Wenlong Gao

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Educations

2007-2011 **Bachelor**, Measurement and Control Technology and Instruments, Tianjin University

2011-2016: **PhD**, Instrument Science and Technology, Tianjin University

2013-2015: **Visiting PhD**, School of Physics and Astronomy, University of Birmingham

Working Experiences

2017-2019: **Research Fellow (Postdoc)**, School of Physics and Astronomy, University of Birmingham.

Supervisor: Prof. Shuang Zhang

2019-now: **Research Fellow (Postdoc)**, Ultrafast Nanophotonics Group, Department of Physics, Paderborn University. **Supervisor: Prof. Thomas Zentgraf**

Research Statement

My research is mostly focused on topological electromagnetic systems, particularly photonic metamaterials, silicon nano-photonics and electrical circuits. It has already been clear that the mathematical theory on topological phases of matter is universally valid for both quantum and coherent classical wave systems, among which topological electromagnetic systems being one of the most vibrant research fields in the recent decade owning to the promised robust protection against fabrication imperfections, that can be utilized directly into optical communication, wireless power transfer, light emission devices, quantum information, optical neural network, and etc. The concept of topology has also led to the rethinking in various aspects in electromagnetism and is begging for both deepened understandings of the fundamental physics and emerging novel applications.

My prior and ongoing research include: **(1)** *Topological photonic phases in metamaterials and homogeneous mediums*, including **(a)** Topological photonic phases in chiral hyperbolic metamaterials [***Physical review letters, 114(3), 037402***], **(b)** Weyl nodes in magnetized plasma [***Nature communications, 7(1), 1-8***], **(c)** Photonic topological line nodes [***Nature communications, 9(1), 1-7***]. **(2)** *Vortical Reflections of topological Weyl metamaterials*, in which a new vortex beam generation scheme was proposed using the topological Weyl metamaterial [***Physical Review Letters (Editors' Suggestion), 125(9), 093904***]. **(3)** *Moiré fringe induced gauge field in photonics,* in which giant effective gauge field is introduced for photons in a bilayer Moiré fringe metacrystal [***Physical Review Letters (Editors' Suggestion), 125, 203901*. (2020)**]. **(4)** *Topological photonic devices for nano photonics and integrated quantum optics* [Science Advance 7, eabl3903 (2021)). In which new ways of manipulating photonic polarization states, lifetimes as well as quantum corelations are proposed with topological photonic devices.

Journal Publications

1. Wang, W., **Gao, W**. et al. Moiré fringe induced gauge field in photonics. *Physical Review Letters (**Editors' Suggestion**), 125, 203901*. (2020) (**Corresponding author**)
2. Cheng, H., **Gao, W**. et al. Vortical Reflection and Spiralling Fermi Arcs with Weyl Metamaterials. *Physical Review Letters (**Editors' Suggestion**)*, 125(9), 093904. (2020). (**Corresponding author**)
3. **Gao, W.**, Yang, B. et al Experimental observation of photonic nodal line degeneracies in metacrystals. *Nature communications*, 9(1), 1-7. (2018).
4. **Gao, W.**, Yang, B. et al. Photonic Weyl degeneracies in magnetized plasma. *Nature communications*, 7(1), 1-8. (2016)

5. **Gao, W.**, Fang, F. Z. et al. Chiral surface waves supported by biaxial hyperbolic metamaterials. *Light: Science & Applications*, *4*(9), e328. (2015)
6. **Gao, W.**, Lawrence, M. et al. Topological photonic phase in chiral hyperbolic metamaterials. *Physical review letters*, *114*(3), 037402. (2015)
7. **Gao, W.**, & Wang, Y. T. Ideal Photonic Weyl Nodes Stabilized by Screw Rotation Symmetry in Space Group 19. *Crystals*, *10*(7), 605. (2020) (**Corresponding author**)
8. Lu, J., Wirth., K, **Gao, W**. et al. Observing 0D subwavelength-localized modes at ~100 THz protected by weak topology. Sci. Adv. 7, eabl3903 (2021) (**Equal contribution**)
9. Yang, Y., **Gao, W.** et al. Spontaneous emission and resonant scattering in transition from type I to type II photonic Weyl systems. *Physical review letters*, 123(3), 033901. (2019) (**Equal contribution**)
10. Wang, W., **Gao, W.** et al. Photonic topological fermi nodal disk in non-Hermitian magnetic plasma. *Light: Science & Applications*, *9*(1), 1-8. (2020) (**Equal contribution**)
11. Xia, L., **Gao, W**. et al. Stretchable photonic 'Fermi Arcs' in twisted magnetized plasma. Laser & Photonics Reviews, 12(1), 1700226. (2018). (**Equal contribution**)
12. Kim, M., **Gao, W.** et al Extremely broadband topological surface states in a photonic topological metamaterial. Advanced Optical Materials, 7(20), 1900900. (2019) (**Equal contribution**)
13. Jia, H., Zhang, R., **Gao, W.** et al. Observation of chiral zero mode in inhomogeneous three-dimensional Weyl metamaterials. *Science*, 363(6423), 148-151. (2019)
14. Liu, S., Ma, S., Yang, C., Zhang, L., **Gao, W.**, Xiang, Y. J., ... & Zhang, S. Gain-and Loss-Induced Topological Insulating Phase in a Non-Hermitian Electrical Circuit. Physical Review Applied, 13(1), 014047. (2020)
15. Wang, D., Yang, B., **Gao, W**., Jia, H., Yang, Q., Chen, X., ... & Zhang, W. Photonic Weyl points due to broken time-reversal symmetry in magnetized semiconductor. Nature Physics, 15(11), 1150-1155. (2019)
16. Yang, B., Guo, Q., Tremain, B., Liu, R., Barr, L. E., Yan, Q., & Fang, C. Ideal Weyl points and helicoid surface states in artificial photonic crystal structures. Science, 359(6379), 1013-1016. (2018)
17. Guo, Q., Yang, B., Xia, L., **Gao, W**., Liu, H., Chen, J., & Zhang, S. Three dimensional photonic Dirac points in metamaterials. Physical Review Letters, 119(21), 213901. (2017)
18. Liu, C., **Gao, W**., Yang, B., & Zhang, S. Disorder-induced topological state transition in photonic metamaterials. Physical review letters, 119(18), 183901. (2017)
19. Yang, B., Guo, Q., Tremain, B., Barr, L. E., **Gao, W**., Liu, H., & Zhang, S. Direct observation of topological surface-state arcs in photonic metamaterials. Nature communications, 8(1), 1-7. (2017)
20. Guo, Q., **Gao, W**., Chen, J., Liu, Y., & Zhang, S. Line degeneracy and strong spin-orbit coupling of light with bulk bianisotropic metamaterials. Physical review letters, 115(6), 067402. (2015)

Projects

1. Project A09," Three-photon state generation with on-chip pump suppression in topological waveguides" within Sonderforschungsbereich/Transregio (Collaborative Research Center) TRR 142 in Paderborn University.
2. European Research Counsil (ERC) Consolidator Grant "Topological Light at Structured Surfaces". (Postdoc Researcher)
3. European Research Counsil (ERC) Consolidator Grant "Functional extreme nonlinear nanomaterials". (Postdoc Researcher)

Conference talks

1. "Topological Photonic Phase in Chiral Hyperbolic Metamaterials" European Quantum Electronics Conference 2015 Munich Germany. Oral presentation.

2. “Topological Photonics in metamaterials and magnetized plasma” METANANO-2017, Vladivostok, Russia. Oral presentation (Invited talk).
3. “Vortical Reflection and Alignment-free Vortex Beam Mirror with Weyl Metamaterials” META 2021, Warsaw, Poland. Oral presentation.