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SEMINAR ZAVODA ZA TEORIJSKU FIZIKU

(Zajednički seminari Zavoda za teorijsku fiziku,
Zavoda za eksperimentalnu fiziku IRB-a i Fizičkog odsjeka PMF-a)

Direct numerical approach to one-loop amplitudes

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Abstract:

The conventional way of calculating one-loop Feynman amplitudes follows a familiar scheme: first the amplitude is written in terms of contributing Feynman diagrams, then each diagram is reduced to a linear combination of known master scalar integrals, and, finally, all the diagrams are combined to give an expression for the amplitude. This, diagram-by-diagram approach, implemented either as an analytical or a numerical calculation, has several shortcomings. For large number of external particles, the number of contributing diagrams grows rapidly, making the calculations very demanding and repetitive. Also, it is known that the expression for the amplitude is, more often than not, much simpler than the bare sum of the diagrams themselves. This means there are large cancellations between contributions of different diagrams, implying that a lot of laborious calculation is probably avoidable. Furthermore, the analytical expressions obtained in such a way are usually used only to numerically evaluate integrals over different phase spaces, questioning the need for the complete analytical evaluation. On the other hand, if a numerical implementation of above diagram-by-diagram approach is used, one confronts inevitable numerical instabilities and loss of precision due to the aforementioned cancellations. In the seminar, I will present a completely numerical approach for evaluation of the one-loop Feynman amplitudes. The approach is complementary to the conventional diagram-by-diagram method in that it calculates the complete amplitude at once and considerably softens the above shortcomings. As an example, N-scalar and N-photon amplitudes are calculated and compared to the exact results.

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