



GORDON AND BETTY
MOORE
FOUNDATION

THE HEBREW UNIVERSITY OF JERUSALEM
ISRAEL INSTITUTE FOR ADVANCED STUDIES

34th Jerusalem Winter School in Theoretical Physics: New Horizons in Quantum Matter

27 December 2016 - 5 January 2017

All lectures will take place at the Israel Institute for Advanced Studies,
on the Edmond J. Safra, Givat Ram Campus

Director:

David Gross (University of California at Santa Barbara)

Organizers:

Erez Berg (Weizmann Institute of Science)

Dror Orgad (The Hebrew University of Jerusalem)

Subir Sachdev (Harvard University)

Program

Tuesday, 27 December

- 10:00 - 11:00 Registration
- 11:00 - 12:30 **Erez Berg** (Weizmann Institute of Science)
Lecture 1 - Topological superconductors, Majorana zero modes and their physical realizations
- 12:30 - 14:00 Lunch
- 14:00 - 14:15 **Michal Linial** (Director, IAS)
Greetings
- 14:15 - 15:30 **Dror Orgad** (The Hebrew University of Jerusalem)
Symmetry properties of thermoelectric transport of interacting electrons
- 15:30 - 16:00 Coffee Break
- 16:00 - 17:30 **Subir Sachdev** (Harvard University)
Lecture 1 - Introduction to spin systems and intrinsic topological order
- 17:30 - 18:00 Coffee Break
- 18:00 - 19:00 **Erez Berg** (Weizmann Institute of Science)
Tutorial
- 19:00 - 20:30 Reception

Wednesday, 28 December

- 09:00 - 10:30 **Sean Hartnoll** (Stanford University)
Lecture 1 - Hydrodynamic effects in metals
- 10:30 - 11:00 Coffee Break

- 11:00 - 12:30 **Erez Berg** (Weizmann Institute of Science)
Lecture 2 - Non-Abelian statistics
- 12:30 - 14:00 Lunch
- 14:00 - 15:30 **Subir Sachdev** (Harvard University)
Lecture 2 - Spin density wave order, topological order, and a model for the pseudogap metal
- 15:30 - 16:00 Coffee Break
- 16:00 - 17:30 **Sean Hartnoll** (Stanford University)
Lecture 2 - The memory matrix formalism
- 17:30 - 18:00 Coffee Break
- 18:00 - 19:00 **Subir Sachdev** (Harvard University)
Tutorial

Thursday, 29 December

- 09:00 - 10:30 **Subir Sachdev** (Harvard University)
Lecture 3 - Quantum criticality in metals, and connections to many-body quantum chaos
- 10:30 - 11:00 Coffee Break
- 11:00 - 12:30 **Erez Berg** (Weizmann Institute of Science)
Lecture 3 - Beyond Majoranas: defects in Abelian states and fractionalized Majorana zero modes
- 12:30 - 14:00 Lunch
- 14:00 - 15:30 Poster Session
- 15:30 - 16:00 Coffee Break
- 16:00 - 17:30 **Sean Hartnoll** (Stanford University)
Lecture 3 - Universal incoherent transport

17:30 - 18:00 Coffee Break

18:00 - 19:00 **Sean Hartnoll** (Stanford University)
Tutorial

Friday, 30 December

09:00 - 10:30 **Sean Hartnoll** (Stanford University)
Lecture 4 - Transport in fluctuating symmetry-
broken phases

10:30 - 11:00 Coffee Break

11:00 - 12:30 **Subir Sachdev** (Harvard University)
Lecture 4 - The SYK models of strange metals and
black holes

12:30 - 13:30 Lunch

Saturday, 31 December

08:30 - 18:00 Tour: Dead Sea and Masada

20:00 - 00:00 New Year's Party

Sunday, 1 January

10:30 - 11:00 Coffee Break

11:00 - 12:30 **Senthil Todadri** (MIT Massachusetts Institute of
Technology)
Lecture 1 - Symmetry Protected Topological
Phases

12:30 - 14:00 Lunch

14:00 - 15:30 **Nathan Seiberg** (IAS Princeton)
Lecture 1 - Continuum QFT methods in 2+1d

15:30 - 16:00 Coffee Break

- 16:00 - 17:30 **Senthil Todadri** (MIT Massachusetts Institute of Technology)
Lecture 2 - Quantum spin liquids
- 17:30 - 18:00 Coffee Break
- 18:00 - 19:00 **Nathan Seiberg** (IAS Princeton)
Tutorial

Monday, 2 January

- 09:00 - 10:30 **Senthil Todadri** (MIT Massachusetts Institute of Technology)
Lecture 3 - Non-Landau quantum criticality
- 10:30 - 11:00 Coffee Break
- 11:00 - 12:30 **Andrey Chubukov** (University of Minnesota)
Lecture 1 - Superconductivity from repulsive interaction - general principles and examples
- 12:30 - 13:30 Lunch
- 13:30 - 16:30 Tour: Old City of Jerusalem

Tuesday, 3 January

- 09:00 - 10:30 **Andrey Chubukov** (University of Minnesota)
Lecture 2 - Superconductivity vs. competing orders
- renormalization group study
- 10:30 - 11:00 Coffee Break
- 11:00 - 12:30 **Steve Kivelson** (Stanford University)
Lecture 1 - Low energy physics of the cuprate high temperature superconductors
- 12:30 - 14:00 Lunch

- 14:00 - 15:30 **Antoine Georges** (College de France)
Lecture 1 - Introduction to strong correlations from
a Dynamical Mean-Field perspective
- 15:30 - 16:00 Coffee Break
- 16:00 - 17:30 **Nathan Seiberg** (IAS Princeton)
Lecture 2 - Continuum QFT methods in 2+1d
- 17:30 - 18:00 Coffee Break
- 18:00 - 19:00 **Andrey Chubukov** (University of Minnesota)
Tutorial
- 19:30 - 21:00 Dinner for Speakers

Wednesday, 4 January

- 09:00 - 10:30 **Antoine Georges** (College de France)
Lecture 2 - Hund's metals, Bad metals, and more
- 10:30 - 11:00 Coffee Break
- 11:00 - 12:30 **Nathan Seiberg** (IAS Princeton)
Lecture 3 - Continuum QFT methods in 2+1d
- 12:30 - 14:00 Lunch
- 14:00 - 15:30 **Andrey Chubukov** (University of Minnesota)
Lecture 3 - Superconductivity near a quantum
critical point - boson-fermion models
- 15:30 - 16:00 Coffee Break
- 16:00 - 17:30 **Steve Kivelson** (Stanford University)
Lecture 2 - Taking metals seriously
- 17:30 - 18:00 Coffee Break

18:00 - 19:00 **Antoine Georges** (College de France)
Tutorial

Thursday, 5 January

09:00 - 10:30 **Steve Kivelson** (Stanford University)
Lecture 3 - Numerical experiments on model
problems

10:30 - 11:00 Coffee Break

11:00 - 12:30 **Antoine Georges** (College de France)
Lecture 3 - Thermoelectric transport - from hot
metals to cold atoms

12:30 - 14:00 Lunch

14:00 - 15:30 **Steve Kivelson** (Stanford University)
Lecture 4 - Effective field theories of intertwined
orders