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Computational algebraic geometry, p-adic numbers and fast linear algebra for scattering amplitude ansätze

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Scattering amplitudes in perturbative quantum field theory exhibit a rich structure of zeros, poles and branch cuts which are best understood in complexified momentum space. It has been recently shown that leveraging this information can significantly simplify both analytical reconstruction and final expressions for the rational coefficients of transcendental functions appearing in phenomenologically-relevant scattering amplitudes. Inspired by these observations, we present a new algorithmic approach to the reconstruction problem based on p-adic numbers and computational algebraic geometry. For the first time, we systematically identify and classify the relevant irreducible varieties in spinor space, and thanks to p-adic numbers – analogous finite fields, but with a richer structure to their absolute value – we stably perform numerical evaluations close to these singular surfaces, thus completely avoiding the use of floating-point numbers. Finally, we discuss a GPU-based implementation of dense Gaussian elimination used to perform some of the linear algebra steps involved in the construction of the ansatz and fitting of its coefficients.

Significance

References

Speaker time zone

Compatible with Europe

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