

*Curriculum vitae*

Thomas M. Schäfer

*Department of Physics*

*North Carolina State University*

*Raleigh, NC 27695*

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**Professional Experience**

*Wesley O. Doggett Distinguished Professor*

Department of Physics, North Carolina State University, 2018-present.

*Distinguished Professor*

Department of Physics, North Carolina State University, 2012-present.

*Professor of Physics*

Department of Physics, North Carolina State University, 2006-present.

*Associate Professor*

Department of Physics, North Carolina State University, 2003-2005.

*Associate Professor*

Department of Physics, SUNY Stony Brook, 2003-2004.

*Assistant Professor*

Department of Physics, SUNY Stony Brook, 2000-2002.

*Fellow*

Riken-BNL Research Center, Brookhaven National Laboratory, 2000-2004.

*Member*

Institute for Advanced Study, Princeton, New Jersey, 1998-1999.

*Research Associate*

Institute for Nuclear Theory, University of Washington, Seattle, 1995-1998.

*Research Associate*

State University of New York at Stony Brook, 1992-1995.

## **Visiting Appointments**

### *Visiting Assistant Professor*

Department of Physics, Duke University, 2002.

### *Visiting Scientist*

TRIUMF, Vancouver, Canada, 1999-2000.

## **Higher Education**

### *University of Giessen*

1984-1986, Vordiplom (1986).

1987-1989, Diplom, with distinction, 1989.

Adviser, Prof. Dr. U. Mosel

### *University of Washington*

1986-1987

### *University of Regensburg*

1989-1992, Ph.D., summa cum laude, 1992.

adviser: Prof. Dr. W. Weise

## **Awards and Honors**

### *Member*

Studienstiftung des deutschen Volkes, 1984-89.

### *Fellowship*

German Academic Exchange Service (DAAD), 1986-87.

### *Feodor Lynen Fellowship*

Alexander v. Humboldt Foundation, 1992-94.

### *Outstanding Junior Investigator*

Department of Energy, Division of Nuclear Physics, 2002.

### *Fellow*

American Physical Society, 2006.

## Advising

### *Ph.D. students advised*

Valeriu Zetocha (2003, Bear Stearns), Jingyi Chao (2011, Lanzhou),  
Clifford Chafin (2013, Consulting), Alireza Behtash (2018, Consulting),  
Jiaxun Hou (2021, NC State), Haosheng Shi (2022, NC State).

### *Postdocs supervised*

Kai Schwenzer (2004-2006, Istanbul U), Andreas Gerhold (2006-2007, Banking),  
Gautam Rupak (2007-2009, Mississippi State), Matt Braby (2008-2011, Hutchison School),  
Kevin Dusling (2011-2014, PRL), Markus Bluhm (2014-2017, Nantes),  
Mauricio Martinez (2016-2021, Duke), Syo Kamata (2018-2020, Wroclaw),  
Chandroday Chattopadhyay (2021).

## Service (selected)

### *Workshops organized*

Institute for Nuclear Theory (INT): “The First Three Years of Heavy-Ion Physics at  
RHIC” (2003); “Dense Matter: From Lattices to Stars” (2004); “The Phases of dense  
Matter” (2016); “Multi-Scale Problems Using Effective Field Theories” (2018)  
European Center for Nuclear Physics and related areas (ECT\*): “Hydrodynamics  
for strongly coupled fluids” (2014)  
Simons Center for Geometry and Physics: “Gauge Field Topology” (2015)  
Aspen Center for Physics: “Exploring Extreme Matter in the Era of Multimessenger  
Astronomy: From the Cosmos to Quarks” (2021)

### *Lecturer*

National Nuclear Physics Summer School (1998, 2001, 2002, 2008);  
ECT\* Doctoral Program (2006, 2015);  
Other schools: RHIC-BNL (1998); Wissenschaftskolleg Heidelberg (1999);  
Bohr Institute, Copenhagen (2001); APCTP, Korea (2001);  
Jinan, China (2002); Bhabha Institute, Mumbai (2003); Jorge Swieca School, Brazil (2003);  
Hampton University Graduate Program (2005); LBNL Summer School (2010);  
Schleching, Germany (2010).

### *Physical Review Letters*

Divisional Associate Editor, Member of Editorial Board (2005-2010)

*APS Division of Nuclear Physics*

Program Committee (2005-2008)

*Institute for Nuclear Theory*

National Advisory Committee (2008-2010)

*National Academy of Sciences*

Study on Electron-Ion Collider Science (2017-2018)

*Department of Energy, Office of Nuclear Physics*

Committee of Visitors (2019)

*National Science Foundation, Department of Energy*

Nuclear Science Advisory Committee (2019-2022)

*Reviews of Modern Physics*

Associate Editor, Nuclear Physics (2021-2024)

### **Research interests**

*Topological effects in gauge theories*

*Dense QCD matter, color superconductivity*

*Fluctuations and non-equilibrium dynamics in hot QCD and heavy ion collisions*

*Nuclear many-body physics, neutron star matter, and lattice EFT*

*Equilibrium and non-equilibrium many body physics in ultra-cold atomic gases*

### **Publication Information**

*HEP-Spires*

Author Identifier: T.Schafer.1

*Google Scholar*

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### **Publications in Refereed Journals:**

1. U. Kalmbach, T. Schäfer, T. S. Biro, U. Mosel, Dirac Sea Effects in the Chiral Quark Soliton Model, Nucl. Phys. A **513** (1990) 621.
2. A. Hosaka, T. Schäfer, U. Kalmbach, Spin Structure of the Nucleon in a Non-topological Chiral Soliton Model, Z. Phys. A **337** (1990) 447.
3. T. Schäfer, W. Weise, Neutral Pion Photoproduction at Threshold and Explicit Chiral Symmetry Breaking, Phys. Lett. B **250** (1990) 6.
4. T. Schäfer, W. Weise, Threshold Pion Photoproduction and chiral Models of the Nucleon, Nucl. Phys. A **531** (1991) 520.
5. T. Schäfer, V. Koch, G. E. Brown, Charge Symmetry Breaking and the Neutron Proton Mass Difference, Nucl. Phys. A **562** (1993) 644.
6. T. Schäfer, E. V. Shuryak, J. J. M. Verbaarschot, Baryonic Correlators in the Random Instanton Vacuum, Nucl. Phys. B **412** (1994) 143.
7. T. Schäfer, E. V. Shuryak, Hadronic Wave Functions in the Instanton Model, Phys. Rev. D **50** (1994) 478.
8. T. Schäfer, E. V. Shuryak, J. J. M. Verbaarschot, The Chiral Phase Transition and Instanton-Antinstanton Molecules, Phys. Rev. D **51** (1995) 1267.
9. T. Schäfer, E. V. Shuryak, Instantons and Glueballs, Phys. Rev. Lett. **75** (1995) 1707.
10. T. Schäfer, E. V. Shuryak, Can Hadrons Survive the Chiral Phase Transition ?, Phys. Lett. B **356** (1995) 147.
11. T. Schäfer, E. V. Shuryak, The Interacting Instanton Liquid in QCD at Zero and Finite Temperature, Phys. Rev. D **53** (1996) 6522.
12. T. Schäfer, E. V. Shuryak, Hadronic Correlators in the Interacting Instanton Liquid, Phys. Rev. D **54** (1996) 1099.

13. T. Schäfer, The  $U(1)_A$  Anomaly at Finite Temperature, Phys. Lett. B **389** (1996) 445.
14. E. V. Shuryak, T. Schäfer, The QCD Vacuum as an Instanton Liquid, Ann. Rev. Nucl. Part. Sci. **47** (1997) 359-394.
15. T. Schäfer, E. V. Shuryak, Instantons in QCD, Rev. Mod. Phys. **70** (1998) 323-426.
16. T. Schäfer, Instantons and the Chiral Phase Transition at non-zero Baryon Density, Phys. Rev. D **57** (1998) 3950.
17. R. Rapp, T. Schäfer, E. V. Shuryak, and M. Velkovsky, Diquark Bose Condensates in High Density Matter and Instantons, Phys. Rev. Lett. **81** (1998) 53.
18. T. Schäfer and F. Wilczek, High Density Quark Matter and the Renormalization Group in QCD with Two and Three Flavors, Phys. Lett. B **450** (1999) 325.
19. T. Schäfer and F. Wilczek, Continuity of Quark and Hadron Matter, Phys. Rev. Lett. **82** (1999) 3956.
20. T. Schäfer and F. Wilczek, Quark Description of Hadronic Phases, Phys. Rev. D **60** (1999) 074014.
21. R. Rapp, T. Schäfer, E. V. Shuryak, and M. Velkovsky, High Density QCD and Instantons, Ann. Phys. **280** (2000) 35.
22. T. Schäfer and F. Wilczek, Superconductivity from Perturbative Gluon Exchange in High Density Quark Matter, Phys. Rev. D **60** (1999) 114033.
23. T. Schäfer, Patterns of Symmetry Breaking in QCD at High Density, Nucl. Phys. B **575** (2000) 269.
24. T. Schäfer, Gluino Condensation in an Interacting Instanton Ensemble, Phys. Rev. D **62** (2000) 035013.

25. T. Schäfer, Quark Hadron Continuity in QCD with one Flavor, Phys. Rev. D **62** (2000) 094007.
26. T. Schäfer, Kaon Condensation in High Density Quark Matter, Phys. Rev. Lett. **85** (2000) 5531.
27. T. Schäfer and E. Shuryak, Implications of the Aleph Tau-Lepton Decay Data for Perturbative and Non-Perturbative QCD, Phys. Rev. Lett. **86** (2001) 3973.
28. T. Schäfer, Possible Color Octet Quark Anti-quark Condensate in the Instanton Model, Phys. Rev. D **64** (2001) 037501.
29. P. F. Bedaque and T. Schäfer, High Density Quark Matter under Stress, Nucl. Phys. A **697** (2002) 802.
30. T. Schäfer, D. T. Son, M. A. Stephanov, D. Toublan and J. J. Verbaarschot, Kaon Condensation and Goldstone's Theorem, Phys. Lett. B **522** (2001) 67.
31. T. Schäfer, Mass Terms in Effective Theories of High Density Quark Matter, Phys. Rev. D **65** (2002) 074006.
32. T. Schäfer, Instanton Effects in QCD at High Baryon Density, Phys. Rev. D **65**, (2002) 094033.
33. P. Jaikumar, M. Prakash and T. Schäfer, Neutrino Emission from Goldstone Modes in Dense Quark Matter, Phys. Rev. D **66**, 063003 (2002).
34. T. Schäfer, Instantons in QCD with Many Colors, Phys. Rev. D **66**, 076009 (2002).
35. T. Schäfer, QCD and the Eta Prime Mass: Instantons or Confinement?, Phys. Rev. D **67**, 074502 (2003).
36. V. Zetocha and T. Schäfer, Instanton Contribution to Scalar Charmonium and Glueball Decays, Phys. Rev. D **67**, 114003 (2003).

37. T. Schäfer, Hard Loops, Soft Loops, and High Density Effective Field Theory, Nucl. Phys. A **728**, 251 (2003).
38. T. Schäfer, Instantons and scalar multiquark states: From small to large  $N_c$ , Phys. Rev. D **68**, 114017 (2003).
39. T. Schäfer and V. Zetocha, Instantons and the spin of the nucleon, Phys. Rev. D **69**, 094028 (2004).
40. D. Lee, B. Borasoy and T. Schäfer, Nuclear lattice simulations with chiral effective field theory, Phys. Rev. C **70**, 014007 (2004).
41. T. Schäfer and K. Schwenzer, Non-Fermi Liquid Effects in QCD at high Density, Phys. Rev. D **70**, 054007 (2004).
42. J. W. Chen, D. Lee and T. Schäfer, Inequalities for Light Nuclei in the Wigner Symmetry Limit, Phys. Rev. Lett. **93**, 242302 (2004).
43. T. Schäfer and K. Schwenzer, Neutrino emission from ungapped quark matter, Phys. Rev. D **70**, 114037 (2004).
44. A. Kryjevski and T. Schäfer, An effective theory for baryons in the CFL phase, Phys. Lett. **606**, 52 (2005).
45. A. Kryjevski, D. B. Kaplan and T. Schäfer, New phases in CFL quark matter, Phys. Rev. D **71**, 034004 (2005).
46. D. Lee and T. Schäfer, Neutron matter on the lattice with pionless effective field theory, Phys. Rev. C **72**, 024006 (2005).
47. T. Schäfer, C. W. Kao and S. R. Cotanch, Many Body Methods and Effective Field Theory, Nucl. Phys. A **762**, 82 (2005).
48. T. Schäfer, Meson supercurrent state in high density QCD, Phys. Rev. Lett. **96**, 012305 (2006).



49. D. Lee and T. Schäfer, Cold dilute neutron matter on the lattice I: Lattice virial coefficients and large scattering lengths, *Phys. Rev. C* **73**, 015201 (2006).
50. D. Lee and T. Schäfer, Cold dilute neutron matter on the lattice II: Results in the unitary limit, *Phys. Rev. C* **73**, 015202 (2006).
51. T. Schäfer and K. Schwenzer, Low energy dynamics in ultradegenerate QCD matter, *Phys. Rev. Lett.* **97**, 092301 (2006).
52. A. Gerhold and T. Schäfer, Meson current in the CFL phase, *Phys. Rev. D* **73**, 125022 (2006).
53. T. Schäfer, The Kohn-Luttinger effect in gauge theories, *Phys. Rev. D* **74**, 054009 (2006).
54. G. Rupak, T. Schäfer and A. Kryjevski, Polarized fermions in the unitarity limit, *Phys. Rev. A*, **75**, 023606 (2007).
55. A. Gerhold, T. Schäfer and A. Kryjevski, Goldstone boson currents in a kaon condensed CFL phase, *Phys. Rev. D* **75**, 054012 (2007).
56. M. G. Alford, M. Braby, S. Reddy and T. Schäfer, Bulk viscosity due to kaons in color-flavor-locked quark matter, *Phys. Rev. C* **75**, 055209 (2007).
57. G. Rupak and T. Schäfer, Shear viscosity of a superfluid Fermi gas in the unitarity limit, *Phys. Rev. A* **76**, 053607 (2007).
58. T. Schäfer, The Shear Viscosity to Entropy Density Ratio of Trapped Fermions in the Unitarity Limit, *Phys. Rev. A* **76**, 063618 (2007).
59. M. G. Alford, K. Rajagopal, T. Schäfer and A. Schmitt, Color superconductivity in dense quark matter, *Rev. Mod. Phys.* **80**, 1455 (2008).
60. R. J. Furnstahl, G. Rupak, and T. Schäfer, Effective Field Theory and Finite Density Systems, *Ann. Rev. Nucl. Part. Sci.* **58**, 1 (2008).

61. T. Schäfer, Euclidean correlation functions in a holographic model of QCD, Phys. Rev. D **77**, 126010 (2008).
62. G. Rupak and T. Schäfer, Density Functional Theory for non-relativistic Fermions in the Unitarity Limit, Nucl. Phys. A **816**, 52 (2009).
63. T. Schäfer and D. Teaney, Nearly Perfect Fluidity: From Cold Atomic Gases to Hot Quark Gluon Plasmas, Rept. Prog. Phys. **72**, 126001 (2009).
64. M. Braby, J. Chao and T. Schäfer, Thermal conductivity of color-flavor locked quark matter, Phys. Rev. C **81**, 045205 (2010).
65. M. Braby, J. Chao and T. Schäfer, Thermal Conductivity and Sound Attenuation in Dilute Atomic Fermi Gases, Phys. Rev. A **82**, 033619 (2010).
66. C. Cao, E. Elliott, J. Joseph, H. Wu, J. Petricka, T. Schäfer and J. E. Thomas, Universal Quantum Viscosity in a Unitary Fermi Gas, Science **331**, 58 (2011).
67. T. Schäfer, Dissipative fluid dynamics for the dilute Fermi gas at unitarity: Free expansion and rotation, Phys. Rev. A **82**, 063629 (2010).
68. J. Chao, M. Braby, T. Schäfer, Viscosity spectral functions of the dilute Fermi gas in kinetic theory, New J. Phys. **13**, 035014 (2011).
69. K. Dusling, T. Schäfer, Elliptic flow of the dilute Fermi gas: From kinetics to hydrodynamics, Phys. Rev. A **84**, 013622 (2011).
70. J. Chao, T. Schäfer, Conformal symmetry and non-relativistic second order fluid dynamics, Annals Phys. **327**, 1852 (2012).
71. K. Dusling, T. Schäfer, Bulk viscosity, particle spectra and flow in heavy-ion collisions, Phys. Rev. C **85**, 044909 (2012).
72. T. Schäfer, Shear viscosity and damping of collective modes in a two-dimensional Fermi gas, Phys. Rev. A **85**, 033623 (2012).

73. E. Poppitz, T. Schäfer and M. Unsal, Continuity, Deconfinement, and (Super) Yang-Mills Theory, JHEP **1210**, 115 (2012).
74. A. Adams, L. D. Carr, T. Schäfer, P. Steinberg and J. E. Thomas, Strongly Correlated Quantum Fluids: Ultracold Quantum Gases, Quantum Chromodynamic Plasmas, and Holographic Duality, New J. Phys. **14**, 115009 (2012).
75. K. Dusling and T. Schäfer, Quasiclassical molecular dynamics for the dilute Fermi gas at unitarity, Phys. Rev. A **86**, 063634 (2012).
76. C. Chafin and T. Schäfer, Hydrodynamic fluctuations and the minimum shear viscosity of the dilute Fermi gas at unitarity, Phys. Rev. A **87**, 023629 (2013).
77. E. Poppitz, T. Schäfer and M. Unsal, Universal mechanism of (semi-classical) deconfinement and theta-dependence for all simple groups, JHEP **1303**, 087 (2013).
78. T. Schäfer and K. Dusling, Bulk viscosity and conformal symmetry breaking in the dilute Fermi gas near unitarity, Phys. Rev. Lett. **111**, 120603 (2013).
79. C. Chafin and T. Schäfer, Scale breaking and fluid dynamics in a dilute two-dimensional Fermi gas, Phys. Rev. A **88**, 043636 (2013).
80. T. Schäfer, Fluid dynamics and viscosity in strongly coupled fluids, Ann. Rev. Nucl. Part. Sci. **64**, 125 (2014)
81. T. Schäfer, Second order fluid dynamics for the unitary Fermi gas from kinetic theory, Phys. Rev. A **90**, 043633 (2014).
82. T. Schäfer, Viscosity spectral function of a scale invariant non-relativistic fluid from holography, Phys. Rev. D **90**, 106008 (2014).
83. M. Bluhm and T. Schäfer, “Medium effects and the shear viscosity of the dilute Fermi gas away from the conformal limit,” Phys. Rev. A **90** 063615 (2014).
84. A. Behtash, T. Sulejmanpasic, T. Schäfer, M. Unsal, “Hidden topological angles and Lefschetz thimbles,” Phys. Rev. Lett. **115**, 041601 (2015).

85. M. Bluhm and T. Schäfer, “Dissipative fluid dynamics for the dilute Fermi gas at unitarity: Anisotropic fluid dynamics,” *Phys. Rev. A* **92** 043602 (2015).
86. P. Braun-Munzinger, V. Koch, T. Schäfer, J. Stachel, “Properties of hot and dense matter from relativistic heavy ion collisions”, *Phys. Rept.* **621** 76 (2016).
87. A. Behtash, G. V. Dunne, T. Schäfer, T. Sulejmanpasic, M. Ünsal, “Complexified path integrals, exact saddles and supersymmetry”, *Phys. Rev. Lett.* **116** 011601 (2016).
88. M. Bluhm and T. Schäfer, “Model-independent determination of the shear viscosity of the unitary Fermi gas at high temperature,” *Phys. Rev. Lett.* **116** 115301 (2016).
89. A. Cherman, T. Schäfer and M. Unsal, “Chiral Lagrangian from Duality and Monopole Operators in Compactified QCD,” *Phys. Rev. Lett.* **117** 081601 (2016).
90. T. Schäfer, “Generalized theory of diffusion based on kinetic theory,” *Phys. Rev. A* **94**, no. 4, 043644 (2016).
91. A. Behtash, G. V. Dunne, T. Schäfer, T. Sulejmanpasic, M. Ünsal, “Picard Lefschetz theory of path integrals, complex saddles, and resurgence”, *Annals of Mathematical Sciences and Applications* **2** 95 (2017).
92. M. Bluhm, M. Nahrgang, S. A. Bass and T. Schäfer, “Impact of resonance decays on critical point signals in net-proton fluctuations,” *Eur. Phys. J. C* **77**, no. 4, 210 (2017).
93. M. Bluhm, J. Hou and T. Schäfer, “Determination of the density and temperature dependence of the shear viscosity of a unitary Fermi gas based on hydrodynamic flow,” *Phys. Rev. Lett.* **119**, no. 6, 065302 (2017).
94. M. Martinez and T. Schäfer, “Hydrodynamic tails and a fluctuation bound on the bulk viscosity,” *Phys. Rev. A* **96**, no. 6, 063607 (2017).

95. A. Behtash, G. V. Dunne, T. Schäfer, T. Sulejmanpasic and M. Ünsal, “Critical Points at Infinity, Non-Gaussian Saddles, and Bions,” JHEP **1806**, 068 (2018).
96. M. Nahrgang, M. Bluhm, T. Schäfer and S. A. Bass, “Diffusive dynamics of critical fluctuations near the QCD critical point,” Phys. Rev. D **99**, no. 11, 116015 (2019).
97. M. Martinez and T. Schäfer, “Stochastic hydrodynamics and long time tails of an expanding conformal charged fluid,” Phys. Rev. C **99**, no. 5, 054902 (2019).
98. M. Martinez, T. Schäfer and V. Skokov, “Critical behavior of the bulk viscosity in QCD,” Phys. Rev. D **100**, no. 7, 074017 (2019).
99. P. Parotto, M. Bluhm, D. Mroczek, M. Nahrgang, J. Noronha-Hostler, K. Rajagopal, C. Ratti, T. Schäfer, M. Stephanov, “Lattice-QCD-based equation of state with a critical point,” Phys. Rev. C **101**, no.3, 034901 (2020).
100. A. Cherman, S. Kamata, T. Schäfer and M. Ünsal, “Flow of Hagedorn singularities and phase transitions in large  $N$  gauge theories,” Phys. Rev. D **101**, no. 1, 014012 (2020).
101. M. Bluhm, M. Nahrgang, A. Kalweit, M. Arslanok, P. Braun-Munzinger, S. Floerchinger, E. Fraga, M. Gazdzicki, C. Hartnack, C. Herold, R. Holzmann, I. Karpenko, M. Kitazawa, V. Koch, S. Leupold, A. Mazeliauskas, B. Mohanty, A. Ohlson, D. Oliinychenko, J. Pawlowski, C. Plumberg, G. Ridgway, T. Schäfer, I. Selyuzhenkov, J. Stachel, M. Stephanov, D. Teaney, N. Touroux, V. Vovchenko, N. Wink, “Dynamics of critical fluctuations: Theory – phenomenology – heavy-ion collisions,” Nucl. Phys. A **1003**, 122016 (2020).
102. J. Chao and T. Schäfer, “Multiplicative noise and the diffusion of conserved densities,” JHEP **01**, 071 (2021).
103. A. Behtash, S. Kamata, M. Martinez, T. Schäfer, V. Skokov, “Transasymptotics and hydrodynamization of the Fokker-Planck equation for gluons”, Phys. Rev.

D **103**, no.5, 056010 (2021).

- 104. J. Hou and T. Schäfer, “Dissipative superfluid hydrodynamics for the unitary Fermi gas,” Phys. Rev. A **104**, no.2, 023313 (2021).
- 105. X. An, *et al.* (42 authors, including corresponding author T. Schäfer), “The BEST framework for the search for the QCD critical point and the chiral magnetic effect,” Nucl. Phys. A **1017**, 122343 (2022).
- 106. T. Schäfer and V. Skokov, “Dynamics of non-Gaussian fluctuations in model A,” Phys. Rev. D **106**, 014006 (2022).

### **Preprints:**

- 107. C. Chattopadhyay, U. Heinz and T. Schäfer, “Far-off-equilibrium expansion trajectories in the QCD phase diagram,” preprint [arXiv:2209.10483 [hep-ph]].
- 108. J. Chao and T. Schäfer, “ $N$ -particle irreducible actions for stochastic fluids”, preprint [arxiv:2302.00720 [hep-ph]],

### **Book Chapters:**

- 109. T. Schäfer, E. V. Shuryak, Phases of QCD at High Baryon Density, Proceedings of the ECT\* International Workshop on Physics of Neutron Star Interiors (NSI00), Lect. Notes Phys. 578 (2001) 203-217, D. Blaschke, A. Sedrakian and N. K. Glendenning (eds), Springer Tracts in Modern Physics (2001).
- 110. T. Schäfer, Quark Matter, Proceedings of the BARC workshop on Quarks and Mesons, Bhabha Atomic Research Center, Mumbai, India (2003), in “Quarks and Mesons”, A. B. Santra et.al, Eds., Narosa Publishing House, New Dehli (2004).
- 111. T. Schäfer, Phases of QCD, in “Proceedings of the 20th Annual Hampton University Graduate Studies Program (HUGS 2005)”, World Scientific, Singapore.

112. T. Schäfer, The CFL phase and  $m(s)$ : An effective field theory approach, in “Pairing in fermionic systems: Basic concepts and modern applications”, Series on Advances in Quantum Many-Body Theory, Vol. 8, World Scientific Publishing, Singapore (2006).
113. T. Schäfer, Effective Theories of Dense (and Very Dense) Matter, Proceedings of the ECT\* School on Renormalization Group and Effective Field Theory Approaches to Many Body Systems, A. Schwenk, J. Polonyi (eds.), Springer Tracts in Physics (2012).
114. T. Schäfer and C. Chafin, Scaling Flows and Dissipation in the Dilute Fermi Gas at Unitarity, in “BCS-BEC crossover and the Unitary Fermi Gas”, Lect. Notes Phys. 836 (2012) 375-406, W. Zwerger (ed.), Springer Tracts in Modern Physics (2012).
115. M. G. Alford, K. Rajagopal, T. Schäfer and A. Schmitt, Color superconductivity in dense quark matter, “The Physics of Unusual Superfluids”, K. H. Bennemann and J. B. Ketterson, eds., Oxford University Press (2012).
116. C. J. Pethick, T. Schäfer, A. Schwenk, “Bose-Einstein condensates in neutron stars”, in “Universal Themes of Bose-Einstein Condensation”, D. Snoke, N. Proukakis, P. Littlewood, editors, Cambridge University Press (2017).
117. T. Schäfer, “Quantum Chromodynamics: Computational Aspects”, in “An advanced course in computational nuclear physics: Bridging the scales from quarks to neutron stars”, Springer Lect. Notes Phys., M. Hjorth-Jensen, M. P. Lombardo, U. van Kolck, Editors (2018).

#### **Editorial Pieces and Publications in Professional Society Journals:**

118. T. Schäfer, “Tunnelvorgänge in QCD (Tunneling in QCD),” *Physikalische Blätter* (German Physical Society magazine), 55:9 (1999) 52.
119. T. Schäfer, “Squeezed Quark Matter,” *APCTP Bulletin*, Asia Pacific Center for Theoretical Physics, Vol. 9-10 (2002) 10.

120. T. Schäfer, “The RHIC Gold Rush,” *Physics World*, 16:6 (2003) 31.
121. T. Schäfer, “Nearly Perfect Fluidity,” *Physics* 2, 88 (2009).
122. T. Schäfer, A. Schwenk, “Stark gekoppelt und universell (Strongly coupled and universal), ” *Physik Journal*, 1 (2014) 27.
123. T. Schäfer, “Quantum-limited sound attenuation,” *Science*, 370 (2020) 1162.
124. T. Schäfer, G. Baym, “From nuclear to unnuclear Physics,” *PNAS* 118 (37) e2113775118 (2021).

### **Reports:**

125. G. Baym, A. Aprahamian, C. Aidala, P. Braun-Munzinger, H. Gao, K. Hafidi, W. Haxton, L. McLerran, L. Merminga, Z.-E. Mezziani, R. Milner, T. Schäfer, E. Sichtermann, M. Turner, “An Assessment of U.S.-Based Electron-Ion Collider Science.” The National Academies Press, Washington, DC (2018).

### **White Papers:**

126. D. Almaalol et al., 40 co-authors, incl. T. Schäfer, QCD Phase Structure and Interactions at High Baryon Density: Completion of BES Physics Program with CBM at FAIR, preprint, arXiv:2209.05009 [nucl-ex].
127. A. Lovato et al., 64 co-authors, incl. T. Schäfer, Long Range Plan: Dense matter theory for heavy-ion collisions and neutron stars, [arXiv:2211.02224 [nucl-th]].

### **Lecture Notes, unpublished:**

128. T. Schäfer, Instantons and Monte Carlo Simulations in Quantum Mechanics, Part of a series of Lectures delivered at Brookhaven (1998), Heidelberg (1999), Copenhagen (2001), hep-lat/0411010.



### Conference Proceedings:

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