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# For Amplitudes, Lie Polynomials and a Twistorial Correspondence are used

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## Introduction

We examine Lie polynomials as a mathematical framework that underpins the structure of gauge and gravity theories' so-called double copy relationship (and a network of other theories besides). We show how Lie polynomials emerge naturally in the geometry and cohomology of M0, n, the moduli space of n points on the Riemann sphere up to the Mobiüs transformation. We establish a twistorial correspondence between the cotangent bundle TDM0, n, the bundle of forms with logarithmic singularities on the divisor D as the twistor space and Kn, the space of momentum invariants of n massless particles subject to momentum conservation, as the space-time analogue [1].

## Description

As the corresponding Penrose transform, this provides a natural framework for Cachazo He and Yuan (CHY) and ambitwistor-string formulae for scattering amplitudes of gauge and gravity theories. We show that it provides a natural correspondence between CHY half-integrands and scattering forms, specifically certain n3-forms on Kn introduced by Arkani-Hamed, Bai, He and Yan (ABHY). We also provide a generalisation and more invariant description of ABHY's associahedral n3-planes in Kn.

Two processes are in duality if a duality function exists, that is, a function of both processes in which the expectations with respect to the original process are related to the expectations with respect to the dual process. Orthogonal polynomials of hypergeometric type were recently obtained as duality functions for several families of stochastic processes, with the orthogonality being with respect to the corresponding stationary measures. As limit cases, these orthogonal polynomials contain the well-known simpler duality functions (also known as the classical and cheap duality functions). Franceschini and Giardinà demonstrate stochastic duality using explicit relationships between orthogonal polynomials of different degrees, such as raising and lowering formulas [2].

The purpose of this paper is to show an alternate method for obtaining orthogonal polynomials (and other 'orthogonal' functions) from as duality functions. The method we use is based on Lie algebra representation theory. This is inspired by, where representation theory of sl(2,C) and the Heisenberg algebra are used to find (non-orthogonal) duality functions; for a Lie algebraic approach to duality, see Sturm et al. The main idea is to consider a specific element Y in the Lie algebra (or better, enveloping algebra). (Y) and (Y) are the stochastic process generators realised in two different but equivalent representations and. Y is closely related to the Casimir operator in the case of sl(2,C) [3,4].

One of the computational obstacles to a complete classification of Automorphic Lie Algebras so far has been the choice of two different group representations, which implies a ground form of higher degree, rather than degree two as in. On the other hand, the intrinsic difficulty of the problem increases as the dimension increases, from $sl_2(C)$ to $sl_n(C)$, n>2. These difficulties are overcome in two ways: first, by employing classical invariant theory, which involves working with polynomials in X and Y rather than rational functions of, until the Riemann sphere is identified with the complex projective line CP1 by setting =X/Y. Instead, we employ the method of classical invariant theory to compute higher-order invariants via transvection, beginning with lower degree g(V)-ground forms and V being an irreducible G-representation. As a result, the problem is reduced to locating lower degree g(V)-ground forms. Furthermore, transvection only requires multiplication and differentiation with respect to X and Y, making it computationally efficient and simple to implement.

Psychopathology symptoms have been proposed to exist on a severity continuum, with the absence of symptoms and psychiatric disorders marking the extreme ends. This is supported by the idea that subthreshold and full-threshold psychopathological symptoms have a similar etiology 6,9-12 and treatment outcome14. This study looked at the stability of psychopathological symptoms, or their attraction strength, along a severity scale. We discovered that the stability of symptoms assessed daily over a six-month period is unrelated to the severity of symptoms. This lends support to the dimensional view of psychopathology, which holds that subthreshold and full-threshold psychopathological symptoms differ in degree rather than kind [5].

Much is known about counting algebraic numbers or, more broadly, points in Pn(Q ) with fixed degree (over Q or any fixed number field) and bounded height: Schanuel first established an asymptotic for the number of algebraic points of bounded height defined over a fixed number field in. Schmidt obtained additional results, including the asymptotic for the number of quadratic points (over Q) of bounded height, in and. If n is greater than the degree of the point (over Q), Gao discovered and demonstrated the correct asymptotic in. He also discovered the correct order of magnitude for any n and degree (over Q).

## Conclusion

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## Conflict of Interest

No conflict of interest.

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