Iraso, R.; **Mnev, P.**

Two-dimensional Yang-Mills theory on surfaces with corners in Batalin-Vilkovisky formalism. (English) Zbl 1421.81085

Commun. Math. Phys. 370, No. 2, 637-702 (2019).

The principal objective in this paper is to construct explicit partition functions of 2D Yang-Mills theory on arbitrary surfaces via the perturbative path integral quantization

$$Z = \int \exp\left(\frac{i}{h} S_{\mathrm{YM}}\right)$$

and to compare them with the known non-perturbative results [*E. Witten*, Commun. Math. Phys. 141, No. 1, 153–209 (1991; Zbl 0762.53063)] formulated in terms of the representation-theoretic data of the structure group G.

The paper consists of four sections together with five appendices, the main original results being presented in §3 and §4. §2 reviews the basics of the BV-BFV formalism [*A. S. Cattaneo* et al., Commun. Math. Phys. 332, No. 2, 535–603 (2014; Zbl 1302.81141); ibid. 357, No. 2, 631–730 (2018; Zbl 1390.81381); "Classical and quantum Lagrangian field theories with boundary", Preprint, arXiv:1207.0239; "Perturbative BV theories with Segal-like gluing", Preprint, arXiv:1602.00741].

§3 computes the perturbative partition functions on 2D Yang-Mills on disks and cylinders. In the first part of §4, the authors address the extension of the BV-BFV formalism to manifolds with corners for 2D Yang-Mills, while the extension is used in the second part of §4 to compute the perturbative 2D Yang-Mills partition functions on surfaces of arbitrary genus including in Ω-cohomology of the known non-perturbative results [*E. Witten*, Commun. Math. Phys. 141, No. 1, 153–209 (1991; Zbl 0762.53063)]. The first appendix (Appendix A) discusses how to compute, within this setting, Wilson loop observables for both non-intersecting and intersecting loops, recovering in Ω-cohomology the well-known non-perturbative result.

Reviewer: Hirokazu Nishimura (Tsukuba)

MSC:

81T13 Yang-Mills and other gauge theories
81S40 Path integrals in quantum mechanics
18D05 Double categories, 2-categories, bicategories and generalizations
17B37 Quantum groups and related deformations
81T60 Supersymmetric field theories

Full Text: DOI

References:

[1] Baez, J., Dolan J.: Higher-dimensional algebra and topological quantum field theory. J. Math. Phys. \textbf{36} (1998). arXiv:q-alg/9503002 · Zbl 0863.18004

[2] Bandiera, R., Schaetz, F.: How to discretize the differential forms on the interval (2016). arXiv:1607.03654

[3] Batalin, I. A.; Vilkovisky, G. A., Gauge algebra and quantization, Phys. Lett. B, 102, 27, (1981)

[4] Bonechi, F., Cattaneo, A.S., Mnev, P.: The Poisson sigma model on closed surfaces. J. High Energy Phys. \textbf{2012} (2012). arXiv:1110.4850 · Zbl 1306.81290

[5] Cattaneo, A.S.: Private communications

[6] Cattaneo, A. S.; Felder, G., A path integral approach to the Kontsevich quantization formula, Commun. Math. Phys., 212, 591, (2000) · Zbl 1038.53088

[7] Cattaneo, A.S., Felder, G.: Coisotropic submanifolds in Poisson geometry and branes in the Poisson sigma model. Lett. Math. Phys. \textbf{69} (2003). arXiv:math/0309180 · Zbl 1065.53063

[8] Cattaneo, A.S., Mnev, P.: Remarks on Chern-Simons invariants. Commun. Math. Phys. \textbf{293} (2008). arXiv:0811.2045

· Zbl 1246.58018

[9] Cattaneo, A.S., Mnev, P., Reshetikhin, N.: Classical and quantum lagrangian field theories with boundary. Proc. Sci. (2012). arXiv:1207.0239 · Zbl 1302.81141

[10] Cattaneo, A. S.; Mnev, P.; Reshetikhin, N., Classical BV theories on manifolds with boundary, Commun. Math. Phys., 332, 535, (2014) · Zbl 1302.81141

[11] Cattaneo, A.S., Mnev, P., Reshetikhin, N.: Perturbative BV theories with Segal-like gluing (2016). arXiv:1602.00741

[12] Cattaneo, A.S., Mnev, P., Reshetikhin, N.: A cellular topological field theory (2017). arXiv:1701.05874 · Zbl 1315.81095

[13] Cattaneo, A. S.; Mnev, P.; Reshetikhin, N., Perturbative quantum gauge theories on manifolds with boundary, Commun. Math. Phys., 357, 631, (2018) · Zbl 1390.81381

[14] Cordes, S., Moore, G., Ramgoolam, S.: Lectures on 2d Yang-Mills theory, equivariant cohomology and topological field theories (1994). arxiv:hep-th/9411210

[15] Costello, K.J.: Renormalisation and the Batalin-Vilkovisky formalism (2007). arXiv:0706.1533

[16] Gugenheim, V. K.A. M.; Lambe, L. A., Perturbation theory in differential homological algebra I, Ill. J. Math., 33, 566, (1989) · Zbl 0661.55018

[17] Henneaux M., Teitelboim C.: Quantization of Gauge Systems. Princeton University Press, Princeton (1994) · Zbl 0838.53053

[18] Kontsevich, M., Deformation quantization of Poisson manifolds, Lett. Math. Phys., 66, 157, (2003) · Zbl 1058.53065

[19] Lawrence, R., Sullivan, D: A formula for topology/deformations and its significance. Fundam. Math. \textbf{225} (2014). arXiv:math/0610949 · Zbl 1300.55024

[20] Lurie, J.: On the classification of topological field theories. Curr. Dev. Math. (2009). arXiv:0905.0465 · Zbl 1180.81122

[21] Migdal, A. A., Recursion equations in gauge theories, Sov. Phys. JETP, 42, 413, (1975)

[22] Mnev, P.: Notes on simplicial BF theory. Mosc. Math. J. \textbf{9} (2006). arXiv:hep-th/0610326 · Zbl 1195.57068

[23] Mnev, P.: Discrete BF theory (2008). arXiv:0809.1160 · Zbl 1209.57024

[24] Oeckl, R., Two-dimensional quantum Yang-Mills theory with corners, J. Phys. A Math. Theor., 41, 135401, (2008) · Zbl 1138.81036

[25] Wernli, K.: Perturbative quantization of split Chern-Simons theory on handlebodies and lens spaces by the BV-BFV formalism. Doctoral thesis (2018)

[26] Witten, E.: On quantum gauge theories in two dimensions. Commun. Math. Phys. \textbf{141}, 153 (1991). https://doi.org/10.1007/BF02 · Zbl 0762.53063

[27] Zhi Cheng, X., Getzler, E.: Transferring homotopy commutative algebraic structures. J. Pure Appl. Algebra \textbf{212} (2006). arXiv:math/0610912 · Zbl 1158.18006