

Curriculum Vitae

Hong-Zhi Shen (H. Z. Shen, 沈宏志)

Basic information

Address: Center for Quantum Sciences and School of Physics, Northeast

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Education

Ph. D in quantum optics (09/2011-06/2016)

School of Physics and Optoelectronic Engineering, Dalian University of Technology, China

Advisor: Xue-Xi Yi

Thesis: "Theoretical study on quantum response and its applications in quantum open system"

M. S. in Applied Physics (09/2004-06/2007)

Bohai University, China

Advisor: Zhen Zhang

Research and Working Experience

Associate Professor (09/2018-present)

Center for Quantum Sciences, Northeast Normal University, China

Postdoc (08/2016-9/2018)

Center for Quantum Sciences, Northeast Normal University, China

Visiting scholar (02/2018-03/2018)

Basque University, Spain

Visiting scholar (05/2017-06/2017)

Peking University, China

Research interests:

Quantum optics; Quantum Open System Theory (non-Markovian); Quantum Control theory; Photon blockade; Photon bound state; Quantum response theory; Bose Einstein condensation; Non Hermitian quantum mechanics; Optomechanical system; Quantum dispersive readout theory; quantum device.

Biography:

Hong-Zhi Shen (H. Z. Shen) received a Bachelor degree from Bohai University in China in 2011. After he graduated from Dalian University of technology with a doctorate in 2016, he matured postdoctoral research experience in Northeast Normal University in China. After that he joined school of physics at NENU as an Associate Professor in 2018. Shen was a visit scholar at Basque University in Spain in March 2018. He was promoted to Ph.D. supervisor in 2019. Shen has been long engaged in quantum optics theory, with strong interests in open quantum systems, photon blockade, quantum response theory, BEC, non-Markovian effects, and bound states, etc.

Honors & Awards:

Excellent Postdoctoral Fellow at Northeast Normal University (2019, China)

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APS paper1:

https://journals.aps.org/search/results?clauses=%5B%7B%22field%22:%22author%22,%22value%22:%22h%20z%20shen%22,%22operator%22:%22AND%22%7D%5D&sort=recent&per_page=20

APS paper2:

https://journals.aps.org/search/results?clauses=%5B%7B%22field%22:%22author%22,%22value%22:%22hong%20zhi%20shen%22,%22operator%22:%22AND%22%7D%5D&sort=recent&per_page=20

Peer-Reviewed papers (*represents the corresponding author)

1. **H. Z. Shen***, Y. Chen, T. Z. Luan, and X. X. Yi, Multiple single-photon generations in three-level atoms coupled to cavity with non-Markovian effects, Phys. Rev. A 107, 053705 (2023).
2. J. Y. Sun and **H. Z. Shen***, Photon blockade in non-Hermitian optomechanical systems with nonreciprocal couplings, Phys. Rev. A 107, 043715 (2023).
3. T. Z. Luan, J. X. Yang, J. Wang, **H. Z. Shen***, Y. H. Zhou, and X. X. Yi, Nonreciprocal unconventional photon blockade with spinning two-mode cavity coupled via χ^2 nonlinearities, Int. J. Quantum Inf. 2023, 2350021 (2023).
4. **H. Z. Shen***, T. Z. Luan, Y. H. Zhou, Z. C. Shi, X. X. Yi, Nonreciprocal Unconventional Photon Blockade in Atom-Cavity with χ^2 Nonlinear Medium, Int. J. Quantum Inf. 21, 2350029 (2023) (2023).
5. T. Z. Luan, J. Y. Sun, and **H. Z. Shen***, Dynamical approach to shortcuts to adiabaticity for general two-level non-Hermitian systems, Europhysics letters, 142, 58001 (2023).
6. S. Xu, W. J. Gong, **H. Z. Shen**, X. X. Yi, Single-step order shift of Schmidt modes in a linear system, Physics Letters A 458, 128598 (2023).
7. L. Xin, S. Xu, X. X. Yi, and **H. Z. Shen***, Tunable non-Markovian dynamics with a three-level atom mediated by the classical laser in a semi-infinite photonic waveguide, Phys. Rev. A 105, 053706 (2022).
8. **H. Z. Shen***, Q. Wang, and X. X. Yi, Dispersive readout with non-Markovian environments, Phys. Rev. A 105, 023707 (2022).
9. T. Z. Luan, **H. Z. Shen***, and X. X. Yi, Shortcuts to adiabaticity with general two-level non-Hermitian systems, Phys. Rev. A **105**, 013714 (2022).
10. J. L. Li, **H. Z. Shen***, and X. X. Yi, Quantum battery in non-Markovian reservoirs, Opt. Lett. **47**, 5614 (2022).
11. Y. H. Zhou, X. Y. Zhang, T. Liu, Q. C. Wu, Z. C. Shi, **H. Z. Shen***, and C. P. Yang, Environmentally Induced Photon Blockade via Two-Photon Absorption Phys. Rev. Appl. 18, 064009 (2022).
12. S. Xu, W. J. Gong, **H. Z. Shen**, and X. X. Yi, Robust lattice manipulation beyond nearest-neighbor coupling by pulsed electric field, Phys. Rev. B 105, 014307

(2022).

13. H. T. Cui, M. Qin, L. Tang, **H. Z. Shen***, X. X. Yi, Open dynamics in the Aubry-André-Harper model coupled to a finite bath: The influence of localization in the system and dimensionality of bath, *Physics Letters A* 421, 127778 (2022).
14. H. T. Cui, M. Qin, L. Tang, **H. Z. Shen**, X. X. Yi, Localization-enhanced dissipation in a generalized Aubry-André-Harper model coupled with Ohmic baths, *Physics Letters A* 448, 128314 (2022).
15. Q. C. Wu, X. Y. Zhang, Y. M. Wang, T. Liu, Y. H. Zhou, **H. Z. Shen***, and C. P. Yang, Two-Photon Blockade with Second-Order Nonlinearity in Cavity Systems, *Int. J. Theor. Phys.* 61, 21 (2022).
16. J. Wang, Q. Wang, and **H. Z. Shen***, Nonreciprocal unconventional photon blockade with spinning atom-cavity, *Europhysics letters* 134, 64003 (2021) .
17. J. N. Li, **H. Z. Shen**, W. Wang, and X. X. Yi, Atom-modulated dynamic optical hysteresis in driven-dissipative systems, *Phys. Rev. A* 104, 013709 (2021).
18. S. Xu, W. J. Gong, **H. Z. Shen**, and X. X. Yi, Effective decoherence of realistic clocks: General theory and application to a topological insulator, *Phys. Rev. A* 103, 032207 (2021).
19. S. Xu, W. J. Gong, **H. Z. Shen**, and X. X. Yi, Linear multi-photon storage based on dark modes with frequency tuning, *New J. Phys.* 23 073027 (2021).
20. D. D. Zou, X. Y. Zhang, Q. C. Wu, B. L. Ye, J. H. Teng, D. W. Zhang, **H. Z. Shen***, and C. P. Yang, Quantum optical switching based on local single-excitation resonance, *Int. J. Theor. Phys.* 59, 2606 (2020).
21. **H. Z. Shen***, Q. Wang, J. Wang, and X. X. Yi, Nonreciprocal unconventional photon blockade in a driven dissipative cavity with parametric amplification, *Phys. Rev. A* 101, 013826 (2020).
22. W. S. Xue, **H. Z. Shen***, and X. X. Yi, Nonreciprocal conventional photon blockade in driven dissipative atom-cavity, *Opt. Lett.* 45, 4424 (2020).
23. Q. Wang, J. Wang, **H. Z. Shen***, S. C. Hou, and X. X. Yi, Exceptional points and dynamics of a non-Hermitian two-level system without PT symmetry, *Europhysics letters*, 131 34001 (2020).
24. Y. H. Zhou, X. Y. Zhang, Q. C. Wu, B. L. Ye, Z. Q. Zhang, D. D. Zou, **H. Z. Shen***, and C. P. Yang, Conventional photon blockade with a three-wave mixing, *Phys. Rev. A* 102, 033713 (2020).

25. H. T. Cui, **H. Z. Shen***, M. Qin, and X. X. Yi, Edge state, bound state, and anomalous dynamics in the Aubry-André-Harper system coupled to non-Markovian baths, *Phys. Rev. A* 102, 032209 (2020).
26. Y. H. Zhou, X. Y. Zhang, D. D. Zou, Q. C. Wu , B. L. Ye , Y. L. Fang, **H. Z. Shen***, and C. P. Yang, Controllable scattering of a single photon inside a one-dimensional coupled resonator waveguide with second-order nonlinearity, *Opt. Express* 28, 380250 (2020).
27. **H. Z. Shen***, S. Xu, H. T. Cui, and X. X. Yi, Non-Markovian dynamics of a system of two-level atoms coupled to a structured environment, *Phys. Rev. A* 99, 032101 (2019).
28. **H. Z. Shen***, S. Xu, Y. H. Zhou, and X. X. Yi, System susceptibility and bound-states in structured reservoirs, *Opt. Express* 27, 31504 (2019).
29. S. Xu, **H. Z. Shen**, X. X. Yi, and W. Wang, Readout of the spectral density of an environment from the dynamics of an open system, *Phys. Rev. A* 100, 032108 (2019).
30. S. Xu, **H. Z. Shen**, and X. X. Yi, Current in an open tight-binding system, *Phys. Rev. A* 99, 012102 (2019).
31. C. Shang, **H. Z. Shen**, X. X. Yi, Nonreciprocity in a strongly coupled three-mode optomechanical circulatory system, *Opt. Express* 27, 25882 (2019).
32. G. C. Wang, R. Q. Xiao, **H. Z. shen***, C. F. Sun, and K. Xue, Simulating Anisotropic quantum Rabi model via frequency modulation, *Sci. Rep.* 9, 4569 (2019).
33. X. X. Luo, Y. F. Peng, **H. Z. Shen** and X. X. Yi, Thermal transport of Josephson junction based on two-dimensional electron gas, *Sci. Rep.* 9, 2187 (2019).
34. **H. Z. Shen**, S. Xu, Su Yi, X. X. Yi, Controllable dissipation of a qubit coupled to an engineering reservoir, *Phys. Rev. A* 98, 062106 (2018).
35. **H. Z. Shen***, C. Shang, Y. H. Zhou, and X. X. Yi, Unconventional single-photon blockade in non-Markovian systems, *Phys. Rev. A* 98, 023856 (2018).
36. **H. Z. Shen**, S. L. Su, Y. H. Zhou, and X. X. Yi, Non-Markovian quantum Brownian motion in electric fields, *Phys. Rev. A* 97, 042121 (2018).
37. **H. Z. Shen**, S. Xu, Hong Li, S. L. Wu, and X. X. Yi, Linear response theory for

periodically driven systems with non-Markovian effects, *Opt. Lett.* 43, 2852 (2018).

38. **H. Z. Shen**, D. X. Li, S. L. Su, Y. H. Zhou, and X. X. Yi, Exact non-Markovian dynamics of qubits coupled to two interacting environments, *Phys. Rev. A* 96, 033805 (2017).
39. **H. Z. Shen**, Hong Li, Y. F. Peng, and X. X. Yi, Mechanism for Hall conductance of two-band systems against decoherence, *Phys. Rev. E* 95, 042129 (2017).
40. **H. Z. Shen**, D. X. Li, and X. X. Yi, Non-Markovian linear response theory for quantum open systems and its applications, *Phys. Rev. E* 95, 012156 (2017).
41. **H. Z. Shen**, S. Xu, Y. H. Zhou, G. C. Wang, and X. X. Yi, Unconventional photon blockade from bimodal driving and dissipations in coupled semiconductor microcavities, *J. Phys. B* 51, 035503 (2018).
42. **H. Z. Shen**, S. S. Zhang, C. M. Dai, and X. X. Yi, Master equation for open two-band systems and its applications to Hall conductance, *J. Phys. A* 51 065302 (2018).
43. S. L. Su, Y. Z. Tian, **H. Z. Shen***, H. P. Zang, E. j. Liang, and S. Zhang, Applications of the modified Rydberg antiblockade regime with simultaneous driving, *Phys. Rev. A* 96, 042335 (2017).
44. S. L. Su, **H. Z. Shen***, E. j. Liang, and S. Zhang, One-step construction of the multiple-qubit Rydberg controlled-PHASE gate, *Phys. Rev. A* 98, 032306 (2018).
45. **H. Z. Shen**, X. Q. Shao, G. C. Wang, X. L. Zhao, and X. X. Yi, Quantum phase transition in a coupled two-level system embedded in anisotropic three dimensional photonic crystals, *Phys. Rev. E* 93, 012107 (2016).
46. **H. Z. Shen**, Y. H. Zhou, and X. X. Yi, Tunable photon blockade in coupled semiconductor cavities, *Phys. Rev. A* 91, 063808 (2015).
47. **H. Z. Shen**, M. Qin, X. Q. Shao, and X. X. Yi, General response formula and application to topological insulator in quantum open system, *Phys. Rev. E* 92, 052122 (2015).
48. **H. Z. Shen**, Y. H. Zhou, H. D. Liu, G. C. Wang, and X. X. Yi, Exact optimal control of photon blockade with weakly nonlinear coupled cavities, *Opt. Express* 23, 32835

(2015).

49. **H. Z. Shen**, W. Wang, and X. X. Yi, Hall conductance and topological invariant for open systems, *Sci. Rep.* 4, 6455 (2014).
50. **H. Z. Shen**, Y. H. Zhou, and X. X. Yi, Quantum optical diode with semiconductor microcavities, *Phys. Rev. A* 90, 023849 (2014).
51. **H. Z. Shen**, M. Qin, X. M. Xiu, and X. X. Yi, Exact non-Markovian master equation for a driven damped two-level system, *Phys. Rev. A* 89, 062113 (2014).
52. **H. Z. Shen**, M. Qin, and X. X. Yi, Single-photon storing in coupled non-Markovian atom-cavity system, *Phys. Rev. A* 88, 033835 (2013).
53. **H. Z. Shen**, X. M. Xiu, and X. X. Yi, Atom-molecule-conversion system subject to phase noises, *Phys. Rev. A* 87, 063613 (2013).
54. **H. Z. Shen**, X. X. Yi, and C. H. Oh, Dynamical signature of the edge state in the 1D Aubry-Andre model, *J. Phys. B* 47, 085501 (2014).
55. Z. C. Shi, **H. Z. Shen**, Wei Wang, and X. X. Yi, Response of two-band systems to a single-mode quantized field, *Phys. Rev. E* 93, 032120 (2016).
56. M. Qin, **H. Z. Shen**, and X. X. Yi, A multi-pathway model for photosynthetic reaction center, *J. Chem. Phys.* 144, 125103 (2016).
57. Y. H. Zhou, **H. Z. Shen**, X. Q. Shao, and X. X. Yi, Strong photon antibunching with weak second-order nonlinearity under dissipation and coherent driving, *Opt. Express* 24, 17332 (2016).
58. Y. H. Zhou, **H. Z. Shen**, and X. X. Yi, Unconventional photon blockade with second-order nonlinearity, *Phys. Rev. A* 92, 023838 (2015).
59. M. Qin, **H. Z. Shen**, X. L. Zhao, and X. X. Yi, Dynamics and quantumness of excitation energy transfer through a complex quantum network, *Phys. Rev. E* 90, 042140 (2014).
60. Y. H. Zhou, **H. Z. Shen**, X. Y. Zhang, and X. X. Yi, Zero eigenvalues of a photon blockade induced by a non-Hermitian Hamiltonian with a gain cavity, *Phys. Rev. A* 97, 043819 (2018).
61. H. T. Cui, **H. Z. Shen**, S. C. Hou, and X. X. Yi, Bound state and localization of

excitation in many-body open systems, Phys. Rev. A 97, 042129 (2018).

62. S. Xu, **H. Z. Shen**, and X. X. Yi, Demultiplexing of photonic temporal modes by a linear system, Phys. Rev. A 97, 033841 (2018).
63. M. Qin, **H. Z. Shen**, X. L. Zhao, and X. X. Yi, Effects of system-bath coupling on a photosynthetic heat engine: A polaron master-equation approach, Phys. Rev. A 96, 012125 (2017).
64. Y. H. Zhou, **H. Z. Shen**, X. Y. Luo, Y. Wang, F. Gao, and C. Y. Xin, Tunable three-wave- mixing-induced transparency, Phys. Rev. A 96, 063815 (2017).
65. Y. H. Zhou, S. S. Zhang, **H. Z. Shen**, and X. X. Yi, Second-order nonlinearity induced transparency, Opt. Lett. 42, 1289 (2017).
66. H. Li, **H. Z. Shen**, S. L. Wu, and X. X. Yi, Shortcuts to adiabaticity in non-Hermitian quantum systems without rotating-wave approximation, Opt. Express 25, 030135 (2017).
67. Y. F. Peng, C. M. Dai, **H. Z. Shen**, and X. X. Yi, Optically tunable spin texture of the surface state for Bi₂Se₃ and SmB₆ topological insulators, Opt. Express 26, 18906 (2018).
68. D. X. Li, **H. Z. Shen**, H. D. Liu, and X. X. Yi, Effect of spin relaxations on the spin mixing conductances for a bilayer structure, Sci. Rep. 8, 1475 (2018).
69. W. Q. Zhang, **H. Z. Shen**, and X. X. Yi, Hall conductance for open two-band system beyond rotating-wave approximation, Sci. Rep. 6, 16243 (2017).
70. H. J. Shan, C. M. Dai, **H. Z. Shen**, and X. X. Yi, Control state transfer in a Heisenberg spin chain by periodic drives, Sci. Rep. 8, 13565 (2018).
71. H. Y. Sun, C. Shang, X. X. Luo, Y. H. Zhou, and **H. Z. Shen**, Optical-assisted Photon Blockade in a Cavity System via Parametric Interactions, Int. J. Theor. Phys. 58, 3640(2019).
72. Y. H. Zhou, Q. C. Wu, B. L. Ye, L. Y. Xue, **H. Z. Shen***, Second-order Nonlinearity Induced Unconventional Photon Blockade, Int. J. Theor. Phys. 58, 472(2019).
73. G. C. Wang, **H. Z. Shen**, C. F. Sun, C. F. Wu, J. L. Chen, and K. Xue, Unconventional photon blockade in weakly nonlinear photonic molecules with bilateral drive, J Mod Opt 64, 583 (2017).

74. Y. H. Zhou and **H. Z. Shen**, Unconventional photon blockade based on two-photon tunneling, *Int. J. Theor. Phys.* 56, 2935 (2017).
75. D. X. Li, S. Wu, **H. Z. Shen**, and X. X. Yi, Adiabatic Evolution of an Open Quantum System in its Instantaneous Steady State, *Int. J. Theor. Phys.* 56, 3562 (2017).
76. S. Xu, **H. Z. Shen**, and X. X. Yi, Single photon transistor based on tunable coupling in cavity QED system, *J Opt Soc Am B* 33, 1600 (2016).
77. L. Dong, J. X. Wang, Q. Y. Li, **H. Z. Shen**, H. K. Dong, X. M. Xiu, Y. J. Gao, and C. H. Oh, Nearly deterministic preparation of the perfect W state with weak cross-Kerr nonlinearities, *Phys. Rev. A* 93, 012308 (2016).
78. L. Dong, J. X. Wang, Q. Y. Li, **H. Z. Shen**, H. K. Dong, X. M. Xiu, and Y. J. Gao, Single logical qubit information encoding scheme with the minimal optical decoherence-free subsystem, *Opt. Lett.* 41, 1030 (2016).
79. L. Dong, J. X. Wang, Q. Y. Li, **H. Z. Shen**, H. K. Dong, X. M. Xiu, Y. P. Ren, and Y. J. Gao, Quantum secure direct communication against the collective noise with polarization-entangled Bell states, *Prog. Theor. Exp. Phys.* 12, 123A02 (2015).
80. L. Dong, J. X. Wang, **H. Z. Shen**, Dan Li, X. M. Xiu, Y. J. Gao, X. X. Yi, Deterministic transmission of an arbitrary single-photon polarization state through bit-flip error channel, *Quantum Inf Process* 13, 1413 (2014).
81. X. M. Xiu, L. Dong, **H. Z. Shen**, Y. J. Gao, and X. X. Yi, Two-party quantum privacy comparison with polarization-entangled bell states and the coherent states, *Quantum Inf Comput* 14, 236 (2014).
82. X. M. Xiu, L. Dong, **H. Z. Shen**, Y. J. Gao, and X. X. Yi, Construction scheme of a two-photon polarization controlled arbitrary phase gate mediated by weak crossphase modulation, *J Opt Soc Am B* 30, 589 (2013).
83. L. Dong, Y. F. Lin, J. X. Wang, Q. Y. Li, **H. Z. Shen**, H. K. Dong, Y. P. Ren, X. M. Xiu, Y. J. Gao, and C. H. Oh. Nearly deterministic Fredkin gate based on weak cross-Kerr nonlinearities, *J Opt Soc Am B* 33, 253 (2016).
84. X. M. Xiu, Q. Y. Li, L. Dong, **H. Z. Shen**, Dan Li, Y. J. Gao, X. X. Yi, Distributing a multi-photon polarization-entangled state with unitary fidelity via arbitrary

collective noise channels, Quantum Inf Process 14, 361 (2015).

85. L. Dong, X. M. Xiu, **H. Z. Shen**, Y. J. Gao, and X. X. Yi, Quantum Fourier transform of polarization photons mediated by weak cross-Kerr nonlinearity, J Opt Soc Am B 30, 2765 (2013).
86. L. Dong, X. M. Xiu, **H. Z. Shen**, Y. J. Gao, and X. X. Yi, Perfect distribution of four-photon \times -type entangled states over an arbitrary collective noise channel by spatial degree of freedom, Opt. Commun. 308, 304 (2013).
87. X. M. Xiu, L. Dong, **H. Z. Shen**, Y. J. Gao, and X. X. Yi. Preparing, linking, and unlinking cluster-type polarization-entangled states by integrating modules, Prog. Theor. Exp. Phys. 9, 093A01 (2013).

Journal Referee

Photonics Research, Physical Review A, New Journal of Physics, Optics Express, Journal of Physics A, Journal of Physics B, Journal of Physics : Condensed Matter, Journal of Physics D, Journal of Optics, Nanotechnology.