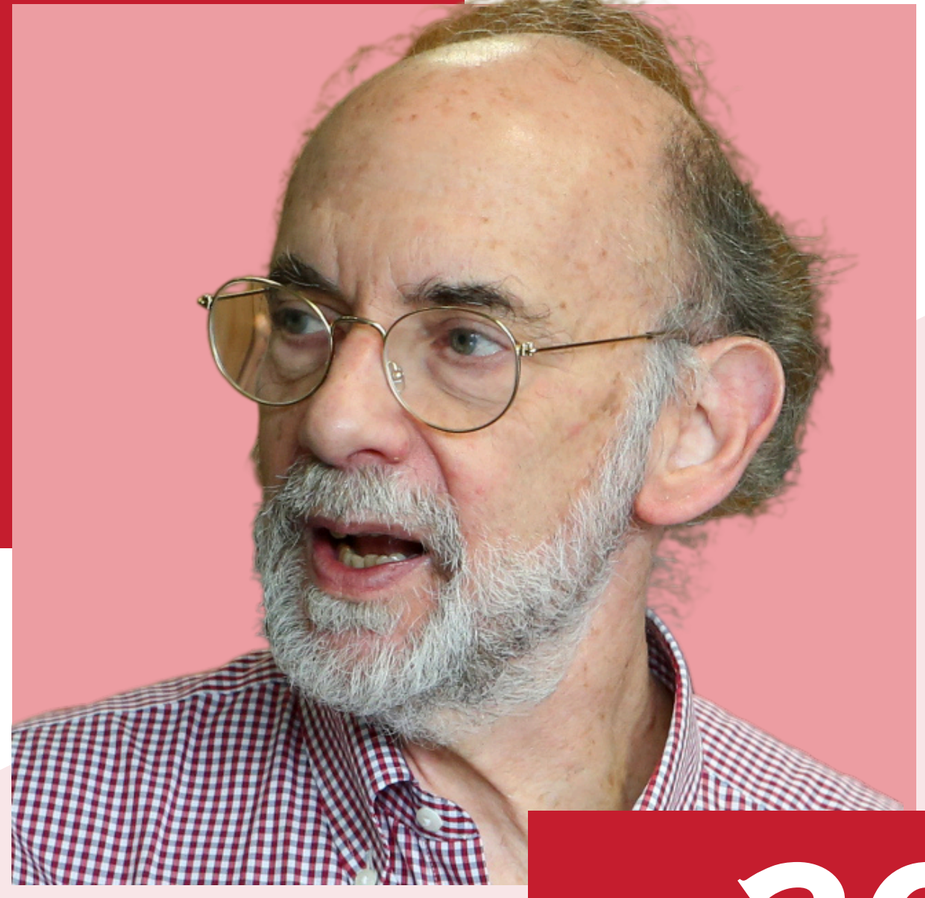
Four lectures on Number Theory and Physics



2024

The International Groupe de Travail on differential equations in Paris

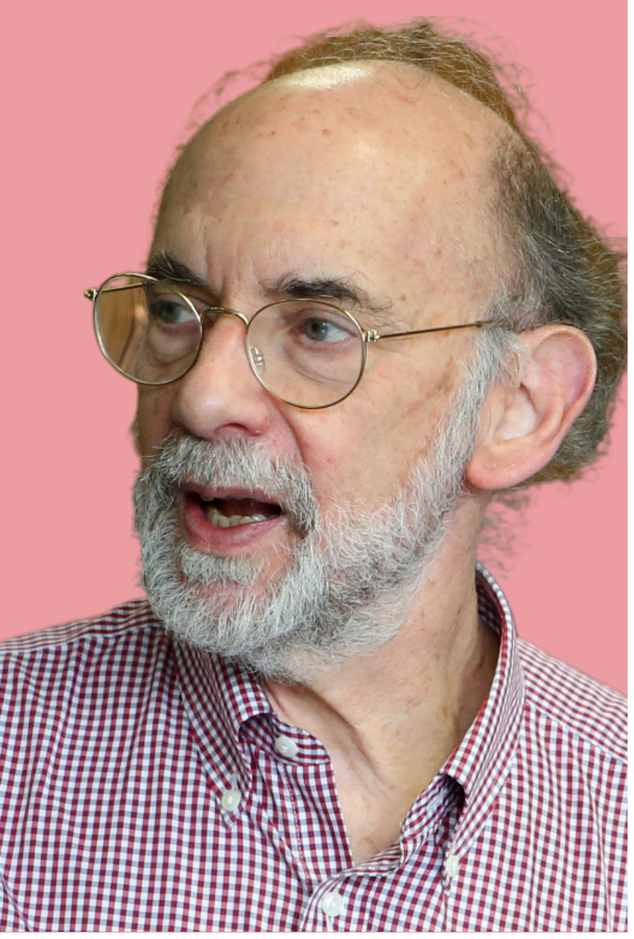
www.PhysicsLatam.com/seminar

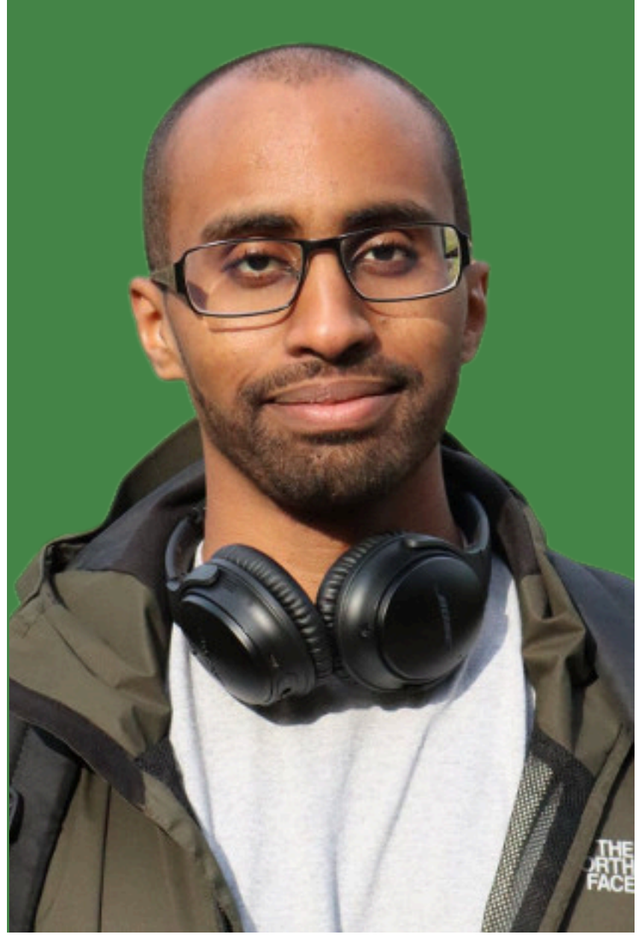
Physics Latam

ADVANCED LECTURES ON THEORETICAL PHYSICS & MATHEMATICS

This series examines some of the latest intersections between number theory and physics.

10 October – 21 November 2024.






Physics Latam &
The International Groupe de Travail on differential equations in Paris *Present:*

Four lectures on Number Theory and Physics

*This series explores the connections between number theory and physics, designed for graduate students and researchers. Topics include Limits of Heights (**Spencer Bloch**), Application of Calabi-Yau Periods in Scattering Amplitudes (**Albrecht Klemm**), Local Zeta Functions and Black Holes in String Theory (**Mohamed Elmi**), and K2 of Curves and Physics (**Matt Kerr**).*

Each lecture balances mathematics/physics theory with practical applications, offering insights into how number theory shapes modern physics and vice versa.

Who should attend:
Graduate students and researchers in mathematics and physics.

Issue
1

10 October – 21 November 2024.

ONLINE SEMINARS
Zoom ID: 835 9644 8829
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Physics Latam
ADVANCED LECTURES ON
THEORETICAL PHYSICS & MATHEMATICS

Four lectures on Number Theory and Physics

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ADVANCED LECTURES ON
THEORETICAL PHYSICS & MATHEMATICS

Limits of Heights

Lecture based on material from the paper Feynman Amplitudes and Limits of Heights, joint work with Omid Amini, Jose Burgos Gil, and Javier Fresan. Published in Izvestiya Math. 80:5, pp. 5-40. (in honor of J.P.Serre). The objective is to compare string amplitudes with Feynman amplitudes.

Spencer Bloch
University of Chicago

Spencer Bloch is a mathematician renowned for his contributions to algebraic geometry and number theory. He obtained his PhD in 1971 at Columbia University and has made significant advances in the study of algebraic cycles, K-theory, and motives.

Bloch is particularly known for developing the Bloch-Kato conjecture and for his work on the theory of higher Chow groups, which generalize classical Chow groups to higher-dimensional cycles. He has held prestigious academic positions, including a long tenure at the University of Chicago. His research continues to shape modern mathematical thought in geometry and, more recently, in number theory and physics.

16:30-18:00 CET
10 October 2024
ONLINE SEMINAR
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Four lectures on Number Theory and Physics

Physics Latam

ADVANCED LECTURES ON
THEORETICAL PHYSICS & MATHEMATICS

Application of Calabi-Yau Periods in Scattering Amplitudes

Periods and relative periods on Calabi-Yau manifolds play an important role in extracting low-energy predictions from superstring compactifications and have mathematical applications in mirror symmetry. Recently, it has been realized that they are essential building blocks to calculate Feynman integrals in perturbative approaches to quantum field theories, to the post-Minkowskian approximation to general relativity, and many other physical problems. This gives a great opportunity to further develop mathematical techniques of current research interest in mixed Hodge structure, algebraic geometry, and arithmetic geometry.

Albrecht Klemm

BCTP, University of Bonn

Albrecht Klemm is a mathematical physicist known for his influential work in string theory, algebraic geometry, and mirror symmetry. He obtained his PhD in 1990 at the University of Heidelberg. He has made significant contributions to the study of Calabi-Yau manifolds, Gromov-Witten theory, and topological string theory. Klemm has worked on the application of mathematical structures to problems in theoretical physics, particularly in the context of string compactifications and the connections between physics and geometry.

He has held academic positions at institutions such as the University of Bonn (BCTP and Hausdorff Center for Mathematics), where he has advanced research at the intersection of mathematics and physics.

16:30-18:00 CET
25 October 2024

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Four lectures on Number Theory and Physics

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ADVANCED LECTURES ON
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Local Zeta Functions and Black Holes in String Theory

I will begin by explaining the attractor mechanism of type II string theory on a Calabi-Yau threefold. This is a flow on the moduli space of a Calabi-Yau threefold and its computation reduces to the computation and analytic continuation of periods (solutions of a Picard-Fuchs equation). I will explain how special attractor points (attractor points of rank two) may be found by computing local zeta functions for many primes with the aid of a computer. Finally, I will explain how these examples are modular and how certain physical quantities can be expressed in terms of critical L-function values. All of this will be illustrated with concrete examples.

Mohamed Elmi

YMSC, Tsinghua University

Mohamed Elmi is a mathematician, recently serving as a postdoctoral researcher at Rutgers University, Piscataway, since 2021. Now, Postdoc at YMSC, Tsinghua University. He completed his PhD at the University of Oxford in 2020 under the supervision of Philip Candelas. His research spans the fields of theoretical physics and mathematics, with a focus on algebraic geometry and its applications in string theory and number theory. Elmi's work often explores advanced topics in moduli spaces and enumerative geometry, contributing to the broader understanding of mathematical structures in theoretical physics.

16:30-18:00 CET
08 November 2024

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ADVANCED LECTURES ON
THEORETICAL PHYSICS & MATHEMATICS

K2 of Curves and Physics

I will discuss three different applications of algebraic K-theory/motivic cohomology/higher Chow cycles to mathematical physics. Rather than look at the general case, I will mainly consider what can be done with "K2 cycles" (or pairs of meromorphic functions on families of curves) and their regulator maps: (i) they explain the asymptotic growth rate of local Gromov-Witten invariants of toric Fano surfaces; (ii) they help to settle a conjecture on eigenvalues of quantum curves arising in the topological string/spectral theory correspondence; and (iii) they facilitate the computation of the sunset Feynman integral in terms of elliptic dilogarithms.

Matt Kerr

Washington University in St. Louis

Matt Kerr is a mathematician specializing in algebraic geometry and Hodge theory. He obtained his PhD in 2003 at Princeton University under Phillip A. Griffiths.

His research focuses on topics such as algebraic cycles, period maps, and degenerations of varieties, with applications to number theory and mathematical physics. Kerr has held faculty positions at Durham University and Washington University in St. Louis.

16:30-18:00 CET
21 November 2024
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