

On the Lindblad equation for open quantum systems: Rényi entropy rate and weak invariants

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© Published under licence by IOP Publishing Ltd. A brief review of two recent topics on the Lindblad equation is presented. One is concerned with time evolution of the quantum Rényi entropy under the equation. The lower bound of the entropy rate is derived in a compact form. The other is about the concept of weak invariants, which generalize the Lewis-Riesenfeld invariant and are defined in such a way that they are not constant but their expectation values remain invariant in time. The Lindbladian operator describing the time-dependent damped quantum oscillator is identified, and the corresponding weak invariant is explicitly constructed as an example.

<http://dx.doi.org/10.1088/1742-6596/1035/1/012001>

References

- [1] Lindblad G 1976 Commun. Math. Phys. 48 119
- [2] Gorini V, Kossakowski A and Sudarshan E C G 1976 J. Math. Phys. 17 821
- [3] Kraus K 1983 Effects, and Operations: Fundamental Notions of Quantum Theory (Heidelberg: Springer-Verlag) States
- [4] Preskill J 2004 Lecture Notes for Ph219/CS219: Quantum Information Chapter 3 available at <http://www.theory.caltech.edu/people/preskill/ph219/chap3-15.pdf>
- [5] Banks T, Susskind L and Peskin M E 1984 Nucl. Phys. B 244 125
- [6] Cowen R 2015 Nature 527 290
- [7] Nielsen M A and Chuang I L 2000 Quantum Computation and Quantum Information (Cambridge: Cambridge University Press)
- [8] Jin B-Q and Korepin V E 2004 J. Stat. Phys. 116 79
- [9] Ares F, Esteve J G and Falceto F 2015 Int. J. Geom. Methods Mod. Phys. 12 1560002
- [10] Hamma A, Giampaolo S M and Illuminati F 2016 Phys. Rev. A 93 012303
- [11] Rényi A 2007 Probability Theory (New York: Dover)
- [12] Shore J E and Johnson R W 1980 IEEE Trans. Inf. Theory 26 26
- [13] Shore J E and Johnson R W 1981 IEEE Trans. Inf. Theory 27 472
- [14] Johnson R W and Shore J E 1983 IEEE Trans. Inf. Theory 29 942
- [15] Pressé S, Ghosh K, Lee J and Dill K A 2013 Phys. Rev. Lett. 111 180604
- [16] Pressé S, Ghosh K, Lee J and Dill K A 2015 Entropy 17 5043
- [17] Lesche B 1982 J. Stat. Phys. 27 419
- [18] Abe S 2002 Phys. Rev. E 66 046134
- [19] Abe S 2016 Phys. Rev. E 94 022106
- [20] Benatti F and Narnhofer H 1988 Lett. Math. Phys. 5 325
- [21] Abe S 2008 EPL 84 60006

- [22] Abe S 2009 J. Stat. Mech.: Theor. Exp. 2009 07027
- [23] El Kaabouchi Aziz and Abe S 2011 J. Appl. Math. 2011 804836
- [24] Abe S 2012 J. Phys.: Conf. Ser. 394 012003
- [25] Abe S 2016 Phys. Rev. A 94 032116
- [26] Lewis H R Jr. and Riesenfeld W B 1969 J. Math. Phys. 10 1458
- [27] Dodonov V V and Man'ko V I 1978 Physica A 94 403
- [28] Ou C and Abe S 2016 EPL 113 40009
- [29] Liu S and Ou C 2016 Entropy 18 205
- [30] Ou C, Chamberlin R V and Abe S 2017 Physica A 466 450
- [31] Hartley J G and Ray J R 1982 Phys. Rev. D 25 382
- [32] Rajagopal A K and Marshall J T 1982 Phys. Rev. A 26 2977
- [33] Ma X 1988 Phys. Rev. A 38 3548
- [34] Abe S and Ehrhardt R 1993 Phys. Rev. A 48 986
- [35] Datta N, Ghosh G and Engineer M H 1989 Phys. Rev. A 40 526
- [36] Dittrich W and Reuter M 1991 Phys. Lett. A 155 94
- [37] Gao X-C, Xu J-B and Qian T-Z 1991 Phys. Rev. A 44 7016
- [38] Abe S and Ehrhardt R 1993 Z. Phys. C 57 471
- [39] Bertoni C, Finelli F and Venturi G 1998 Phys. Lett. A 237 331
- [40] Abe S 1993 Phys. Lett. A 181 359
- [41] Sarandy M S, Duzzioni E I and Serra R M 2011 Phys. Lett. A 375 3343
- [42] Abe S 1993 Phys. Rev. D 47 718
- [43] Song H and Mao Y 2017 Phys. Rev. A 96 032115
- [44] Abe S 2017 Eur. Phys. J. Special Topics 226 529
- [45] Wu S L, Zhang X Y and Yi X X 2015 Phys. Rev. A 92 062122