

Ablinger, J.; Blümlein, J.; De Freitas, A.; Hasselhuhn, A.; von Manteuffel, A.; Round, M.; Schneider, C.

The $O(\alpha_s^3 T_F^2) C_F(C_A)$ contributions to the gluonic operator matrix element. (English) Zbl 1323.81126
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Summary: The $O(\alpha_s^3 T_F^2 C_F(C_A))$ contributions to the transition matrix element $A_{gg,Q}$ relevant for the variable flavor number scheme at 3-loop order are calculated. The corresponding graphs contain two massive fermion lines of equal mass leading to terms given by inverse binomially weighted sums beyond the usual harmonic sums. In x -space two root-valued letters contribute in the iterated integrals in addition to those forming the harmonic polylogarithms. We outline technical details needed in the calculation of graphs of this type, which are as well of importance in the case of two different internal massive lines.

MSC:

81V35 Nuclear physics

81V05 Strong interaction, including quantum chromodynamics

81T15 Perturbative methods of renormalization applied to problems in quantum field theory

81T18 Feynman diagrams

11G55 Polylogarithms and relations with K -theory

Cited in 4 Documents

Software:

[AMBRE](#); [Axodraw](#); [Fermat](#); [HarmonicSums](#); [MATAD](#)

Full Text: [DOI](#) [arXiv](#)

References:

- [1] Bethke, S., Workshop on precision measurements of α_s
- [2] Alekhin, S.; Blümlein, J.; Moch, S.; Perez, E.; Rizvi, E.; Blümlein, J., Phys. Rev. D, Rep. Prog. Phys., Prog. Part. Nucl. Phys., 69, 28, (2013), 054028
- [3] Laenen, E.; Riemersma, S.; Smith, J.; van Neerven, W. L.; Laenen, E.; Riemersma, S.; Smith, J.; van Neerven, W. L.; Riemersma, S.; Smith, J.; van Neerven, W. L., Nucl. Phys. B, Nucl. Phys. B, Phys. Lett. B, 347, 143, (1995)
- [4] Alekhin, S. I.; Blümlein, J., Phys. Lett. B, 594, 299, (2004)
- [5] Buza, M.; Matiounine, Y.; Smith, J.; Mignerone, R.; van Neerven, W. L., Nucl. Phys. B, 472, 611, (1996)
- [6] Bierenbaum, I.; Blümlein, J.; Klein, S., Nucl. Phys. B, 820, 417, (2009)
- [7] Vermaseren, J. A.M.; Vogt, A.; Moch, S., Nucl. Phys. B, 724, 3, (2005)
- [8] Bierenbaum, I.; Blümlein, J.; Klein, S., Nucl. Phys. B, 780, 40, (2007)
- [9] Buza, M.; Matiounine, Y.; Smith, J.; van Neerven, W. L., Eur. Phys. J. C, 1, 301, (1998)
- [10] Bierenbaum, I.; Blümlein, J.; Klein, S., Phys. Lett. B, 672, 401, (2009)
- [11] Buza, M.; Matiounine, Y.; Smith, J.; van Neerven, W. L., Nucl. Phys. B, 485, 420, (1997)
- [12] Bierenbaum, I.; Blümlein, J.; Klein, S., PoS, ACAT, (2007), 070
- [13] Bierenbaum, I.; Blümlein, J.; Klein, S.; Schneider, C., Nucl. Phys. B, 803, 1, (2008)
- [14] Blümlein, J.; Klein, S.; Tödtli, B., Phys. Rev. D, 80, 094010, (2009)
- [15] Gottschalk, T.; Glück, M.; Kretzer, S.; Reya, E.; Glück, M.; Kretzer, S.; Reya, E.; Blümlein, J.; Hasselhuhn, A.; Kovacicova, P.; Moch, S.; Buza, M.; van Neerven, W. L.; Blümlein, J.; Hasselhuhn, A.; Pfoh, T., Phys. Rev. D, Phys. Lett. B, Phys. Lett. B, Phys. Lett. B, Nucl. Phys. B, Nucl. Phys. B, 881, 1, (2014), (Erratum)
- [16] Behring, A.; Bierenbaum, I.; Blümlein, J.; De Freitas, A.; Klein, S.; Wißbrock, F.
- [17] Blümlein, J.; De Freitas, A.; van Neerven, W. L.; Klein, S., Nucl. Phys. B, 755, 272, (2006)
- [18] Ablinger, J.; Blümlein, J.; Klein, S.; Schneider, C.; Wißbrock, F., Nucl. Phys. B, 844, 26, (2011)
- [19] Blümlein, J.; Hasselhuhn, A.; Klein, S.; Schneider, C., Nucl. Phys. B, 866, 196, (2013)
- [20] Ablinger, J.; Blümlein, J.; Hasselhuhn, A.; Klein, S.; Schneider, C.; Wißbrock, F., Nucl. Phys. B, 864, 52, (2012)

- [21] Ablinger, J.; Blümlein, J.; Raab, C.; Schneider, C.; Wißbrock, F.
- [22] Ablinger, J.; Blümlein, J.; Klein, S.; Schneider, C.; Wißbrock, F.
- [23] Ablinger, J.; Blümlein, J.; Hasselhuhn, A.; Klein, S.; Schneider, C.; Wißbrock, F.
- [24] Ablinger, J.; Blümlein, J.; De Freitas, A.; Hasselhuhn, A.; von Manteuffel, A.; Round, M.; Schneider, C.; Wißbrock, F., Nucl. Phys. B, 882, 263, (2014)
- [25] J. Ablinger, et al., DESY 13-210, DESY 13-232.
- [26] Blümlein, J.; De Freitas, A.; van Neerven, W., Nucl. Phys. B, 855, 508, (2012)
- [27] Vermaseren, J. A.M.; Blümlein, J.; Kurth, S., Int. J. Mod. Phys. A, Phys. Rev. D, 60, 014018, (1999)
- [28] J. Ablinger, J. Blümlein, C. Raab, C. Schneider, DESY 14-021.
- [29] Kalmykov, M. Y.; Veretin, O.; Davydychev, A. I.; Kalmykov, M. Y.; Weinzierl, S.; Kalmykov, M. Y.; Ward, B. F.L.; Yost, S. A., Phys. Lett. B, Nucl. Phys. B, J. Math. Phys., J. High Energy Phys., 0710, 2656, (2007), 048
- [30] Fleischer, J.; Kotikov, A. V.; Veretin, O. L., Nucl. Phys. B, 547, 343, (1999)
- [31] Schneider, C.; Schneider, C.; Schneider, C.; Schneider, C.; Schneider, C.; Carey, A.; Ellwood, D.; Paycha, S.; Rosenberg, S.; Schneider, C.; Ablinger, J.; Blümlein, J.; Klein, S.; Schneider, C.; Schneider, C., J. Symb. Comput., Ann. Comb., J. Differ. Equ. Appl., Ann. Comb., Proceedings of the Workshop “Motives, Quantum Field Theory, and Pseudodifferential Operators”, held at the Clay Mathematics Institute, Boston University, June 2-13, 2008, Clay Math. Proc., Sémin. Lothar. Comb., Nucl. Phys. B (Proc. Suppl.), 205-206, 4, 1, (2013), in: J. Gutierrez, J. Schicho, M. Weimann (Eds.), in: Lecture Notes in Computer Science (LNCS), in press
- [32] Ablinger, J.; Ablinger, J., Computer algebra algorithms for special functions in particle physics, PhD Thesis, JKU Linz
- [33] J. Ablinger, J. Blümlein, C. Schneider, in preparation.
- [34] Ablinger, J.; Blümlein, J.; Schneider, C., J. Math. Phys., 54, 082301, (2013)
- [35] Ablinger, J.; Blümlein, J.; Klein, S.; Schneider, C.; Blümlein, J.; Hasselhuhn, A.; Schneider, C.; Schneider, C., Nucl. Phys. B (Proc. Suppl.), PoS RADCOR, PoS, ACAT, 110, (2013), J. Phys., in press
- [36] M. Round, et al., in preparation.
- [37] Lagrange, J.; Gauss, C. F.; Green, G.; Ostrogradski, M.; Chetyrkin, K. G.; Kataev, A. L.; Tkachov, F. V., Essay on the mathematical theory of electricity and magnetism, (Commentationes societatis scientiarum Gottingensis recentiores, vol. III, Werke Bd. V, (1813)), Mém. Acad. Sci. St.-Petersbg., Nucl. Phys. B, 174, 345-115, (1980), Nottingham, Green Papers
- [38] Vogt, A.; Moch, S.; Vermaseren, J. A.M., Nucl. Phys. B, 691, 129, (2004)
- [39] Bierenbaum, I.; Blümlein, J.; Klein, S., PoS, DIS2010, 148, (2010)
- [40] Steinhauser, M., Comput. Phys. Commun., 134, 335, (2001)
- [41] Nogueira, P., J. Comput. Phys., 105, 279, (1993)
- [42] Klein, S. W.G., Mellin moments of heavy flavor contributions to $F_2(x, Q^2)$ at NNLO
- [43] A. Hasselhuhn, 3-loop contributions to heavy flavor Wilson coefficients of neutral and charged current DIS, DESY-THESIS-2013-050.
- [44] van Ritbergen, T.; Schellekens, A. N.; Vermaseren, J. A.M., Int. J. Mod. Phys. A, 14, 41, (1999)
- [45] Hamberg, R., Second order gluonic contributions to physical quantities, (1991), Leiden University, PhD thesis
- [46] Bierenbaum, I.; Blümlein, J.; Klein, S., Phys. Lett. B, 648, 195, (2007)
- [47] Bierenbaum, I.; Blümlein, J.; Klein, S., Nucl. Phys. B, 780, 40, (2007)
- [48] Mellin, H.; Mellin, H., Acta Soc. Sci. Fenn., Math. Ann., 68, 7, 305, (1910)
- [49] Barnes, E. W.; Barnes, E. W., Proc. Lond. Math. Soc. (2), Quart. J. Math., 41, 136, (1910)
- [50] Whittaker, E. T.; Watson, G. N.; Titchmarsh, E. C., Introduction to the theory of Fourier integrals, (1937), Calendron Press Oxford, 2nd edition 1948
- [51] Smirnov, V. A., Feynman integral calculus, (2006), Springer Berlin
- [52] Bailey, W. N.; Erdélyi, A.; Appell, P.; Kampé de Fériet, J.; Appell, P.; Kampé de Fériet, J.; Exton, H.; Exton, H.; Srivastava, H. M.; Karlsson, P. W., Multiple Gaussian hypergeometric series, (1985), Ellis Horwood Chichester
- [53] Slater, L. J., Generalized hypergeometric functions, (1966), Cambridge University Press Cambridge · [Zbl 0135.28101](#)
- [54] Tausk, J. B., Phys. Lett. B, 469, 225, (1999)
- [55] Gluza, J.; Kajda, K.; Riemann, T., Comput. Phys. Commun., 177, 879, (2007)
- [56] Czakon, M., Comput. Phys. Commun., 175, 559, (2006)
- [57] Kosower, D.
- [58] Moch, S.; Uwer, P.; Weinzierl, S., J. Math. Phys., 43, 3363, (2002)
- [59] Gehrmann, T.; Remiddi, E., Comput. Phys. Commun., 144, 200, (2002)
- [60] Brown, F., Commun. Math. Phys., 287, 925, (2009)
- [61] Remiddi, E.; Vermaseren, J. A.M., Int. J. Mod. Phys. A, 15, 725, (2000)
- [62] Blümlein, J., Comput. Phys. Commun., 159, 19, (2004)

- [63] von Manteuffel, A.; Schabinger, R. M.; Zhu, H. X., *J. High Energy Phys.*, 1403, (2014), 139
- [64] Vermaseren, J. A.M.; Tentyukov, M.; Vermaseren, J. A.M., *Comput. Phys. Commun.*, 181, 1419, (2010)
- [65] von Manteuffel, A.; Studerus, C.; Studerus, C., *Comput. Phys. Commun.*, 181, 1293, (2010)
- [66] Lewis, R. H., *Computer algebra system*
- [67] Bauer, C. W.; Frink, A.; Kreckel, R.
- [68] Laporta, S., *Int. J. Mod. Phys. A*, 15, 5087, (2000)
- [69] Kotikov, A. V.; Caffo, M.; Czyz, H.; Laporta, S.; Remiddi, E.; Caffo, M.; Czyz, H.; Laporta, S.; Remiddi, E.; Gehrmann, T.; Remiddi, E.; Caffo, M.; Czyz, H.; Remiddi, E., *Phys. Lett. B, Acta Phys. Pol. B, Nuovo Cimento A, Nucl. Phys. B, Nucl. Phys. B*, 634, 309, (2002)
- [70] Gerhold, S., *Uncoupling systems of linear ore operator equations*, (2002), RISC, J. Kepler University Linz, Master's thesis
- [71] Blümlein, J.; Klein, S.; Schneider, C.; Stan, F., *J. Symb. Comput.*, 47, 1267, (2012)
- [72] Kauers, M., *Guessing handbook*, (2009), JKU Linz, Technical Report RISC 09-07
- [73] Blümlein, J., *Comput. Phys. Commun.*, 180, 2218, (2009)
- [74] Blümlein, J.; Blümlein, J.; Carey, A.; Ellwood, D.; Paycha, S.; Rosenberg, S.; Kotikov, A. V.; Velizhanin, V. N.; Blümlein, J.; Moch, S.-O., *Comput. Phys. Commun.*, Proceedings of the Workshop "Motives, Quantum Field Theory, and Pseudodifferential Operators", held at the Clay Mathematics Institute, Boston University, June 2-13, 2008, *Clay Math. Proc., Phys. Lett. B*, 614, 53, (2005)
- [75] Vermaseren, J. A.M., *Comput. Phys. Commun.*, 83, 45, (1994)

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