

# Curriculum vitae - Paul Romatschke

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as of September 15, 2022

## Personal Information

- Nationality: Austrian
- Current Address:  
Department of Physics  
390 UCB  
University of Colorado  
Boulder, CO 80309-0390  
Email: paul.romatschke@colorado.edu
- Homepage: <http://hep.itp.tuwien.ac.at/~paulrom>



## Educational Background

- November 2003 Graduation to “Doktor der technischen Wissenschaften” with honors, Technical University of Vienna, Austria
- 04-06 Postdoctoral Position at Bielefeld University, Bielefeld, Germany
- 06-07 Postdoctoral Position at INT, University of Washington, Seattle, USA

## Academic Employment History

- 07-10 Research Assistant Professor/INT 5-year fellow, University of Washington, Seattle, USA
- 10-11 Fellow, Frankfurt Institute for Advanced Studies (FIAS), Frankfurt, Germany
- 11-17 Assistant Professor, Department of Physics, University of Colorado Boulder, Boulder USA
- 17-22 Associate Professor, Department of Physics, University of Colorado Boulder, Boulder USA
- **currently (since 08/2022) Full Professor**, Department of Physics, University of Colorado Boulder, Boulder USA

# Teaching

## Different Lecture Courses Taught

1. “**New Developments in Viscous Hydrodynamics**” (2 credits), University of Jyväskylä, Finland (Summer 2008)
2. “**Hydrodynamics and Transport Theory**” (4 credits), Johann-Wolfgang von Goethe Universität Frankfurt, Germany (Fall 2010)
3. “**Thermal Quantum Field Theory**” (4 credits), Johann-Wolfgang von Goethe Universität Frankfurt, Germany (Spring 2011)
4. “**Energy and the Environment**” (PHYS 3070, 3 credits), University of Colorado, Boulder, USA (Spring 2012)
5. “**Electromagnetism I for Graduate Students**” (PHYS 7310, 3 credits), University of Colorado, Boulder, USA (Fall 2012 & Fall 2013)
6. “**Electromagnetism II for Graduate Students**” (PHYS 7320, 3 credits), University of Colorado, Boulder, USA (Spring 2013)
7. “**Quantum Mechanics II for Graduate Students**” (PHYS 5260, 3 credits), University of Colorado, Boulder, USA (Spring 2015& Spring 2017)
8. “**Classical Electromagnetism**” (PHYS 3320, 3 credits), University of Colorado, Boulder, USA (Fall 2015)
9. “**Introduction to Modern Physics**” (PHYS 2170, 3 credits), University of Colorado, Boulder, USA (Spring 2016 & Fall 2016)
10. “**Introduction to Quantum Field Theory**” (PHYS 7270, 3 credits), University of Colorado, Boulder, USA (Fall 2020, 2021, 2022)
11. “**Finite Temperature Quantum Field Theory**” (PHYS 7280, 3 credits), University of Colorado, Boulder, USA (Spring 2018)
12. “**General Relativity**” (PHYS 5770, 3 credits), University of Colorado, Boulder, USA (Spring 2019, 2021, 2022, 2023)

## Current Supervision: U. of Colorado, Boulder

- **Scott Lawrence**, postdoc since Fall 2020
- **Max Weiner**, PhD candidate at CU Boulder, expected graduation date: May 2023
- **Seth Grable**, PhD candidate at CU Boulder, expected graduation date: May 2025

## Previous Student/Postdoc Supervision

### Undergraduate Students

- 2010-2011: **M. Habich**, **BS 2011** FIAS, Frankfurt, Germany
- 2010-2011: **S. Henneberg**, **BS 2011** FIAS, Frankfurt, Germany
- 2013: **J.D. Hogg**, **BS 2013** U. Colorado, Boulder
- 2013-2015: **J. Brewer**, **BA 2015** U. Colorado, Boulder
- 2016-2017: **R. Weller**, **BA 2017** U. Colorado, Boulder
- 2020-2021: **Sanjeev Mahabir**, **BS 2021**, U. Colorado, Boulder

### Graduate Students

- 2007-2009: **M. Luzum**, co-supervision with G. Miller. **PhD 2009** U. of Washington, Seattle, thesis was awarded the 2011 American Physical Society Dissertation Award in Nuclear Physics
- 2012-2013: **R. Young**, **MS 2013** U. Colorado, Boulder
- 2012-2016: **T. Gorda**, **PhD 2016** U. Colorado, Boulder
- 2015-2017: **W. Lewis**, **PhD 2017** U. Colorado, Boulder
- 2015-2017: **M. Habich**, **PhD 2017** U. Colorado, Boulder
- 2017-2022 **Mark Watson**, **PhD 2022** U. Colorado, Colorado Springs

### Postdocs

- 2010-2011: **I. Sagert**, FIAS, Frankfurt, Germany
- 2013-2016: **H. Bantilan**, U. Colorado, Boulder
- 2015-2016: **W. Xiang**, U. Colorado, Boulder
- 2015-2017: **I. Takaaki**, U. Colorado, Boulder

## Honors and Awards

- 02/2012: Alfred P. Sloan Fellow 2012 (Sloan Foundation)
- 05/2012: Department of Energy Early Career Research Award
- 10/2022: Provost Faculty Achievement Award, U. Colorado, Boulder

## Recent Invited Talks

- “Holography for Heavy-Ion Collisions”, **Fire and Ice: Hot QCD meets cold and dense matter**, Saariselkä, Finland, April 2018
- “Holographic Heavy-Ion Collisions: new analytic solutions”, **Theoretical Foundations of Relativistic Hydrodynamics**, Trento, Italy, May 2018
- “Hydrodynamics Off Equilibrium”, plenary, **Strong and Electroweak Matter 2018**, Barcelona, Spain, June 2018
- “Small Collision Systems”, **Fourth Mont-Sainte-Odile Meeting**, Terzolas, Italy, May 2018
- “The Physics of Non-Hydrodynamic Modes”, **Numerical approaches to holography, quantum gravity and cosmology**, Edinburgh, UK, May 2018
- “Hydrodynamic evolution, flow, bulk properties”, 3 lectures, **Indian Summer School**, Prague, Czech Republic, September 2018
- “Real Time Quantum Gravity Dynamics from Yang-Mills Simulations”, **Quantum Gravity meets Lattice QFT**, Trento, Italy, September 2018
- “Relativistic Fluid Dynamics Out of Equilibrium”, 3 lectures, U Maryland, November 2018
- “Azimuthal Anisotropies at High Momentum”, **Jetscape Virtual Seminar**, January 2019
- “Relativistic Hydrodynamics in Strong Gravity”, **Accretion in strong gravity, 689. WE-Heraeus-Seminar**, Bad Honnef, Germany, February 2019
- “Hydrodynamics applied to small collision systems”, **Workshop on collectivity of small systems in high-energy collisions**, Rice University, Houston, March 2019
- “On the smallest droplets of QCD fluids”, **APS April Meeting**, Denver, April 2019
- “Relativistic Fluid Dynamics Out of Equilibrium”, 3 lectures, TU Vienna, October 2019
- “Relativistic Fluid Dynamics Out of Equilibrium”, 5 lectures, The Ohio State University, November 2019 (available on youtube)

- “Pure CFT Thermodynamics and Fractional Degrees of Freedom”, **Ttmu virtual seminar**, November 2019 (available on youtube)
- “Pure CFT Thermodynamics and Fractional Degrees of Freedom”, **CTQM seminar**, CU Boulder, January 2020
- “Pure CFT Thermodynamics and Fractional Degrees of Freedom”, **4th conference on Holography and String Theory Hanoi**, virtual , August 2020
- “Hydrodynamics off Equilibrium”, **HoloTube (Berlin)**, virtual , September 2020
- “From weak to strong coupling without holography”, **Extreme Nonequilibrium QCD (ONLINE)**, **ICTS**, virtual , October 2020
- “Quantum Transport at Infinite Coupling”, **Physics Department Colloquium**, Boulder, CO, October 2021
- “Transport at Strong Coupling – a Field Theory Approach”, **High Energy Physics Seminar**, virtual, University of Victoria, November 2021
- “Transport at Strong Coupling – a Field Theory Approach”, **Nuclear Physics Seminar**, virtual, University of Minnesota, February 2022
- “ $3/4$ ,  $4/5$  and  $1/(4\pi)$ – towards understanding universal ratios in strongly coupled large N field theories”, **Nonperturbative and Numerical Approaches to Quantum Gravity, String Theory and Holography (HYBRID)**, **ICTS** , virtual, August 2022

## Refereed Publications

1. P. Romatschke and M. Strickland, *Collective Modes of an Anisotropic Quark-Gluon Plasma*, **Phys.Rev.D68:036004, 2003**
2. A. Rebhan and P. Romatschke, *HTL Quasiparticle Models of Deconfined QCD at Finite Chemical Potential*, **Phys.Rev.D68:025022, 2003**
3. P. Romatschke and M. Strickland, *Energy Loss of a Heavy Fermion in an Anisotropic QED Plasma*, **Phys.Rev.D69:065005, 2004**
4. P. Romatschke and M. Strickland, *Collective Modes of an Anisotropic Quark-Gluon Plasma II*, **Phys.Rev.D70:116006, 2004**
5. P. Romatschke and M. Strickland, *Collisional Energy Loss of a Heavy Quark in an Anisotropic Quark-Gluon Plasma*, **Phys.Rev.D71:125008, 2005**
6. A. Rebhan, P. Romatschke and M. Strickland, *Hard-Loop Dynamics of Non-Abelian Plasma Instabilities*, **Phys.Rev.Lett.94:102303, 2005**
7. E.S. Fraga and P. Romatschke, *The Role of Quark Mass in Cold and Dense Perturbative QCD*, **Phys.Rev.D71:105014, 2005**
8. A. Rebhan, P. Romatschke and M. Strickland, *Dynamics of Quark-Gluon-Plasma Instabilities in Discretized Hard-Loop-Approximation*, **JHEP 0509:041, 2005**
9. P. Romatschke and R. Venugopalan, *Collective Non-Abelian Instabilities in a Melting Color Glass Condensate*, **Phys.Rev.Lett.96:062302, 2006**
10. R. Baier, P. Romatschke and U.A. Wiedemann, *Dissipative hydrodynamics and heavy ion collisions*, **Phys.Rev. C73:064903, 2006**
11. P. Romatschke and R. Venugopalan, *The Unstable Glasma*, **Phys.Rev. D74:045011, 2006**
12. P. Romatschke and A. Rebhan, *Plasma Instabilities in an Anisotropically Expanding Geometry*, **Phys.Rev.Lett. 97:252301, 2006**
13. P. Romatschke, *Momentum broadening in an anisotropic plasma*, **Phys.Rev. C75:014901, 2007**
14. R. Baier and P. Romatschke, *Causal viscous hydrodynamics for central heavy-ion collisions*, **Eur.Phys.J.C51:677-687, 2007**
15. M. Laine, O. Philipsen, P. Romatschke and M. Tassler, *Real-time static potential in hot QCD*, **JHEP 0703:054, 2007**

16. P. Romatschke, *Causal viscous hydrodynamics for central heavy-ion collisions. II. Meson spectra and HBT radii*, **Eur.Phys.J.C52:203-209, 2007**
17. P. Romatschke and U. Romatschke, *Viscosity information from relativistic nuclear collisions: How perfect is the fluid observed at RHIC?*, **Phys.Rev.Lett. 99:172301, 2007**
18. R. Baier, P. Romatschke, D.T. Son, M. Stephanov and A. Starinets, *Relativistic viscous hydrodynamics, conformal invariance, and holography*, **JHEP 0804:100, 2008**
19. D. Grumiller and P. Romatschke, *On the collision of two shock waves in  $AdS_5$* , **JHEP 0808:027, 2008**
20. M. Luzum and P. Romatschke, *Conformal Relativistic Viscous Hydrodynamics: Applications to RHIC results at  $\sqrt{s_{NN}} = 200\text{-GeV}$* , **Phys.Rev. C78:034915, 2008**
21. M. Luzum and P. Romatschke, *Viscous Hydrodynamic Predictions for Nuclear Collisions at the LHC*, **Phys.Rev.Lett. 103:262302, 2009**
22. P. Romatschke, *New Developments in Relativistic Viscous Hydrodynamics*, **Int.J.Mod.Phys.E19:1-53, 2010**
23. P. Romatschke and D.T. Son, *Spectral sum rules for the quark-gluon plasma*, **Phys.Rev. D80:065021, 2009**
24. P. Romatschke, *Relativistic Viscous Fluid Dynamics and Non-Equilibrium Entropy*, **Class.Quant.Grav.27:025006, 2010**
25. A. Kurkela, P. Romatschke and A. Vuorinen, *Cold Quark Matter*, **Phys.Rev.D81:105021, 2010**
26. P. Kovtun, G.D. Moore and P. Romatschke, *The stickiness of sound: An absolute lower limit on viscosity and the breakdown of second order relativistic hydrodynamics*, **Phys.Rev.D84:025006, 2011**
27. P. Romatschke, M. Mendoza and S. Succi, *A fully relativistic lattice Boltzmann algorithm*, **Phys.Rev.C84:034903, 2011**
28. Bin Wu and P. Romatschke, *Shock wave collisions in  $AdS_5$ : approximate numerical solutions*, **Int.J.Mod.Phys. C22:1317-1342, 2011**
29. P. Romatschke, *Relativistic (Lattice) Boltzmann Equation with Non-Ideal Equation of State*, **Phys. Rev. D85:065012, 2012**

30. P. Romatschke and R. Young, *Implications of hydrodynamic fluctuations on the minimum shear viscosity of the dilute Fermi gas at unitarity*, **Phys.Rev. A87:053606, 2013**
31. P. Romatschke and J.D. Hogg, *Pre-Equilibrium Radial Flow from Central Shock-Wave Collisions in AdS<sub>5</sub>*, **JHEP 1304:048, 2013**
32. W. van der Schee, P. Romatschke and S. Pratt, *A fully dynamical simulation of central nuclear collisions*, **Phys.Rev.Lett.111:222302, 2013**
33. A. Adare et al., *Examination whether heavy quarks carry information on the early-time coupling of the quark-gluon plasma*, **Phys.Rev. C90:024911, 2014**
34. J.L. Nagle et al., *Exploiting Intrinsic Triangular Geometry in Relativistic He<sup>3</sup>+Au Collisions to Disentangle Medium Properties*, **Phys.Rev.Lett. 113:112301, 2014**
35. M. Habich and P. Romatschke, *Onset of cavitation in the quark-gluon plasma*, **JHEP 1412:054, 2014**
36. P. Kovtun, G.D. Moore and P. Romatschke, *Towards an effective action for relativistic dissipative hydrodynamics*, **JHEP 1407:123, 2014**
37. T. Gorda and P. Romatschke, *Precision studies of  $v_n$  fluctuations*, **Phys.Rev. C90:054908, 2014**
38. P. Arnold, W. van der Schee and P. Romatschke, *Absence of a local rest frame in far from equilibrium quantum matter*, **JHEP 1410:110, 2014**
39. M. Habich, J.L. Nagle and P. Romatschke, *Particle spectra and HBT radii for simulated central nuclear collisions of C + C, Al + Al, Cu + Cu, Au + Au, and Pb + Pb from  $\sqrt{s}=62.4 - 2760$  GeV*, **Eur.Phys.J. C75:15, 2015**
40. H. Bantilan and P. Romatschke, *Simulation of Black Hole Collisions in Asymptotically Anti-de Sitter Spacetimes*, **Phys.Rev.Lett. 114 (2015) 8, 081601**
41. T. Gorda and P. Romatschke, *Equation of state in two-, three-, and four-color QCD at nonzero temperature and density*, **Phys.Rev. D92 (2015) 1, 014019**
42. P. Romatschke, *Light-Heavy Ion Collisions: A window into pre-equilibrium QCD dynamics?*, **Eur.Phys.J. C75 (2015) 7, 305**



43. P. Romatschke, *Collective flow without hydrodynamics: simulation results for relativistic ion collisions*, **Eur.Phys.J. C75** (2015) **9**, 429
44. J. Brewer, M. Mendoza, R.E. Young and P. Romatschke, *Lattice Boltzmann simulations of a strongly interacting two-dimensional Fermi gas*, **Phys.Rev. A93** (2016) **1**, 013618
45. J. Brewer and P. Romatschke, *Nonhydrodynamic Transport in Trapped Unitary Fermi Gases*, **Phys.Rev.Lett.** **115** (2015) **19**, 190404
46. P. Romatschke, *Retarded correlators in kinetic theory: branch cuts, poles and hydrodynamic onset transitions*, **Eur.Phys.J. C77** (2016) **6**, 352
47. L. Keegan, A. Kurkela, P. Romatschke, W. van der Schee and Y. Zhu, *Weak and strong coupling equilibration in nonabelian gauge theories*, **JHEP** **1604** (2016) **013**
48. M. Habich, G.A. Miller, P. Romatschke, W. Xiang, *Testing hydrodynamic descriptions in  $p+p$  collisions at  $\sqrt{s} = 7$  TeV*, **Eur.Phys.J. C76** (2016) **7**, 408
49. H. Bantilan, J. Brewer, T. Ishii, W.E. Lewis, and P. Romatschke, *String Theory Based Predictions for Nonhydrodynamic Collective Modes in Strongly Interacting Fermi Gases*, **Phys.Rev.** **A94** (2016), 033621
50. P. Romatschke, *Do nuclear collisions create a locally equilibrated quark-gluon plasma?*, **Eur.Phys.J. C77** (2017), 21
51. I. Ghioiu, T. Gorda, A. Kurkela, P. Romatschke, M. Säppi, A. Vuorinen, *On high-order perturbative calculations at finite density*, **Nucl.Phys. B915** (2017) 102
52. W. Lewis and P. Romatschke, *Higher-Order Collective Modes in a Trapped Gas from Second-Order Hydrodynamics*, **New J.Phys.** **19** (2017) 023042
53. M. Hanada and P. Romatschke, *Lattice Simulations of 10d Yang-Mills toroidally compactified to 1d, 2d and 4d*, **Phys. Rev. D96** (2017) 094502
54. R.D. Weller and P. Romatschke, *One fluid to rule them all: viscous hydrodynamic description of event-by-event central  $p+p$ ,  $p+Pb$  and  $Pb+Pb$  collisions at  $\sqrt{s}=5.02$  TeV*, **Phys. Lett. B774** (2017) 351
55. H. Bantilan, P. Figueras, M. Kunesch and P. Romatschke, *Nonspherically Symmetric Collapse in Asymptotically AdS Spacetimes*, **Phys. Rev. Lett.** **119** (2017), 191103

56. P. Romatschke, *Relativistic Hydrodynamic Attractors with Broken Symmetries: Non-Conformal and Non-Homogeneous*, **JHEP** **1712** (2017) **079**
57. P. Romatschke, *Relativistic Fluid Dynamics Far From Local Equilibrium*, **Phys. Rev. Lett.** **120** (2018), **012301**
58. P. Romatschke and U. Romatschke, *Relativistic Fluid Dynamics In and Out of Equilibrium*, Cambridge Monographs in Physics, Cambridge University Press, in press
59. P. Romatschke, *Azimuthal Anisotropies at High Momentum from Purely Non-Hydrodynamic Transport*, **Eur. Phys. J.C78** (2018) **636**
60. H. Bantilan, T. Ishii and P. Romatschke, *Holographic Heavy-Ion Collisions: Analytic Solutions with Longitudinal Flow, Elliptic Flow and Vorticity*, **Phys. Lett.** **B785** (2018) **201**
61. T. Gorda, A. Kurkela, P. Romatschke, M. Säppi, A. Vuorinen, *NNLO pressure of cold quark matter: leading logarithm*, **Phys.Rev.Lett.** **121** (2018) **no.20**, **202701**
62. M. Hanada and P. Romatschke, *Real Time Quantum Gravity Dynamics from Classical Statistical Yang-Mills Simulations*, **JHEP** **1901** (2019) **201**
63. P. Romatschke, *Simple non-perturbative resummation schemes beyond mean-field: case study for scalar  $\phi^4$  theory in 1+1 dimensions*, **JHEP** **1903** (2019) **149**
64. P. Romatschke, *Simple non-perturbative resummation schemes beyond mean-field: case study for scalar  $\phi^4$  theory in 1+1 dimensions*, **Modern Physics Letters A35** (2020) **09**, **2050054**
65. P. Romatschke, *Finite-Temperature Conformal Field Theory Results for All Couplings:  $O(N)$  Model in 2+1 Dimensions*, **Phys.Rev.Lett.** **122** (2019) **no.23**, **231603**
66. O. DeWolfe and P. Romatschke, *Strong Coupling Universality at Large  $N$  for Pure CFT Thermodynamics in 2+1 dimensions*, **JHEP** **1910** (2019) **272**
67. P. Romatschke, *Analytic Transport from Weak to Strong Coupling in the  $O(N)$  model*, **Phys.Rev.** **D100** (2019) **no.5**, **054029**
68. P. Romatschke, *Fractionalized Degrees of Freedom at Infinite Coupling in large  $N_f$  QED in 2+1 dimensions*, **Phys.Rev.Lett.** **123** (2019) **no.24**, **241602**

69. P. Romatschke and M. Säppi, *Thermal free energy of large  $N_f$  QED in 2+1 dimensions from weak to strong coupling*, **Phys.Rev. D100 (2019) 073009**
70. P. Romatschke, *Exact  $\beta$ -function of Yang-Mills theory in 2+1 dimensions*, **JHEP 03 (2020) 174**
71. P. Romatschke, *Quantum Mechanical Out-Of-Time-Ordered-Correlators for the Anharmonic (Quartic) Oscillator*, **JHEP 01 (2021) 030**
72. P. Romatschke, *Shear Viscosity at Infinite Coupling: A Field Theory Calculation*, **Phys.Rev.Lett. 127 (2021) 11, 111603**