

Matthew Kirk

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Current Position

Postdoctoral Research Associate – IPPP, Durham University, United Kingdom

Research Interests

- Precision calculations of B physics observables
- Explaining anomalies through simplified model building and EFT approaches
- Use of open source software to efficiently conduct global fits

Employment and Education

- 2022-2023: María Zambrano postdoctoral research fellow – ICCUB, Universitat de Barcelona, Spain
- 2021-2022: Postdoctoral researcher – ICCUB, Universitat de Barcelona, Spain
- 2018-2021: Postdoctoral researcher – Università di Roma “La Sapienza”, Italy
- 2014-2018: PhD – IPPP, Durham University, UK, supervised by Alexander Lenz. My PhD thesis was awarded the Springer Thesis Prize in 2019, and subsequently published as a book.
- 2010-2014: MSci, BA in Natural Sciences (Physics) – King's College, University of Cambridge, UK

Publications & Talks

Articles

Diquark explanation of $b \rightarrow s\ell + \ell^-$

Andreas Crivellin, Matthew Kirk

Phys. Rev. D **108** (2023) L111701 (arXiv:2309.07205)

Cabibbo angle anomalies and a global fit to vector-like quarks

Matthew Kirk

PoS(FPCP2023)059 (arXiv:2308.09669)

A ν window onto leptoquarks?

Matthew Kirk, Shohei Okawa, Keyun Wu

JHEP **12** (2023) 093 (arXiv:2307.11152)

$Y=0$ Scalar Triplet Beyond the W Mass: $(g-2)\mu$, $h \rightarrow \mu\mu$, and CKM Unitarity

Andreas Crivellin, Matthew Kirk, Anil Thapa

Phys.Rev.D **108** (2023) L031702 (arXiv:2305.03081)

Global fit of modified quark couplings to EW gauge bosons and vector-like quarks in light of the Cabibbo angle anomaly

Andreas Crivellin, Matthew Kirk, Teppei Kitahara, Federico Mescia
JHEP 03 (2023) 234 (arXiv:2212.06862)

Large $t \rightarrow cZ$ as a sign of vectorlike quarks in light of the W Mass

Andreas Crivellin, Matthew Kirk, Teppei Kitahara, Federico Mescia
Phys.Rev.D 106 (2022) L031704 (arXiv:2204.05962)

Unveiling Hidden Physics at the LHC

Oliver Fisher et. al.

arXiv:2109.06065 (White paper including input from the workshop "Unveiling Hidden Physics Beyond the Standard Model at the LHC")

First-generation new physics in simplified models: from low-energy parity violation to the LHC

Andreas Crivellin, Martin Hoferichter, Matthew Kirk, Claudio Andrea Manzari, Luc Schnell
JHEP 10 (2021) 221 (arXiv:2107.13569)

Cabibbo anomaly versus electroweak precision tests: An exploration of extensions of the Standard Model

Matthew Kirk

Phys.Rev.D 103 (2021) 3, 035004 (arXiv:2008.03261)

Anomalies and accidental symmetries: charging the scalar leptoquark under $L\mu-L\tau$

Joe Davighi, Matthew Kirk, Marco Nardecchia

JHEP 12 (2020) 111 (arXiv:2007.15016)

Vcb and gamma from B-mixing

Daniel King, Matthew Kirk, Alexander Lenz, Thomas Rauh

JHEP 3 (2020) 112 (arXiv:1911.07856)

Charming New B-Physics

Sebastian Jäger, Kirsten Leslie, Matthew Kirk, Alexander Lenz

JHEP 3 (2020) 122 (arXiv:1910.12924)

ΔM_s theory precision confronts flavour anomalies

Luca Di Luzio, Matthew Kirk, Alexander Lenz, Thomas Rauh

JHEP 12 (2019) 009 (arXiv:1909.11087)

Updated Bs-mixing constraints on new physics models for $b \rightarrow s\ell + \ell^-$ anomalies

Luca Di Luzio, Matthew Kirk, Alexander Lenz

Phys.Rev.D 97 (2018) 9, 095035 (arXiv:1712.06572)

Dimension-six matrix elements for meson mixing and lifetimes from sum rules

Matthew Kirk, Alexander Lenz, Thomas Rauh

JHEP 12 (2017) 068 (arXiv:1711.02100)

Charming Dark Matter

Thomas Jubb, Matthew Kirk, Alexander Lenz

JHEP 12 (2017) 010 (arXiv:1709.01930)

Charming new physics in rare B-decays and mixing?

Sebastian Jäger, Kirsten Leslie, Matthew Kirk, Alexander Lenz

Phys.Rev.D 97 (2018) 1, 015021 (arXiv:1701.09183)

On the ultimate precision of meson mixing observables

Thomas Jubb, Matthew Kirk, Alexander Lenz, Gilberto Tetlalmatzi-Xolocotzi

Nucl.Phys.B 915 (2017) 431-453 (arXiv:1603.07770)

Talks

Leptoquarks without leptons – a new scalar for the universal $b \rightarrow sll$ anomalies – Seminar at Siegen (Dec 2023)

A global fit at 1-loop the easy way - VLQs for BSM – Invited talk at “EFT Foundations and Tools” workshop, MITP Mainz (Sep 2023)

The Cabibbo Angle Anomaly and a global fit to vector-like quarks – Talk at “FPCP 2023” conference, Lyon (May 2023)

The Cabibbo Angle Anomaly and potential BSM explanations – Invited talk at “Beyond the Flavour Anomalies IV” workshop, Barcelona (Apr 2023)

Vector-like Leptons – Invited talk at "Electroweak Precision Physics from Beta Decays to the Z Pole" workshop, MITP (Oct 2022)

Vector-like quarks for $t \rightarrow cZ$, B physics, and MW with automated 1-loop matching – Seminar at La Sapienza (Jun 2022)

Review of New Physics in non-leptonic tree level B meson decays – Invited talk at "Status and Prospects of Non-leptonic B meson decays" conference, Siegen (Jun 2022)

CP violation in flavour anomaly models – Invited talk at "Heavy Quarks and Leptons" conference, Warwick (Sep 2021)

Cabibbo Angle Anomaly – Invited talk at "Anomalies and Precision in the Belle II Era" workshop, Vienna (Sep 2021)

Charging a leptoquark under $L\mu-L\tau$ - Seminar at Siegen (June 2020)

Anomalies vs Mixing and CPV - Invited talk at "Beyond the Flavour Anomalies" workshop, IPPP (Apr 2020)

BSM in Charming operators? - Seminar at Nikhef (Feb 2020)

Interplay between Δ Ms and flavour anomalies - Talk at "bsll 2019" conference, Lyon (Sep 2019)

Hints of new physics in flavour anomalies - Invited talk at "7th Rome Joint Workshop", Frascati (Dec 2018)

What Mixing and Lifetimes can tell us about NP - Invited talk at "LHCb Implications", CERN (Oct 2018)

Constraints on new physics from the latest results in meson mixing - “From Flavour to New Physics” conference, Lyon (April 2018)

Future of CP violation in asl - “Towards the Ultimate Precision in Flavour Physics” workshop, Warwick (April 2018)

Meson mixing and lifetimes – LHCb-UK annual meeting, Glasgow (January 2018)

What is the ultimate precision of meson mixing variables? – “Heavy Flavour 2016 – Quo Vadis?” workshop, Islay, Scotland (July 2016)

Charming Dark Matter – YTF 8, IPPP (January 2016)

Combining dark matter and charm bounds – LHCb-UK annual meeting, Liverpool (January 2016)

Poster Presentations

Charming Dark Matter – UK HEP Forum, Abingdon (November 2015)

Looking forward to new lattice inputs for flavour phenomenology – “Lattice 2016” conference, Southampton (July 2016)

Scientific Activities

- Theory convener for the "Mixing and CP violation in Beauty and Charm" stream at the "Implications of LHCb measurements and future prospects" workshop in 2019 and 2022
- Peer referee for JHEP, EPJC and PRD journals (2022 – present)
- IPPP (and previously ICCUB) seminar organiser

Supervisory and Teaching Activities

- 2023-2024: Foundations of Physics 1 (1st year undergraduate course) – group tutorial supervisor, weekly homework marking
- 2022: Co-supervisor (with Professor Federico Mescia) of undergraduate thesis on perturbative unitarity bounds on new physics.
- 2017–2018: Introduction to Programming in Python (1st year undergraduate course) – examples class demonstrating, project marking.
- 2016–2017: Computational Physics (2nd year undergraduate course) – examples class demonstrating.
- 2015–2016: Mathematics Workshop (3rd year undergraduate course) – problem class demonstrating.
- 2014–2015: Mathematical Methods in Physics (2nd year undergraduate course) – problem class demonstrating, exam marking.

Outreach

- August 2018: Chi ha ordinato quel?
Talk to postgraduate students at Grey College, Durham University as condition of "Grey College Trust Student Experience" funding award.
- February 2018: Phenomenology: Not Just a Long Word
Talk to postgraduate students at Grey College, Durham University as part of postgraduate academic programme.
- July 2017: Modelling the Invisible (Royal Society Summer Science Exhibition)
The Summer Science Exhibition is a week long event at the Royal Society in London each year, with approximately 14000 visitors total, and 20 exhibitors. I was involved with the preparation of the exhibition pieces, publicising our stand through a blog post by the Raspberry Pi Foundation, and engaging with the public over four days at the exhibit.
- April 2017: Durham University Supported Progression tutorial supervisor
Program to support school students from the local area into university, including small group tutorials with university style problems, with reduced entry requirements for participants.
- October 2016: Dark Matter – A Particle Physicist's Perspective
Talk to postgraduate students at Grey College, Durham University as part of postgraduate academic programme.
- August 2016: Sutton Trust Summer School tutorial supervisor
The Sutton Trust organises summer schools for school students from disadvantaged backgrounds, which include small group tutorials .
- June 2016: What don't we know?
Talk to postgraduate students at Grey College, Durham University as part of postgraduate academic programme.
- August 2015: Sutton Trust Summer School tutorial and poster project supervisor
The Sutton Trust organises summer schools for school students from disadvantaged backgrounds, which include small group tutorials and poster creation and presentation sessions.
- Summer 2012: Raspberry Pi (Undergraduate Research Program, Computer Science Department, University of Cambridge)
10 week project to produce materials for students and the general public, following the

launch of the Raspberry Pi earlier that year, and working with several of the founders of the Raspberry Pi Foundation.