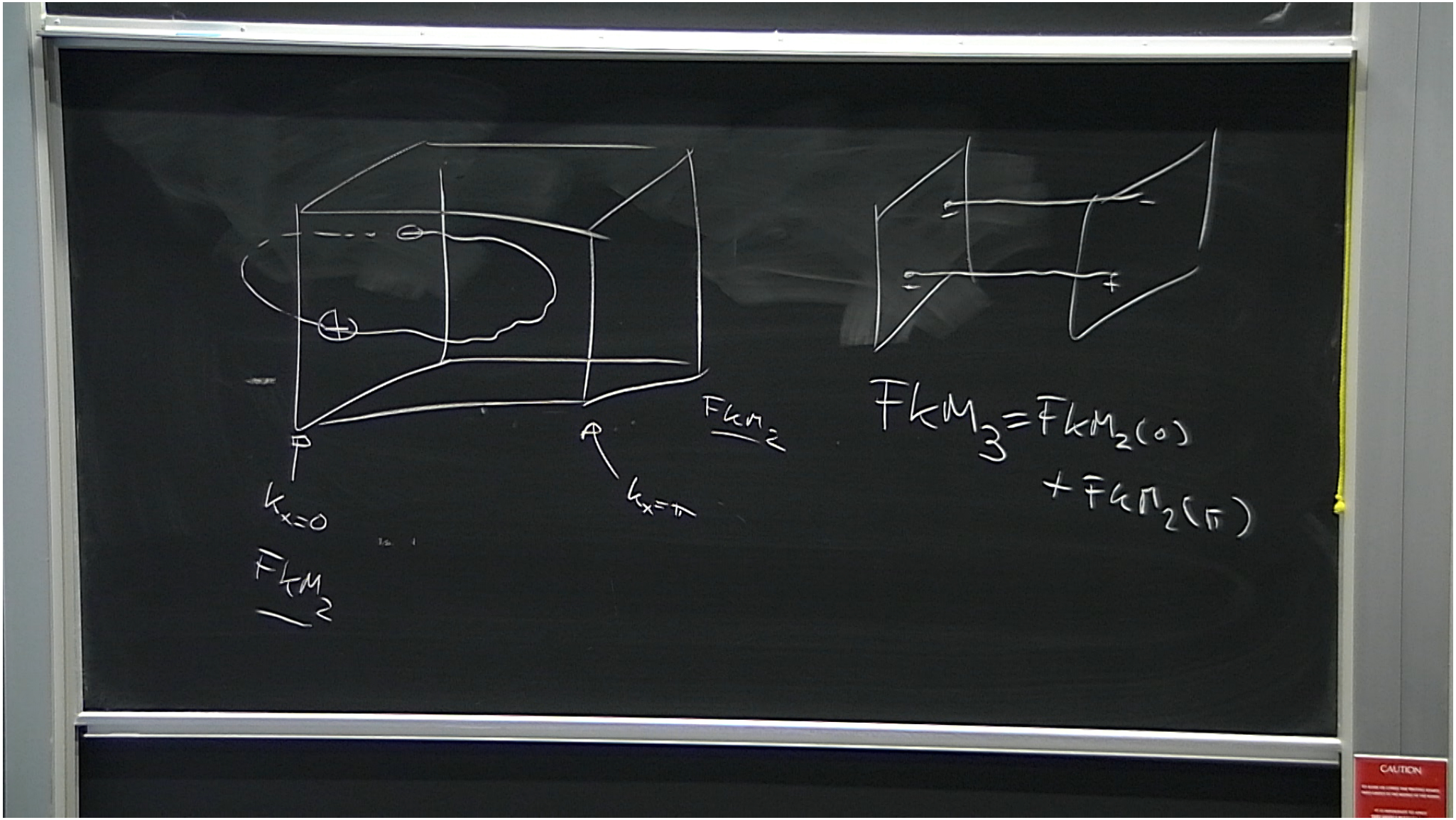
$\nu_0 = 1 \quad \nu_\pi = 0$

$FKM = 4$

$\nu_0 = 0 \quad \nu_\pi = 1$

OR

$\nu_\pi = 1 \quad \nu_0 = 0$


$k_x=0$
$k_x=\pi$
$Fk M_2$
$Fk M_2$
$Fk M_3 = Fk M_2(0) + Fk M_2(\pi)$