Nabil Iqbal

Department of Mathematical Sciences
Durham University
Phone: +447465981361
Email: nabil.iqbal@durham.ac.uk
Website: www.nabiliqbal.com
Profiles: inSpire / Google Scholar

Current Position

Professor, Mathematical and Theoretical Particle Physics, Durham University

Areas of Interest

I pursue a broad research program in theoretical physics. An overall theme is the understanding of strongly interacting systems using principles of duality, universality, and symmetry.

Employment

2023-...	Professor, Durham University
2020-2023	Associate Professor, Durham University
2017-2020	Assistant Professor, Durham University
2014-2016	Postdoctoral Scholar, University of Amsterdam
2011-2014	Postdoctoral Scholar, Kavli Institute for Theoretical Physics

Education

2006-2011	PhD in Physics, Massachusetts Institute of Technology Thesis title: *Holography and strongly correlated systems*, supervised by Hong Liu.
2002-2006	B.A. in Physics and Mathematics *summa cum laude*, Cornell University

Grants

2024-2025	Simons Pivot Fellowship: *Conformally Equivariant Neural Networks*, 125,940 GBP (to begin)
2023-2026	co-I on STFC Group Grant: *Particles, Fields and Spacetime*, 1,093,355 GBP (ongoing).
2020-2023	co-I on STFC Group Grant: *Particles, Fields and Spacetime*, 1,413,113 GBP.

Interviews

2023	Interviewed for ERC Consolidator Grant
2023	Interviewed for EPSRC Open Fellowship.
2018	Interviewed for ERC Starting Grant.

Honors & awards

2024-2025	Simons Pivot Fellowship
2015-2016	Delta-ITP Postdoctoral Fellowship, U. of Amsterdam
2010	Andrew M. Lockett III Memorial Fund Award (for excellence in graduate research), MIT
2010	Henry Kendall Teaching Award (for excellence in graduate teaching), MIT
2006-2009	National Science Foundation Graduate Fellowship
2006	Donald R. Yennie Prize in Physics (top student in Physics in graduating class), Cornell U.
2002-2006	Pauline and Irving Tanner Dean's Scholar, Cornell U.

Invited talks at international conferences and workshops

I list below selected talks given at large international conferences or workshops. I have not listed any online talks. In addition to the talks below, I have also given roughly 75 invited seminar talks at various institutes around the world. I have to routinely decline invitations due to teaching obligations.

7/2023	KITP Workshop: The many faces of relativistic fluid dynamics, Santa Barbara, CA. *"Higher-form symmetries, hydrodynamics, and the superconducting transition"*.
3/2023	ECT* Trento Workshop: Holographic perspectives on chiral transport, Trento, Italy. *"Non-invertible axial symmetries and Goldstone modes."*
3/2023	Institute for Nuclear Theory Workshop: Topological Phases of Matter: From Low to High Energy, Seattle. *"Non-invertible axial symmetries and Goldstone modes."*
6/2022	Physics Sessions Initiative, Crete. *"Higher Form Symmetries: Several Attempts to Solve the 3d Ising Model"*
7/2022	Amsterdam String Workshop, Amsterdam. *"Mean String Field Theory"*
8/2019	Aspen Center for Theoretical Physics Program: Generalized Symmetries, Anomalies and Observables, Aspen. *"Effective Field Theory of Force-Free Electrodynamics"*
1/2019	Qubits on the Horizon, Aruba. *"Effective Field Theory of Force-Free Electrodynamics"*
10/2018	GQFI Workshop on AQFT, Modular Techniques, and Renyi Entropy, MPI Potsdam, *"Applications of Higher Form Symmetries"*
9/2018	Nordita Workshop: Bounding Transport and Chaos in Condensed Matter and Holography, Stockholm. *"Applications of Higher Form Symmetries"*
8/2018	CERN Workshop: Black holes, quantum information, and space-time reconstruction, *"Bulk entanglement entropy in perturbative excited states"*
6/2017	Aspen Center for Theoretical Physics Program: Information in Quantum Field Theory, Aspen, *"Generalized global symmetries and dissipative magnetohydrodynamics"*
7/2016	Nordita Workshop: Black Holes and Emergent Spacetime, Stockholm, *"Generalized global symmetries and dissipative magnetohydrodynamics"*
12/2015	Holograv Workshop: Applied Holography in Condensed Matter Systems, Porto, *"Anomalies of the entanglement entropy in chiral theories"*
7/2015	KITPC Workshop: Holographic Duality for Condensed Matter Physics, Beijing, *"Electric fields and quantum wormholes"*
7/2014	APCTP Focus Program on Aspects of Holography, Pohang, South Korea, *"Monopole correlations in holographically flavored liquids"*
7/2014	Amsterdam String Workshop, Amsterdam, *"Monopole correlations in holographically flavored liquids"*
4/2014	Solvay Workshop on Holography for Black Holes and Cosmology, Brussels, *"Holographic en-*

tanglement entropy and gravitational anomalies"

9/2013 Workshop: Mathematics and Physics of the Holographic Principle, Cambridge University, *"Wilson lines and entanglement entropy in higher spin gravity"*

2/2013 Holography and Applied String Theory Workshop, Banff, Canada *"Friedel oscillations and horizon charge in 1d holographic liquids"*

7/2012 Strings 2012, Munich, *"Friedel oscillations and horizon charge in 1d holographic liquids"*

3/2010 Applications of AdS/CFT to Condensed Matter and Nuclear Physics Workshop, Texas A&M University, *"Quantum phase transitions and holographic models of symmetry breaking"*

Colloquia

11/2018 Department of Mathematical Sciences Research Colloquium, Durham University , *"Generalized global symmetries: from counting strings to magnetohydrodynamics"*

11/2017 Center for Particle Theory Colloquium, Durham University , *"Generalized global symmetries, Goldstone modes, and hydrodynamics"*

11/2017 Theoretical Physics Colloquium (*Colloque Theorique*), University of Geneva, *"Generalized global symmetries, Goldstone modes, and hydrodynamics"*

5/2017 HEP/GR Colloquium, DAMTP, Cambridge University, *"Generalized global symmetries and dissipative magnetohydrodynamics"*

Service

Citizenship at Durham University

2020-2023 *Course Director and Chair of Board of Examiners for MSc in Particles, Strings and Cosmology.* Management of all aspects of instruction and assessment of masters program in theoretical physics:

- During the pandemic, led the development of a new online version of program suitable for Covid-19
- Oversee teaching team of $\sim$ 15 faculty members and $\sim$ 4 postdocs.

2020-... *Lead Organizer of Global Masters Scholarship*: Management of scholarship that supports students from Low or Middle Income Countries to do an MSc in Department of Mathematical Sciences:

- Chair of search committee and advertising
- Liaise with the International Students and Scholarships Office, support student on arrival.

2022 *Exam scanning system:* helped design and implement/code a system which allowed efficient scanning of roughly 10K physical exam scripts into an online marking software for parallel marking by staff members. We have since been approached by other departments both inside and outside Durham to use the system for their own exams.

2020 *Member of hiring committee* for assistant professorship faculty search.

2020-... *Member of Management Board*, Taught MSc in Mathematical Sciences.

2020-... *Member of Staff Student Consultative Committee*, Postgraduate Teaching in Mathematical Sciences.

2020-2022 *Member of Board of Examiners*, MiSCADA Program (MSc in Data Sciences).

2019-... *Departmental website:* assist in maintaining departmental web site.

Covid-19

2020 In response to Covid-19 crisis, I sat on the National Data Analytics Task Force for the government of Bangladesh (my home country). Provided mathematical support to epidemiology team:

- Led team to develop Bayesian inference algorithm for real-time monitoring of effective reproduction number $R(t)$ for government dashboard
- Co-authored guidelines for rollout of antigen testing program.

Examination

2022-... External examiner for Part III (MSc in Theoretical Physics) at DAMTP, Cambridge University.
2016-... Examiner for Ph.D defense of twelve doctoral students (at Cambridge U. (1), Durham U. (4), U. of Amsterdam (2), Kings College London (1), U. of Southampton (2) and U. Libre Bruxelles (2)).

Organization of meetings

2023 Paths to Quantum Field Theory Workshop III at Durham University.
2022 Paths to Quantum Field Theory Workshop II at Durham University.
2022 Palestinian Advanced School in Learning with Machines (PALMs) at Birzeit U., Palestine
2021 Paths to Quantum Field Theory Workshop I at Durham University.
2019 First India-Bangladesh Winter School, Dhaka, Bangladesh.
2019 Third Palestinian Advanced Physics School (PAPS) at Birzeit University, Palestine.
2017 Second Palestinian Advanced Physics School (PAPS) at Birzeit University, Palestine.
2016 D-ITP Entanglement Workshop at University of Amsterdam.
2016 First Palestinian Advanced Physics School (PAPS) at Arab-American University, Palestine.

Refereeing

2010-... Referee for the journals *Nature Physics*, *Phys. Rev. Lett.*, *Phys. Rev. D*, *JHEP*, *Phys. Lett. B*, *Sci-Post Physics*.
2018-... Research grant referee for European Research Council (ERC), Dutch Research Council (NWO), Ernest Rutherford Fellowships awarded by Science and Technologies Facilities Council (STFC), UKRI Future Leaders Fellowship, Irish Research Council, and the Czech Science Foundation.

Citizenship at other institutes

2014-2015 Co-organized seminars at University of Amsterdam.
2012-2013 Co-organized seminars at Kavli Institute for Theoretical Physics.

Teaching

2023	*At Durham University:* Lecturer for Advanced Quantum Theory IV (introductory undergraduate quantum field theory)
2023	Lecturer for Single Mathematics B (1st year calculus for physicists)
2020-2022	Lecturer for Statistical Mechanics III/IV (3rd/4th year course)
2017-2021	Lecturer for Quantum Field Theory 2, MSc (graduate course in path integral methods)
2017-2020	Lecturer for General Relativity IV (4th year course)
2017-2019	Tutor for Single Mathematics B (1st year calculus for physicists), Analysis in Multiple Variables II (2nd year multivariable calculus), Dynamics I (1st year classical mechanics), Calculus I (1st year calculus for mathematicians) Statistical Concepts II (2nd year statistical analysis)
	Teaching Assistant for the following courses at MIT:
2011	8.962 – General Relativity
2009	8.02 – Electricity and Magnetism
	Lecture series:
2/2024	Lectures on *"Generalized Global Symmetries: Principles and Applications"* at *TPI Jena School on QFT and Holography: Principles and Applications*, Germany.
12/2020	Lectures on *"Introduction to AdS/CFT"* at *India-Bangladesh Winter School*, Dhaka, Bangladesh.
7/2019	Lectures on *"Introduction to String Theory"* at *Palestinian Advanced Physics School*, Birzeit University.
9/2015	Lectures on *"Entanglement in Field Theory and Gravity"* at *Modave Summer School*, Belgium.

Supervision and Mentorship

2023-...	Supervisor of PhD student Navonil Neogi.
2019-2023	Supervisor of PhD student Arpit Das, defended September 2023. Thesis title: *"Generalised symmetries, anomalous magnetohydrodynamics and holography"*. Currently a postdoc at U. of Edinburgh.
2017-2021	Supervisor of PhD student Kieran Macfarlane, defended December 2021. Thesis title: *"Applications of higher-form symmetries at weak and strong coupling,"*
2023	Supervisor of MSc student Ben Hind (to start PhD program, U. of Liverpool).
2022	Supervisor of MSc student Rashad Hamidi (currently PhD student, Durham U.)
2019	Supervisor of MSc student Simon Guisset (winner of Winston prize, given to top student in year).
2018-...	Supervisor of 4-6 BSc or MMath (i.e. 3rd or 4th year undergraduate) theses each year. Previous topics include the fractional quantum hall effect, topological phases of matter, black hole information, gravitational waves, cosmology and the early universe, and Monte Carlo simulations for phase transitions in statistical models.
	Other mentorship experience:
2013 - 2014	Tutor for School on Wheels program for disadvantaged youth in Santa Barbara, California.
2010	Mentor for the Research Science Initiative 2010 program at MIT supervising high-school student research.

Culture and outreach

2022	Appearance on *Physics for Phiish* podcast (link)
2021	Worked with Portuguese art collective *Plataforma Uma* to create interactive visualization (link) of black hole evaporation, set to soundtrack by sound artist Jonathan Ulien Saldanha.
2022	Worked with *Plataforma Uma* to create real-life exhibit titled *Hair*[1], shown at Transeuropa 2022 in Porto, April 2022.
2021	Interview by Scientific American (link).
2019	Appearance on *Rich Chocolaty Goodness* podcast (link).
2019-...	Created several interactive visualizations of phenomena in physics (e.g. flying a spaceship around a Schwarzschild black hole), visible on my website (link).

I am active in outreach and have given numerous outreach talks at different levels (usually 3-4 a year). Examples include:

- A description of black hole entropy to humanities students in Bangladesh
- An explanation of relativity and time dilation to high-school students in Cambridge, MA
- An introduction to string theory to a medical physics group at the NHS.

Languages

Fluent in English (first language). Competent in Bengali, A2 qualification in Dutch.

Publications

As of March 2024, I have a total of 44 publications (including preprints) with approximately 3000 citations and an H-index of 28. I have a single paper with more than 500 citations and eight papers with more than 100. Author ordering in my field is alphabetical. An up-to-date list can be found on inSpire.

1. A. Das, N. Iqbal and N. Poovuttikul, "Hydrodynamic fluctuations and topological susceptibility in chiral magnetohydrodynamics," [arXiv:2403.16957 [hep-th]].
2. A. Das, A. Florio, N. Iqbal and N. Poovuttikul, "Higher-form symmetry and chiral transport in real-time lattice $U(1)$ gauge theory," [arXiv:2309.14438 [hep-th]].
3. A. Das, N. Iqbal and N. Poovuttikul, "Towards an effective action for chiral magnetohydrodynamics," [arXiv:2212.09787 [hep-th]].
4. I. García Etxebarria and N. Iqbal, "A Goldstone theorem for continuous non-invertible symmetries," [arXiv:2211.09570 [hep-th]].
5. A. Das, R. Gregory and N. Iqbal, "Higher-form symmetries, anomalous magnetohydrodynamics, and holography," [arXiv:2205.03619 [hep-th]].
6. M. Anosova, C. Gattringer, N. Iqbal and T. Sulejmanpasic, "Phase structure of self-dual lattice gauge theories in 4d," JHEP **06**, 149 (2022) [arXiv:2203.14774 [hep-th]].

[1] My contribution involved a representation of black hole hair.

7. N. Iqbal and K. Macfarlane, "Higher-form symmetry breaking and holographic flavour," [arXiv:2107.00373 [hep-th]].

8. N. Iqbal and J. McGreevy, "Mean string field theory: Landau-Ginzburg theory for 1-form symmetries," SciPost Phys. **13**, 114 (2022) [arXiv:2106.12610 [hep-th]].

9. N. Iqbal and S. F. Ross, "Towards traversable wormholes from force-free plasmas," SciPost Phys. **12**, no.3, 086 (2022) [arXiv:2103.01920 [hep-th]].

10. N. Iqbal and N. Poovuttikul, "2-group global symmetries, hydrodynamics and holography," arXiv:2010.00320 [hep-th].

11. N. Iqbal and J. McGreevy, "Toward a 3d Ising model with a weakly-coupled string theory dual," SciPost Phys. **9**, no.2, 019 (2020) [arXiv:2003.04349 [hep-th]]. (Highlighed by Nature Physics).

12. A. Belin, N. Iqbal and J. Kruthoff, "Bulk entanglement entropy for photons and gravitons in AdS_3," SciPost Phys. **8**, no.5, 075 (2020) [arXiv:1912.00024 [hep-th]].

13. N. Iqbal, "Effective description of non-equilibrium currents in cold magnetized plasma," SciPost Phys. **12**, no.2, 078 (2022) [arXiv:1909.12609 [hep-th]].

14. S. E. Gralla and N. Iqbal, "Effective Field Theory of Force-Free Electrodynamics," Phys. Rev. D **99**, no. 10, 105004 (2019) [arXiv:1811.07438 [hep-th]]. (Phys. Rev. D Editors Suggestion).

15. A. Belin, N. Iqbal and S. F. Lokhande, "Bulk entanglement entropy in perturbative excited states," SciPost Phys. **5**, no. 3, 024 (2018) [arXiv:1805.08782 [hep-th]].

16. A. Castro, N. Iqbal and E. Llabres, "Wilson lines and Ishibashi states in AdS_3/CFT_2," JHEP **1809**, 066 (2018) [arXiv:1805.05398 [hep-th]].

17. D. M. Hofman and N. Iqbal, "Goldstone modes and photonization for higher form symmetries," SciPost Phys. **6**, no. 1, 006 (2019) [arXiv:1802.09512 [hep-th]].

18. D. M. Hofman and N. Iqbal,"Generalized global symmetries and holography," SciPost Phys. **4**, no. 1, 005 (2018) [arXiv:1707.08577 [hep-th]].

19. S. Grozdanov, D. M. Hofman and N. Iqbal, "Generalized global symmetries and dissipative magnetohydrodynamics," Phys. Rev. D **95**, no. 9, 096003 (2017) [arXiv:1610.07392 [hep-th]].

20. N. Iqbal, "Entanglement Entropy in Field Theory and Gravity *(lecture notes)*," PoS Modave **2015**, 002 (2016).

21. A. Castro, N. Iqbal and E. Llabres, "Eternal Higher Spin Black Holes: a Thermofield Interpretation," JHEP **1608**, 022 (2016) [arXiv:1602.09057 [hep-th]].

22. A. Castro, D. M. Hofman and N. Iqbal, "Entanglement Entropy in Warped Conformal Field Theories," JHEP **1602**, 033 (2016) [arXiv:1511.00707 [hep-th]].

23. N. Iqbal and A. C. Wall, "Anomalies of the Entanglement Entropy in Chiral Theories," JHEP **1610**, 111 (2016) [arXiv:1509.04325 [hep-th]].

24. D. Engelhardt, B. Freivogel and N. Iqbal, "Electric fields and quantum wormholes," Phys. Rev. D **92**, no. 6, 064050 (2015) [arXiv:1504.06336 [hep-th]].

25. G. T. Horowitz, N. Iqbal, J. E. Santos and B. Way, "Hovering Black Holes from Charged Defects," Class. Quant. Grav. **32**, 105001 (2015) [arXiv:1412.1830 [hep-th]].

26. N. Iqbal, "Monopole correlations in holographically flavored liquids," Phys. Rev. D **91**, 106001 (2015) [arXiv:1409.5467 [hep-th]].

27. A. Castro, S. Detournay, N. Iqbal and E. Perlmutter, "Holographic entanglement entropy and gravitational anomalies," JHEP **1407**, 114 (2014) [arXiv:1405.2792 [hep-th]]

28. O. J. C. Dias, G. T. Horowitz, N. Iqbal and J. E. Santos, "Vortices in holographic superfluids and superconductors as conformal defects," JHEP **1404**, 096 (2014) [arXiv:1311.3673 [hep-th]].

29. G. T. Horowitz, N. Iqbal and J. E. Santos, "A Simple Holographic Model of Nonlinear Conductivity," Phys. Rev. D **88**, 126002 (2013) [arXiv:1309.5088 [hep-th]].

30. T. Faulkner, N. Iqbal, H. Liu, J. McGreevy and D. Vegh, "Charge transport by holographic Fermi surfaces," Phys. Rev. D **88**, 045016 (2013) [arXiv:1306.6396 [hep-th]].

31. M. Ammon, A. Castro and N. Iqbal, "Wilson Lines and Entanglement Entropy in Higher Spin Gravity," JHEP **1310**, 110 (2013) [arXiv:1306.4338 [hep-th]].

32. T. Faulkner and N. Iqbal, "Friedel oscillations and horizon charge in 1D holographic liquids," JHEP **1307**, 060 (2013) [arXiv:1207.4208 [hep-th]].

33. N. Iqbal and H. Liu, "Luttinger's Theorem, Superfluid Vortices, and Holography," Class. Quant. Grav. **29**, 194004 (2012) [arXiv:1112.3671 [hep-th]].

34. N. Iqbal, H. Liu and M. Mezei, "Lectures on holographic non-Fermi liquids and quantum phase transitions," arXiv:1110.3814 [hep-th].

35. N. Iqbal, H. Liu and M. Mezei, "Quantum phase transitions in semilocal quantum liquids," Phys. Rev. D **91**, no. 2, 025024 (2015) [arXiv:1108.0425 [hep-th]].

36. N. Iqbal, H. Liu and M. Mezei, "Semi-local quantum liquids," JHEP **1204**, 086 (2012) [arXiv:1105.4621 [hep-th]].

37. T. Faulkner, N. Iqbal, H. Liu, J. McGreevy and D. Vegh, "Holographic non-Fermi liquid fixed points," Phil. Trans. Roy. Soc. A **369**, 1640 (2011) [arXiv:1101.0597 [hep-th]].

38. D. Anninos, S. A. Hartnoll and N. Iqbal, "Holography and the Coleman-Mermin-Wagner theorem," Phys. Rev. D **82**, 066008 (2010) [arXiv:1005.1973 [hep-th]].

39. T. Faulkner, N. Iqbal, H. Liu, J. McGreevy and D. Vegh, "Strange Metal Transport Realized by Gauge/Gravity Duality," Science **329**, 1043–1047 (2010) [arXiv:1003.1728 [hep-th]].

40. N. Iqbal, H. Liu, M. Mezei and Q. Si, "Quantum phase transitions in holographic models of magnetism and superconductors," Phys. Rev. D **82**, 045002 (2010) [arXiv:1003.0010 [hep-th]].

41. N. Iqbal and H. B. Meyer, "Spatial correlators in strongly coupled plasmas," JHEP **0911**, 029 (2009) [arXiv:0909.0582 [hep-lat]].

42. N. Iqbal and H. Liu, "Real-time response in AdS/CFT with application to spinors," Fortsch. Phys. **57**, 367 (2009) [arXiv:0903.2596 [hep-th]].

43. N. Iqbal and H. Liu, "Universality of the hydrodynamic limit in AdS/CFT and the membrane paradigm," Phys. Rev. D **79**, 025023 (2009) [arXiv:0809.3808 [hep-th]].

44. E. Farhi, N. Graham, A. H. Guth, N. Iqbal, R. R. Rosales and N. Stamatopoulos, "Emergence of Oscillons in an Expanding Background," Phys. Rev. D **77**, 085019 (2008) [arXiv:0712.3034 [hep-th]]