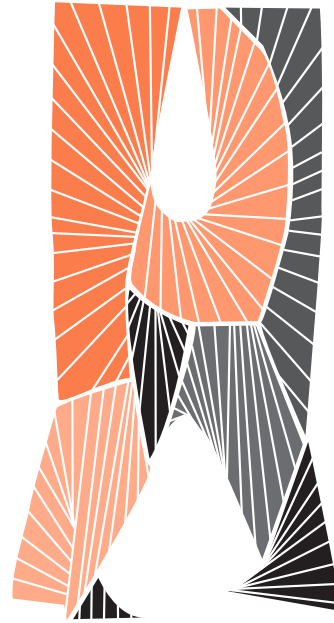


PCTS@ten



PRINCETON
CENTER FOR
THEORETICAL
SCIENCE

past, present and future

6-7 MAY 2016

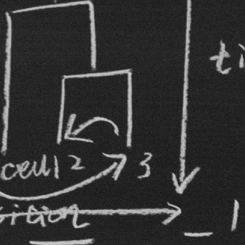
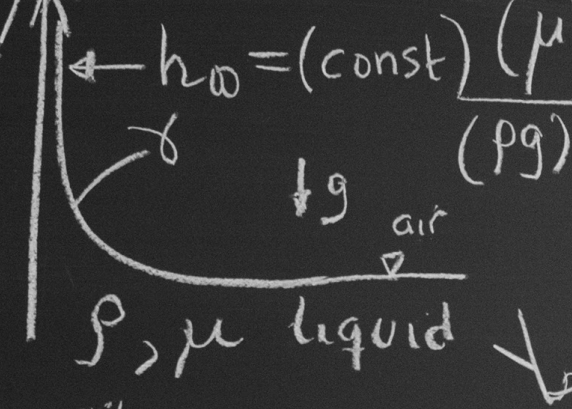
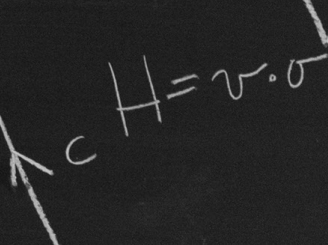
Jadwin Hall, Room 407

$$= \sum_{i,j} f_{ij} t_i^a + \frac{1}{4} \sum_{i,j,a,b} \langle ij || ab \rangle (t_{ij}^{ab} - 2t_i^a t_j^b)$$

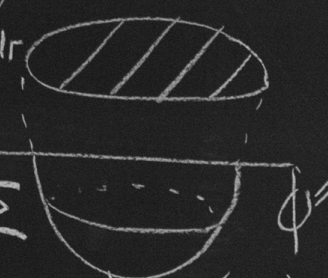


$$= R_{ab} = R_c$$

$$E_x = c_x \int \rho^{4/3}(r) / dr$$



$$L = \frac{1}{2} \frac{\pi}{\theta} \epsilon m v \sigma \sum_{a m \nu \rho \sigma} S_{EE} = \frac{\text{Area}(\Sigma)}{4 G_N}$$



$$\phi = \frac{\pi}{\sqrt{8}} \dots$$

$$x_n = n + \alpha + \frac{1}{\uparrow}$$

$$ds_{10}^2 = H^{-\frac{1}{2}} (-dt^2 + dx^2 + dy^2)$$

$$J \Phi = \prod P(\lambda_{i+1} / \lambda_i)$$

$$\oint d\vec{S} \cdot \vec{\Omega} e^{\int H = \sum_{i=1}^N S_i^z + h \sum_{i=1}^N S_i^x + \lambda \sum_{i=1}^N S_i^y}$$

$$S = \frac{1}{2} M_{PL}^2 \int d^4x \sqrt{-h} N$$

$$\frac{\delta \phi}{\delta \rho} \sim \frac{H^2}{\phi} \left(\frac{\partial K_T}{\partial T} \right)_{P, TMD} = \frac{1}{\sqrt{P}} \frac{(\partial^2 N / \partial T^2)_P}{(1/P \partial P / \partial T)_{TMD}}$$

$$\frac{\partial h_{\mu\nu}}{\partial t} + v_{\mu}^{\nu} \cdot \nabla h_{\mu\nu} + (N D_{\mu} + \frac{c}{13} b_{\mu} \dots) = z_{\mu\nu} \frac{\partial \langle \rho \rangle}{\partial t} \frac{\partial F_{\mu}}{\partial \epsilon_{\mu}} + v_{\mu}^{\nu} \dots$$

$$J^{\alpha} E = M C^2$$

$$J^{\lambda} (z_1 \dots z_N)$$



$$G(x) = \int \frac{G(x)}{K T} dx$$

$$(\partial_x + i \partial_y + j \partial_z) f^H = 0$$





Our dream was for a place that brings together outstanding young talents across a wide range of natural sciences and engineering to spend their postdoctoral period in an environment where they learn from one another and pursue whatever questions they wish, and to make this same place a hub where, through workshops and other activities, scientists and engineers from diverse disciplines meet to share ideas, brainstorm, debate, discover, challenge paradigms, identify new directions, meet old friends and make new ones. Through the guidance of a fantastic cadre of Faculty Fellows and supporters across the campus, we have been improving each year in achieving this dream.

Ten great years are past, but the best is yet to come.

— Paul J. Steinhardt, Director

PCTS@ten

6-7 May 2016 ~ Jadwin Hall, Room 407

Friday, May 6, 2016

10:00-10:05 am Welcome and Introductions, Paul Steinhardt

Morning Session Chair: Igor Klebanov

10:05-10:35 **David Limmer**
Driving structural change with light

10:35-11:00 **Antonello Scardicchio**
Breakdown of statistical mechanics due to quantum effects

11:00-11:25 **Mariangela Lisanti**
Searching for dark matter in the Milky Way

11:25-11:50 **Timothy Merlis**
Do hurricanes and organized convection affect the global climate sensitivity?

12:00-1:15 pm Lunch at PCTS, Jadwin Hall, Fourth Floor

Afternoon Session #1 Chair: Anna Ijjas

1:15-1:45 **Titus Neupert**
Bosons that cannot condense

1:45-2:10 **Jean-Luc Lehners**
Classically smooth

2:10-2:35 **Sabetta Matsumoto**
Phytomimetic 4D printing

2:35-3:00 **Dmitry Abanin**
Ergodicity, entanglement, and many-body localization

3:00-3:30 Coffee break

Afternoon Session #2 Chair: Curt von Keyserlingk

3:30-4:00 **Timothy Berkelbach**
A couple coupled-cluster stories

4:00-4:25 **Adam Brown**
Computational complexity and black holes

4:25-4:50 **B. Andrei Bernevig**
New fermions

4:50-5:15 **Alexander Tchekhovskoy**
The "hole" story

PCTS@ten

6-7 May 2016 ~ Jadwin Hall, Room 407

Saturday, May 7, 2016

8:45-9:15 am Coffee and Continental Breakfast

Session #1 Chair: Mark Mezei

9:15-9:45 **Yi Li**
Monopole harmonic cooper pairing

9:45-10:10 **Daniel Harlow**
How to cut a gauge theory

10:10-10:35 **Masahito Yamazaki**
QFT 4.0

10:35-11:00 **Marco Schiro**
The importance of being a photon: quantum phases of light and matter far from equilibrium

11:00-11:15 Coffee break

Session #2 Chair: Curtis Callan

11:15-11:45 **Ian Abel**
Between the abstract and the applied: using theoretical physics to advance fusion energy

11:45-12:10 pm **Matthew Reece**
What is the weak gravity conjecture?

12:10-12:35 **Bryan Clark**
Quantum coloring

12:35-1:00 **Rahul Nandkishore**
Many body localization and thermalization: insights from the entanglement spectrum

1:00-2:00 Lunch at PCTS with friends and family

PROGRAM ORGANIZERS

Michael Aizenman

Nima Arkani-Hamed

Waseem Bakr

Amitava Bhattacharjee

Eric Blackman

Kfir Blum

Cliff Brangwynne

Avery Broderick

Damiano Caprioli

John Paul Chou

Tony Chu

Chris Chyba

Peter Constantin

Raffaele Tito d'Agnolo

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Weinan E

Cristiano Galbiati

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Jeremy Kasdin

Vedika Khemani

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Matthew Kunz

Laura Landweber

Paul Langacker

Elliot Lieb

Juan Maldacena	Anatoly Spitkovsky
Dan Marlow	Frank Stillinger
Chiara Nappi	James Stone
Tatsuma Nishioka	Scott Tremaine
Vadim Oganesyan	Hakan Tureci
Nai Phuan Ong	Ed Turner
Tullis Onstott	Neil Turok
Enrico Pajer	Sigurd Wagner
Vasileios Paschalidis	Ned Wingreen
Alexander Polyakov	Edward Witten
Stewart Prager	Steven Worm
Frans Pretorius	Ran Yacoby
Silviu Pufu	Amos Yarom
Frank Ricci	Ali Yazdani
Nathan Seiberg	
Frederik Simons	
Lorenzo Sironi	
Tracy Slatyer	

PROGRAMS

2006-2007

Physics at Large Hadron Collider
Packing Problems, Classical Ground States and Glasses

2007-2008

Quantum Computing

2008-2009

PCTS—OFFICIAL OPENING, RECEPTION AND DINNER

The Big Bang and Beyond
Iron-based High Temperature Superconductors
Physical Principles in Biological Networks
Fundamental Problems in Climate Dynamics

2009-2010

Rare Fluctuations and Large Disorder in Quantum Systems
Anti-de Sitter/Conformal Field Theory: New Developments and Applications
Nucleation Phenomena -- Rare Events
Computational Relativistic Astrophysics
Rare Events in Biology
Understanding Cancer via the Theoretical Sciences
Rare Events—Random Events

2010-2011

Low Dimensional Systems
Electronic Properties of Graphene
Rare Events in Computational, Financial and Physical Sciences
Topological Insulators and Superconductors
Dark Matter Detection
Structure & Dynamics of Water & Aqueous Solutions in Materials Science
Challenges for Inflationary Cosmology
Seismology of Earth and Stars
Differential Rotation in Stars
BOOST 11 - CERN
First Annual PCTS Lecturer, Sir Michael Berry

2011-2012

Low Dimensional Systems (cont'd.)
Towards Unifying Concepts in the Physics of Aperiodic Systems
Exact Methods in Gauge/String Theories
Applied Topology
Quantum Statistical Mechanics & Quantum Computation
Non Equilibrium Phenomena in Ultra-cold Atoms & strongly Interacting Photons
Connecting the Electromagnetic and Gravitational Waves Skies in the Era of Advanced Laser Interferometer Gravitational-Wave Observatory
Hot Topics at Colliders: Exploring Hints of New Physics
Second Annual PCTS Lecturer, Leo Kadanoff

2012-2013

Discovery of the Higgs Boson
Bridging the Gap Between the Geosciences and
Mathematics, Statistics, and Computer Science
Higgs Physics After Discovery
Entanglement in Discrete & Continuous Quantum
Systems
Nonequilibrium Physics with Strongly Interacting
Quantum Matter and Light
Through the Looking Glass
Origins of Life
Geostrophic Turbulence & Active Tracer Transport in
Two Dimensions
Stability, Energetics, and Turbulent Transport in
Astrophysical, Fusion, and Solar Plasmas
Revealing Radiative Processes Near Black Holes
Cosmology in the Planck Era
Third Annual PCTS Lecturer, Ignacio Cirac

2013-2014

Astrophysics Focused Telescope Asset Space
Coronagraphy for Exoplanet Imaging
Living with a Star: Past Accomplishments and Future
Promise
The US-Italy Physics Program at Laboratori Nazionali
del Gran Sasso
The Dark Matter Paradigm: Current Status and
Challenges
CMS* Exotic Physics (*Compact Muon Solenoid
experiment at the Large Hadron Collider)
Bulk Microscopy from Holography
"Toy Models", Director's Lecture
Effective Field Theory for Large Scale Structures
Symmetry in Topological Phases
Many Body Localization and Related Phenomena

The Origin of Biological Homochirality
Searching for Simplicity
Fourth Annual PCTS Lecturer, Michael Peskin

2014-2015

Kuncik/LaFleur Public Lecture: Quantum Universe
Open Questions in String Cosmology and Inflation
Majorana Zero Modes and Beyond
Higher Spin Symmetries and Conformal Bootstrap
Numerical Approaches to Nonadiabatic Dynamics
Plasma Processes in Astrophysics and Fusion
Energy: A Workshop of the Max-Planck/
Princeton Center for Plasma Physics
Accelerating Cosmic-Ray Comprehension
Intracellular Phase Transitions: RNA, Protein, Lipids
and Beyond
Ice Nucleation
Topological and Strongly Correlated Phases in Cold
Atoms
Fifth Annual PCTS Lecturer, Gavin Crooks

2015-2016

The Non-Equilibrium Quantum Frontier
Magnetic Fields in Laboratory High Energy Density
Plasmas
Large Deviation Theory In Principle And Practice
The Dynamo Effect in Astrophysical and Laboratory
Plasmas
Dirac and Weyl Fermions in Topological
Semimetals
Exploring New Data from LHC Run-II
General Relativity in the Next 100 Years
Rethinking Cosmology
PCTS@TEN CONFERENCE AND CELEBRATION
Sixth Annual PCTS Lecturer, Michael Brenner

PCTS@ten

Director: Paul J. Steinhardt • Associate Director: Igor R. Klebanov
Center Coordinator: Charlene Borsack

CURRENT FACULTY FELLOWS

B. Andrei Bernevig • Curtis Callan (Director, 2006-08) • Garnet Chan •
Pablo Debenedetti • Eve Ostriker • Howard A. Stone • Herman Verlinde

POSTDOCTORAL FELLOWS

2006–09: B. Andrei Bernevig, Meera Parish, and Antonello Scardicchio
2007-10: Thomas Klose, Jean-Luc Lehners, Branson Stephens, and Aleksandra Walczak
2008-11: Dmitry Abanin, Lisa Manning, and Matthew Reece
2009-12: Benjamin Basso, Adam Brown, and Bryan Clark
2010-13: Mariangela Lisanti, Marco Schiro, Alexander Tchekhovskoy, and Masahito Yamazaki
2011-13: Timothy Merlis
2011-14: Yoav Kallus, Joseph Maciejko, and Elisabetta Matsumoto
2012-15: Daniel Harlow, Samuel Lee, and Rahul Nandkishore
2013-16: Ian Abel, Yi Li, David Limmer, and Titus Neupert
2014-16: Timothy Berkelbach
2014-17: Anna Ijjas, Curt von Keyserlingk, Mark Mezei, and David Pinner
2015-18: Barry Bradlyn, Jennifer Cano, Bruno Le Floch, Zhiyuan Li, and Yaojun Zhang
2016-19: Anna Frishman, Daniel Lecoanet, Pierre Ronceray, and Pierfranceso Urbani

EMERITUS FACULTY FELLOWS

Ravindra Bhatt • William Bialek • Adam Burrows • Roberto Car • David Huse •
Shivaji Sondhi • David Spergel • Salvatore Torquato • Jeroen Tromp

R_c
 $E_x = c_x \int \rho^{4/3}(r) / dr$
 $L = \frac{1}{2} \frac{\pi}{\theta} \epsilon^{m\nu\sigma} \sum \phi = \frac{\pi}{\sqrt{18}} \dots$
 $X_n = n + \alpha + \frac{1}{\tau} L \frac{n}{\tau} + \dots$
 $ds_{10}^2 = H^{-\frac{1}{2}} (-dt^2 + dx^2 + dy^2 + dz^2) + H^{\frac{1}{2}}$
 $S = \frac{1}{2} M_{PL}^2 \int d^4x \sqrt{|h|} N \left(R^{(3)} - \frac{1}{N^2} (E_{ij}^2) \right)$
 $H = \int S_i^z S_i^z + h S_i^x + \dots$
 $\left(\frac{\partial K_T}{\partial T} \right)_{P, TMD} = \frac{1}{N} \frac{(\partial^2 N / \partial T^2)_P}{(dP/dT)_{TMD}}$
 $\frac{\partial h_\alpha}{\partial t} + \dots = Z_{\alpha\beta} \frac{\partial \langle \phi \rangle}{\partial t} \frac{\partial F_\alpha}{\partial \epsilon_\alpha} + \dots$
 $G(x) = \dots$
 $\frac{\partial^2 f}{\partial y^2 + \partial z^2} = 0$
 $S_{\text{sub}} = \dots$

The page contains several diagrams:

- A sphere with a shaded top and a dashed horizontal line, representing a cross-section or a specific state.
- A cylinder with a shaded top, similar to the sphere diagram.
- A graph showing a curve $G(x)$ with a peak, and axes labeled $\frac{\sigma_{xx}}{e^2/h}$ and σ_{xy} .
- A circular diagram with a vertical arrow labeled B pointing upwards, possibly representing a magnetic field.
- A circular diagram with a vertical arrow labeled ω pointing upwards, possibly representing angular frequency.



*Ten great years are past,
but the best is yet to come . . .*