Mathematical Physics
Physique mathématique
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MATTHEW ALEXANDER, Regina

SETH ASANTE, University of New Brunswick
Deferred Cyclotomic Representations: Exact Algebraic Evaluation of Quantum Group Invariants and q-Hypergeometric Series

The computation of topological invariants for 3-manifolds, such as the Turaev-Viro state sums, relies heavily on the representation theory of the quantum group $U_q(sl_2)$. The fundamental building blocks of these invariants (such as the quantum 6j-symbols) are expressed as complex q-hypergeometric series. Evaluating these rational functions poses severe challenges. Standard evaluations rely on dense polynomial or rational formulations, which trigger expression swell in exact symbolic algebra and severe catastrophic cancellation in finite-precision arithmetic.

In this talk, we introduce the Deferred Cyclotomic Representation (DCR) of the q-hypergeometric series, an algebraic framework that resolves these computational bottlenecks. By mapping the multiplicative structure of q-factorials onto a free abelian group generated by irreducible cyclotomic polynomials, the DCR framework translates algebraic multiplication and division into exact sparse integer vector additions. This isolates the combinatorial skeleton of the series from the target evaluation field. We shall demonstrate how DCR enables the extraction of common polynomial divisors, intrinsically resolves root-of-unity poles, and allows the evaluation of generic tensor category identities in exact cyclotomic fields. QRecoupling.jl open-source package is developed for further research and applications.

CONNOR BEHAN, Perimeter Institute
Supercharge cohomology in holographic theories

To leverage the full power of holographic duality, one must be able to interpolate between weak and strong coupling on the field theory side. This can be done for the superconformal index which is coupling independent but still sensitive to the distinction between multi-graviton states and black holes. I will discuss a natural refinement of this which comes from viewing supersymmetric states through the lens of cohomology. Although this space receives corrections in perturbation theory, these appear in a rather controlled way. This viewpoint makes it easier to search the low-lying Hilbert space and it also makes some relations between different theories more transparent. I will give thoughts on how supercharge cohomologies can serve as fundamental data of supersymmetric gauge theories with their own universality classes.

SERAPHIM JAROV, Toronto

PETER MARZLIN, St. Francis Xavier University
Locality and the phase space representation of quantum fields

The Hegerfeldt theorem asserts that any localized state of a relativistic particle would become delocalized in an arbitrarily short time. We derive a phase space representation of non-relativistic and relativistic quantum fields that circumvents this problem by using a set of localized wave packets that are neither particles nor anti-particles. The dynamical equation of the probability amplitude takes the form of a classical Vlasov equation with quantum corrections. We discuss applications of the method, including Schwinger and Unruh effect.

ARAD NASIRI, UNB

WENJUN NIU, Perimeter

ADRIAN LOPEZ RAVEN, Perimeter

RUBEN SANDAPEN, Acadia University
Conformal inversion in the internal light-front dynamics of a pion

In light-front Quantum Chromodynamics (QCD), there is a natural separation between longitudinal and transverse dynamics. Here, we focus on the pion where we find that the equations of motion governing transverse and longitudinal dynamics map onto the infrared and ultraviolet limits of the equation of motion for a scalar field in 5-dimensional anti de Sitter spacetime (AdS) deformed by a quadratic dilaton. While conformal symmetry is explicitly broken on the AdS side for transverse dynamics, it is explicitly broken on the QCD side for longitudinal dynamics.

ROBERT VAN DEN HOOGEN, St. Francis Xavier University
Using gauge covariant Lie derivatives to impose symmetries

A procedure to determine the initial ansatz for the co-frame and spin connection characterizing a Riemann-Cartan geometry respecting a given group of continuous symmetries is illustrated by employing a gauge covariant Lie derivative to the metric, co-frame and spin connection. The procedure will be applied to a simple non-trivial geometry in teleparallel gravity.