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Forgotten (or not) possibility of the application of the least squares method: the analysis of the computer-based numerical results to QCD $\overline{\rm MS}$-on-shell mass relation at the four-loop level

The set of the four-loop numerical results for the relation between pole and running heavy quarks masses in QCD at fixed number of lighter flavors $3 \leq n_l \leq 15$, which was obtained in Ref.[1] with help of the Lomonosov Supercomputer of Moscow State University, is analysed by the ordinary method of the least squares. We use its variant which allows to solve the overdetermined system of 13 linear equations and to define 4 coefficients of the polynomial of the third power in n_l in the expression for the four-loop correction to the QCD $\overline{\rm MS}$-on-shell mass relation with corresponding uncertainties of this approach. The central values of these terms are consistent with a high degree of accuracy with the results obtained in Ref.[1]. To demonstrate the stability of the least squares method to the number of equations we also consider the situation when the number of equations is equal to 3 at $3 \leq n_l \leq 5$. It is interesting that in both cases the central values of all unknown terms coincide with the previously obtained two unknown in analytical form values at $3 \leq n_l \leq 15$ [2,3] while the uncertainties increase no more than 10 times. Thus the least squares method allows to check for self-consistency the results of numerical computations [1] and analytical calculations [4], obtained using different methods of evaluation of Feynman diagrams and of advanced computer-oriented programs.

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