

HERTZ LECTURE.

DESY Lecture on Physics 2026

The Quantum Nature of Space and Time

Prof. Dr. Jan de Boer
Amsterdam U.



Wednesday, 23 Sep 2026, 17:30 h

DESY main auditorium

<https://webcast.desy.de>

Deutsches Elektronen-Synchrotron DESY
A Research Centre of the Helmholtz Association

Six-Dimensional Supergravity on $S^3 \times AdS_3$ and 2d Conformal Field Theory

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Einstein's theory of general relativity describes gravity as the geometry of space and time, while quantum mechanics governs the microscopic world of atoms and elementary particles. Reconciling these two pillars of modern physics remains one of the greatest scientific challenges. Over the past decade, however, remarkable new connections between gravity, quantum information, and black holes have reshaped our understanding of the problem. This lecture will introduce the central ideas behind quantum gravity, and explain why black holes have become invaluable theoretical laboratories. Along the way we will discuss both the progress that has been made and the profound mysteries that remain.

Topological classification of crystalline insulators through band structure combinatorics

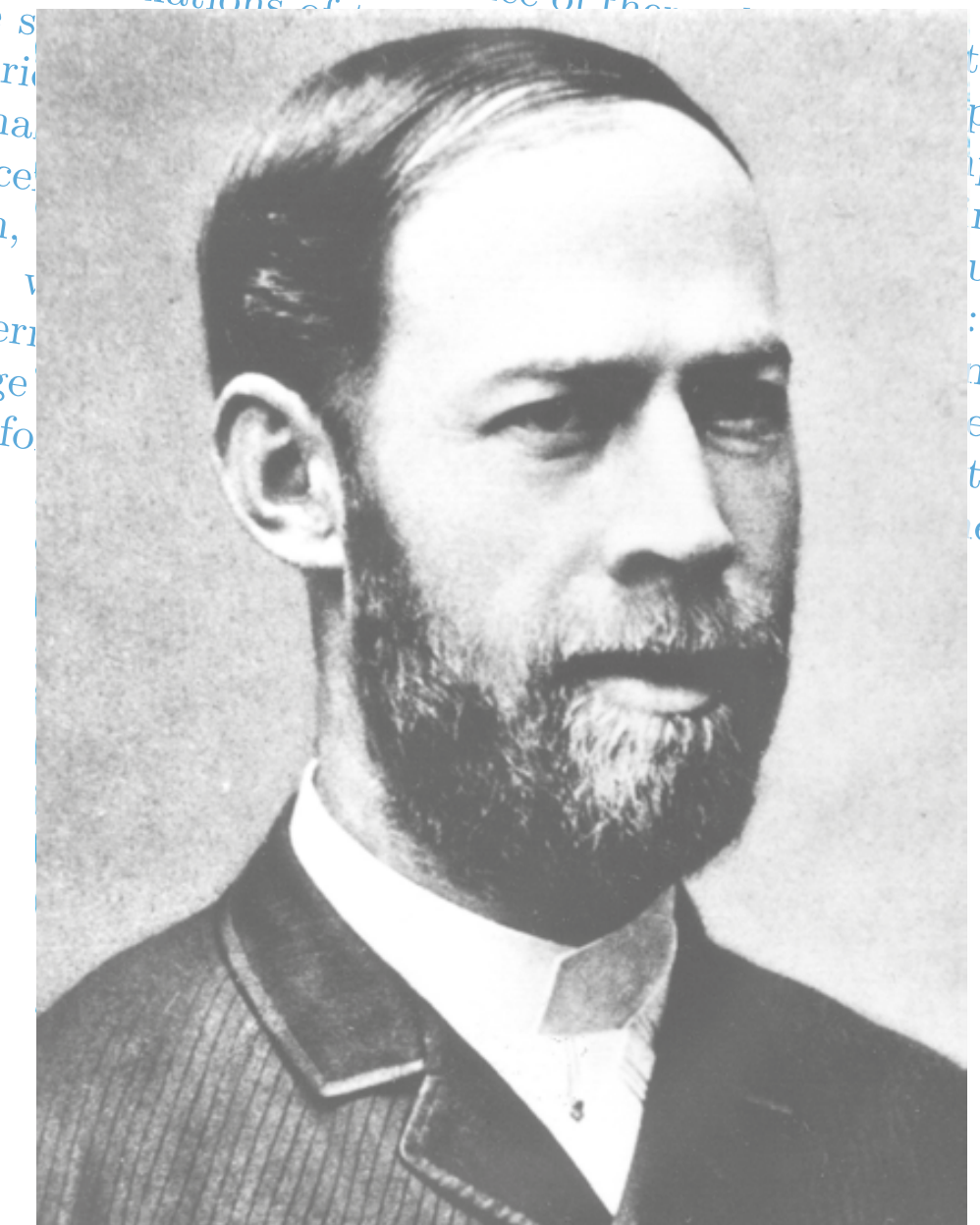
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We present a method for efficiently enumerating all allowed, topologically distinct, electronic band structures within a given crystal structure. The algorithm applies to crystals with broken time-reversal, particle-hole, and chiral symmetries in any dimension. The presented recasting of the mathematical structure underlying the topological classification of these band structures into a straightforward counting problem from the perspective of combinatorics, and therefore elucidate this abstract mathematical structure in any possible two-dimensional perspective. Using a straightforward counting problem from the perspective of combinatorics, and therefore elucidate this abstract mathematical structure in any possible two-dimensional perspective.

Holographic Thermalization

V. Balasubramanian,¹ A. Bernamonti,² J. de Boer,³ N. Copland,² B. Craps,² E. Keski-Vakkuri,⁴ B. Müller,⁵ A. Schäfer,⁶ M. Shigemori,⁷ and W. Staessens²
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Using the AdS/CFT correspondence, we probe the scale-dependence of the entanglement entropy in $d = 2, 3, 4$. In the case of invariant geometries, the entanglement entropy in AdS space in terms of invariant geometric volumes. Our results show that for two-dimensional volumes, the entanglement entropy probes in all dimensions share certain features. (3) top-down thermalization, a slight delay in the onset of thermalization, initial conditions the entanglement entropy then that saturates the entanglement entropy density is nearly volume-independent for



Heinrich Hertz

1857 Hamburg-Karlsruhe-Bonn 1894

ON THE HOLOGRAPHIC RENORMALIZATION GROUP
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