Richard Stiskalek[ORCID], Curriculum Vitae

PROFILE	**Affiliation:** University of Oxford **Email:** richard.stiskalek@physics.ox.ac.uk

Affiliation: University of Oxford   **Email:** richard.stiskalek@physics.ox.ac.uk
NASA ADS: 15 first-author, 13 co-author papers; h-index = 10; citations = 584
Website: richard-sti.github.io

I specialize in Bayesian field-level inference and digital twins of the local Universe to bridge observations and theory. My research combines constrained cosmological simulations, semi-analytic galaxy formation models, simulation-based inference, and machine learning to test galaxy physics, map large-scale flows, and deliver precision measurements of cosmological parameters.

EDUCATION

University of Oxford (Balliol College), DPhil in Astrophysics   2022 – expected 2026
Thesis: "Testing the local Universe with constrained cosmological simulations"
Supervised by *Harry Desmond*, *Julien Devriendt*, and *Adrianne Slyz*

Ludwig-Maximilians-Universität München, M.Sc. in Physics   2020 – 2022
Thesis: "Strong-field lensing of gravitational waves" (partially with Albert Einstein Institute Potsdam)
Supervised by *Miguel Zumalacárregui*, *Marius A. Oancea*, and *Jochen Weller*

Hong Kong University of Science and Technology   2017 – 2018
Undergraduate Exchange Programme in Physics

University of Glasgow, B.Sc. in Physics with Astrophysics   2016 – 2020
Thesis: "Gravitational-wave cosmology"
Supervised by *Martin Hendry*

ACADEMIC APPOINTMENTS

Flatiron Institute, Center for Computational Astrophysics   2025
Pre-Doctoral Fellow (with *Shy Genel* and *Lucia A. Perez*)

Institut d'astrophysique de Paris   2024
Long Term Attachment (with *Guilhem Lavaux*)

Max Planck Institute for Gravitational Physics, Observational Relativity and Cosmology 2020
Summer Research Intern (with *Collin Capano*)

University of Oxford, Sub-department of Astrophysics   2019
Summer Research Intern (with *Harry Desmond*)

University of Glasgow, Institute for Gravitational Research   2018
Summer Research Intern (with *John Veitch* and *Chris Messenger*)

COLLABORATION MEMBERSHIPS

Learning the Universe   2025 –
Simons Foundation collaboration developing next-generation cosmological simulations, machine learning methods, and advanced Bayesian inference for large-scale surveys
Contributions: Training set generation and BORG team

Aquila Consortium   2022 –
International collaboration developing Bayesian field-level inference techniques to reconstruct initial conditions and study large-scale structure formation
Contributions: Leading projects on data generation, benchmarking, large-scale flows and cosmological parameters

TEACHING, MENTORING & SERVICE

Student Supervision

Noah Pierce (BSc, Southampton; with H. Desmond & T. Yasin)   2025 – present
"Field-Level Inference of the Galaxy Luminosity Function"

Joshua Darne (MPhys, Oxford; with T. Yasin & H. Desmond)   2024
"Radial acceleration relation in the NewHorizon hydrodynamical simulation"

Fedir Boreiko (BSc, Manchester; with T. Yasin & H. Desmond)   2024
"The correlation between light and dark matter across cosmic time"

Enoch Ko (BSc, Warwick; with T. Yasin & H. Desmond)   2024
  "Dark matter and galaxy dynamics: enduring puzzles" [arXiv:2508.03569]
Catherine Gallagher (MPhys, Oxford; with T. Yasin & H. Desmond)   2023 – 2024
  "The influence of cosmic environment on galaxy properties" [arXiv:2503.14732]
James Harvey (BSc, Oxford; with T. Yasin & H. Desmond)   2023 – 2024
  "Machine learning the time of last major merger from spectroscopic data"

Teaching Experience

Tutor, *MPhys C1 Astrophysics*, University of Oxford   2023 – 2024
  Graduate tutorials in cosmology and stellar astrophysics
Mentor, *Lumiere Education*   2023 – present
  Supervision of senior high school students carrying out independent research projects
Demonstrator, *3rd-Year Practical Course*, University of Oxford   2023
  Computational astrophysics practical sessions

Academic Service

Referee for *A&A*, *ApJ*, *MNRAS*, *PNAS*, and *PRD*   2022 – present
  Reviewed 15+ manuscripts for leading journals
Coordinator, Aquila Consortium Monthly Telecon   2023 – present
Organiser, "Simulator's Coffee", University of Oxford   2023 – 2024
Local organiser, Aquila Consortium Oxford Meeting   2023
Lead organiser, "Middle of Scotland Science Festival"   2018

SELECTED
AWARDS AND
SCHOLARSHIPS

Snell Exhibition, Balliol College   2022 - 2026
STFC PhD Funding, Science and Technology Facilities Council   2022 - 2026
DAAD Study Scholarship, German Academic Exchange Service   2021 - 2022
Kerr Bursary, University of Glasgow   2020
Lang Scholarship, University of Glasgow   2019
Undergraduate Summer Bursary, Royal Astronomical Society   2018
Dean's List, Hong Kong University of Science and Technology   2018
Astronomy 1 Prize, University of Glasgow   2017
Matthew A Muir Bursary, University of Glasgow   2017
South East Asia Study Abroad Scholarship, University of Glasgow   2017 - 2018

SKILLS

Programming: Python, Julia, C/C++, Fortran; high-performance computing (MPI, GPU acceleration)

Statistics & Machine Learning: Bayesian inference (NumPyro/JAX, PyMC, Stan), simulation-based inference, density estimation; deep learning (MLPs, CNNs, GNNs, normalizing flows) with JAX, TensorFlow, PyTorch; tree-based methods (random forests, gradient boosting) with scikit-learn

Astrophysics Software: RAMSES, AREPO, Gadget, Rockstar, DisPerSe; N-body/hydrodynamical simulation analysis

Languages: English (fluent), Czech (native), Slovak (fluent), French (intermediate), German (beginner)

PUBLICATIONS

First-Author – Submitted

[1] "Enhancing thermal Sunyaev–Zel'dovich analyses with digital twins of the local Universe"; **R. Stiskalek**, H. Desmond [arXiv:2601.15935]

[2] "S_8 from Tully–Fisher, fundamental plane, and supernova distances agree with *Planck*"; **R. Stiskalek** [arXiv:2509.20235]

First-Author – Accepted

[3] "Revisiting the Great Attractor: The Local Group's streamline trajectory, cosmic velocity and dynamical fate"; **R. Stiskalek**, H. Desmond, S. McAlpine, G. Lavaux, J. Jasche, M. J. Hudson [Open Journal of Astrophysics, arXiv:2601.08524]

[4] "1.8 per cent measurement of H_0 from Cepheids alone"; **R. Stiskalek**, H. Desmond, E. Tsaprazi, A. Heavens, G. Lavaux, S. McAlpine, J. Jasche [MNRAS, arXiv:2509.09665]

[5] "No evidence for local H_0 anisotropy from Tully–Fisher or supernova distances"; **R. Stiskalek**, H. Desmond, G. Lavaux [MNRAS 546:staf2048, arXiv:2509.14997]

[6] "The Velocity Field Olympics: Assessing velocity field reconstructions with direct distance tracers"; **R. Stiskalek**, H. Desmond, J. Devriendt, A. Slyz, G. Lavaux, M. Hudson, D. Bartlett, H. Courtois [MNRAS 545:staf1960, arXiv:2502.00121]

[7] "Testing the local supervoid solution to the Hubble tension with direct distance tracers"; **R. Stiskalek**, H. Desmond, I. Banik [MNRAS 543:1556, arXiv:2506.10518]

[8] "Symmetry in Hyper Suprime-Cam galaxy spin directions"; **R. Stiskalek**, H. Desmond [Res. Notes AAS 8 281, arXiv:2410.18884]

[9] "Evaluating the variance of individual halo properties in constrained cosmological simulations"; **R. Stiskalek**, H. Desmond, J. Devriendt, A. Slyz [MNRAS 534:3120, arXiv:2310.20672]

[10] "Probing general relativistic spin-orbit coupling with gravitational waves from hierarchical triple systems"; M. A. Oancea, **R. Stiskalek**, M. Zumalacárregui [MNRAS 535:L1, arXiv:2307.01903]

[11] "On the fundamentality of the radial acceleration relation for late-type galaxy dynamics"; **R. Stiskalek**, H. Desmond [MNRAS 525:6130, arXiv:2305.19978]

[12] "Frequency- and polarization-dependent lensing of gravitational waves in strong gravitational fields"; M. A. Oancea, **R. Stiskalek**, M. Zumalacárregui [Phys. Rev. D 109, 124045, arXiv:2209.06459]

[13] "The scatter in the galaxy–halo connection: a machine learning analysis"; **R. Stiskalek**, D. J. Bartlett, H. Desmond, D. Anbajagane [MNRAS 514:4026, arXiv:2202.14006]

[14] "The dependence of subhalo abundance matching on galaxy photometry and selection criteria"; **R. Stiskalek**, H. Desmond, T. Holvey, M. G. Jones [MNRAS 506:3205, arXiv:2101.02765]

[15] "Are stellar-mass binary black hole mergers isotropically distributed?"; **R. Stiskalek**, J. Veitch, C. Messenger [MNRAS 501:970, arXiv:2003.02919]

Co-Author – Submitted

[1] "Testing cosmic anisotropy with cluster scaling relations"; T. Yasin, **R. Stiskalek**, H. Desmond, S. von Hausegger, P. G. Ferreira [arXiv:2602.06007]

[2] "Constraining cosmological simulations with peculiar velocities: a forward-modelling approach"; A. Valade, N. Libeskind, D. Pomarède, **R. Stiskalek**, Y. Hoffman, S. Gottlöber, R. B. Tully [arXiv:2602.03699]

[3] "Testing subhalo abundance matching with galaxy kinematics"; F. Boreiko, T. Yasin, H. Desmond, **R. Stiskalek**, M. Jarvis [arXiv:2601.07799]

[4] "The subtle statistics of the distance ladder: On the distance prior and selection effects"; H. Desmond, **R. Stiskalek**, J. A. Najera, I. Banik [arXiv:2511.03394]

[5] "MEGATRON: Reproducing the Diversity of High-Redshift Galaxy Spectra with Cosmological Radiation Hydrodynamics Simulations"; H. Katz, . . . , **R. Stiskalek**, . . . [arXiv:2510.05201]

[6] "MEGATRON: how the first stars create an iron metallicity plateau in the smallest dwarf galaxies"; M. Rey, . . . , **R. Stiskalek**, . . . [arXiv:2510.05232]

[7] "MEGATRON: the impact of non-equilibrium effects and local radiation fields on the circumgalactic medium at cosmic noon"; C. Cadiou, . . . , **R. Stiskalek**, . . . [arXiv:2510.05667]

Co-Author – Accepted

[8] "The galaxy-environment connection revealed by constrained simulations"; C. Gallagher, T. Yasin, **R. Stiskalek**, H. Desmond, M. Jarvis [MNRAS:stag108, arXiv:2503.14732]

[9] "Renzo's rule revisited: A statistical study of galaxies baryon–dark matter coupling"; E. Ko,

T. Yasin, H. Desmond, **R. Stiskalek**, M. J. Jarvis [MNRAS 544:4288, arXiv:2508.03569]

[10] "CosmoBench: A Multiscale, Multiview, Multitask Cosmology Benchmark for Geometric Deep Learning"; N. Huang, **R. Stiskalek**, J.-Y. Lee, A. E. Bayer, C. C. Margossian, C. K. Jespersen, L. A. Perez, L. K. Saul, F. Villaescusa-Navarro [NeurIPS 2025, arXiv:2507.03707]

[11] "The Manticore Project I: a digital twin of our cosmic neighbourhood from Bayesian field-level analysis"; S. McAlpine, J. Jasche, M. Ata, G. Lavaux, **R. Stiskalek**, C. S. Frenk, A. Jenkins [MNRAS 540:716, arXiv:2505.10682]

[12] "The CosmoVerse White Paper: Addressing observational tensions in cosmology with systematics and fundamental physics"; Eleonora Di Valentino, ..., **R. Stiskalek**, ... [Physics of the Dark Universe, Volume 49, 2025, 101965, arXiv:2504.01669]

[13] "Inferring the Ionizing Photon Contributions of High-Redshift Galaxies to Reionization with JWST NIRCam Photometry"; N. Choustikov, **R. Stiskalek**, A. Saxena, H. Katz, J. Devriendt, A. Slyz [MNRAS 537:2273, arXiv:2405.09720]

INVITED TALKS

Velocity Field Olympics   **2026**
    Leibniz Institute for Astrophysics Potsdam, Germany

Forward modelling of peculiar velocities and large-scale structure   **2025**
    Institut d'Astrophysique de Paris
Pinning down the local Universe with digital twins
    University of Cambridge
Do SH0ES Cepheids prefer the Planck Hubble constant?
    National Astronomy Meeting, Durham
Towards accurate models and tests of the local Universe
    Columbia University
Towards accurate models and tests of the local Universe
    Princeton University
Towards accurate models and tests of the local Universe
    Center for Computational Astrophysics, Flatiron Institute
Cosmological Rescaling of Merger Trees for Semi-Analytic Galaxy Modelling
    Center for Computational Astrophysics, Flatiron Institute
Velocity Field Olympics
    Center for Computational Astrophysics, Flatiron Institute
Velocity Field Olympics
    Cosmic Flows 2025, Brisbane

Velocity Field Olympics   **2024**
    University of Portsmouth

Search for the optimal dark matter halo density profile   **2023**
    University of Oxford
Is the radial acceleration relation a fundamental correlation?
    University of Oxford

Frequency and polarization dependent propagation of gravitational waves   **2022**
    University of Glasgow
Frequency and polarization dependent propagation of gravitational waves
    LMU Munich
Frequency and polarization dependent propagation of gravitational waves
    Max Planck Institute for Gravitational Physics, Potsdam
The scatter in the galaxy–halo connection
    Baryon Pasters Collaboration meeting

The scatter in the galaxy–halo connection   **2021**
    LMU Munich

Reversible-jump MCMC in gravitational-wave astronomy   **2020**
    Max Planck Institute for Gravitational Physics, Hannover
Are binary-black hole mergers isotropically distributed?