

UKLFT Annual Meeting 2026

Report of Contributions

Contribution ID: 25

Type: **not specified**

Flavour Physics on the Lattice

Wednesday, 25 March 2026 13:00 (35 minutes)

Flavour physics is an important area of phenomenology for performing tests of the Standard Model and searching for new physics using the rich category of decays available. These pursuits require high-precision theoretical predictions to compare to experiment, where lattice QCD has been instrumental in driving the precision of many processes. I will first give a short overview of the contributions of lattice QCD to the broader flavour physics programme, before focusing on an area of phenomenology that has as of yet received little attention from the lattice community: the lifetimes of heavy mesons.

The Heavy Quark Expansion is the framework through which such predictions can be made, describing an operator product expansion of $\Delta Q = 0$ operators of increasing mass dimension. The dimension-six $\Delta Q = 0$ four-quark operators are particularly interesting as they contribute the leading uncertainties to lifetime ratios such as $\tau(B_s)/\tau(B^0)$ and are rather similar to the $\Delta Q = 2$ four-quark operators describing neutral meson mixing which are well established on the lattice. However, the $\Delta Q = 0$ operators introduce power-divergent operator mixing under renormalisation and thus new techniques are required. I will introduce the gradient flow and its short-flow-time expansion as a renormalisation and matching strategy for $\Delta Q = 0$ four-quark operators, and show results for the operator matrix elements contributing to the lifetime ratio $\tau(D_s)/\tau(D^0)$ as an important first towards better predictions for B mesons.

Author: BLACK, Matthew (University of Edinburgh)

Presenter: BLACK, Matthew (University of Edinburgh)

Session Classification: Session 1

Contribution ID: 26

Type: **not specified**

TBD

Wednesday, 25 March 2026 13:35 (35 minutes)

Author: HANSEN, Max (Edinburgh)

Presenter: HANSEN, Max (Edinburgh)

Session Classification: Session 1

Contribution ID: 27

Type: **not specified**

Variance reduction for inclusive semileptonic decays on the lattice

Wednesday, 25 March 2026 14:10 (25 minutes)

We discuss the calculation of the inclusive semileptonic decay for the process $B_s \rightarrow X_c l \nu_l$ using lattice QCD. Such a calculation could be decisive in understanding the CKM matrix puzzle: the long-standing tension between inclusive and exclusive determinations of the CKM matrix element, $|V_{cb}|$. A key quantity in these inclusive decays is the four-point correlation function. In this talk we investigate the calculation of such four-point functions and show that by computing the four-point function in a specific way on the lattice the statistical error of the signal can be significantly reduced without a significant increase in computational cost. In addition, we explore the systematic effects of this new four-point function calculation under varying parameters of the four-point function. We show results based on Chebyshev reconstruction techniques, which are part of a larger effort towards a first phenomenologically relevant computation of the inclusive decay rate in the continuum and infinite-volume limits.

Author: ELGAZIARI, Ahmed (University of Southampton)

Presenter: ELGAZIARI, Ahmed (University of Southampton)

Session Classification: Session 1

Contribution ID: 28

Type: **not specified**

Topological structure of Abelian monopole current networks & deconfinement in QCD

Wednesday, 25 March 2026 14:35 (25 minutes)

Recent numerical results have provided evidence for a conjectured regime of finite temperature QCD where chiral symmetry remains unbroken but the system still confines. Moreover, it has been shown that observables constructed from non-perturbative excitations of the Yang-Mills vacuum, namely monopoles and vortices, can be highly sensitive to the deconfinement transition in pure Yang-Mills.

In this talk, we apply methods from topological data analysis (TDA), a field combining algebraic topology and data science, to extract features of Abelian monopoles from finite temperature SU(3) and QCD configurations. In particular, we investigate monopole currents across the deconfinement transition extracted from configurations using a maximally Abelian projection. We introduce novel observables, referred to as the complexity and simplicity, that characterise the topology of current networks and study their behaviour as a function of temperature. In the pure theory, we demonstrate that they precisely capture the quantitative features of the deconfinement phase transition. We then comment on the effectiveness of these observables at delineating the phase structure of the theory in the presence of dynamical fermions.

Author: Mr CREAN, Xavier (Swansea University)

Presenter: Mr CREAN, Xavier (Swansea University)

Session Classification: Session 1

Contribution ID: 29

Type: **not specified**

Center vortices and Coulomb phase

Wednesday, 25 March 2026 15:30 (35 minutes)

Center vortices are often portrayed as objects which cause confinement. I will demonstrate that this is not necessarily true, and that they play a central role in causing a photon to emerge.

Author: SULEJMANPASIC, Tin

Presenter: SULEJMANPASIC, Tin

Session Classification: Session 2

Contribution ID: 30

Type: **not specified**

Hamiltonian Truncation

Wednesday, 25 March 2026 16:05 (35 minutes)

Hamiltonian Truncation provides a non-perturbative approach to quantum field theory in which one starts from a solvable theory, constructs its Hilbert space, and restricts to a finite-dimensional subspace of states below an energy cutoff E_{\max} . Within this truncated space, the target Hamiltonian is approximated and studied. In this talk I will introduce this framework (distinguishing it from related uses of the term) and give a selective overview of several active directions. I will discuss the construction of effective Hamiltonians and the treatment of UV divergences, recent progress in applying these ideas to gauge theories (including exploratory work on chiral gauge theories), and emerging connections to quantum computing, where truncated Hilbert spaces offer a natural setting for simulating quantum field dynamics.

Author: INGOLDBY, James (Durham (IPPP))

Presenter: INGOLDBY, James (Durham (IPPP))

Session Classification: Session 2

Contribution ID: 31

Type: **not specified**

Non-Compact Variable Formalism for Quantum Simulations of Lattice Gauge Theories

Thursday, 26 March 2026 09:00 (35 minutes)

Simulating lattice gauge theories on quantum computers presents unique challenges driving the development of novel theoretical frameworks. The orbifold lattice formulation offers a scalable framework for quantum simulations of lattice gauge theories. The corresponding quantum circuits can be constructed explicitly, and the computational cost grows polynomially with the number of qubits. Preliminary Monte Carlo simulations show that the orbifold lattice for $SU(2)$ in $(2+1)$ dimensions reproduces the Kogut–Susskind formulation in the limit of large scalar mass.

Author: MENDICELLI, Emanuele (University of Liverpool (United Kingdom))

Presenter: MENDICELLI, Emanuele (University of Liverpool (United Kingdom))

Session Classification: Session 3

Contribution ID: 32

Type: **not specified**

Quantum Algorithm for QED

Thursday, 26 March 2026 09:35 (35 minutes)

The general simulation of Quantum Field Theory scales exponentially with the spatial volume, which makes the sizable computation possible only through the quantum computer. The standard quantum algorithm for the scalar field theory has long been developed, where the scalar field is simple enough to admit an obviously optimal qubit approximation to the continuum theory. When extending to the gauge theory, we are confronted with more constraints and limits. Here we present a standard qubit approach for the Quantum Electrodynamics, an Abelian gauge field theory in 3+1 dimension. The extra constraint, the Gauss's law, is dissolved by the fact that when the implementation is completely gauge invariant, the Gauss's law will be satisfied automatically. In light of this, the exact gauge transformation is enabled only by the gauge link, so the approach is also in the shape of the Wilson or Kogut-Susskind lattice theory. We have set up both 2+1 and 3+1 dimensional lattices, and tested out the codes on IBM quantum platforms. In the framework, we have also investigated the quantum error mitigation methods and found that in comparison to the post-selection method, the calibration method works better in the situation.

Author: MOU, Zong-Gang (University of Southampton)

Presenter: MOU, Zong-Gang (University of Southampton)

Session Classification: Session 3

Contribution ID: 33

Type: **not specified**

Higgs-like phase transitions, nonperturbatively

Thursday, 26 March 2026 10:10 (35 minutes)

In the study of cosmological phase transitions, even apparently weakly coupled theories develop strongly coupled sectors. For static equilibrium quantities, lattice and effective field theory methods have been developed to tackle this which are able to yield unambiguously correct results up to small errors. For real-time quantities, the problem is more complicated. In this talk, I will review approaches to using lattice simulations for studying real-time bubble dynamics.

Author: Dr GOULD, Oliver (University of Nottingham)

Presenter: Dr GOULD, Oliver (University of Nottingham)

Session Classification: Session 3

Contribution ID: 34

Type: **not specified**

Sp(4) gauge theories for Higgs compositeness

Thursday, 26 March 2026 11:15 (35 minutes)

Non-supersymmetric strongly interacting gauge theories can provide ultraviolet completions of the Higgs sector of the Standard Model that address several outstanding problems at the energy frontier of particle physics: the absence of new particle discoveries across a wide energy range above the electroweak scale, the proximity of the top quark mass to the electroweak scale, and the nature of dark matter. The Sp(4) gauge theory with two degenerate fermion flavours in the fundamental representation and three in the antisymmetric representation offers a comparatively minimal template for Higgs compositeness and top partial compositeness arising from a beyond-the-Standard-Model strong interaction. I will present recent lattice results for this model and for its restriction to phenomenologically relevant sectors, at both zero and finite temperature. I will emphasise methodological advances alongside implications for the viability of Higgs compositeness, with discussion of potential connections to dark matter and to the prospect of detecting a primordial gravitational wave spectrum sourced by early-universe phase transitions.

Author: LUCINI, Biagio (Queen Mary University of London (UK))

Presenter: LUCINI, Biagio (Queen Mary University of London (UK))

Session Classification: Season 4

Contribution ID: 35

Type: **not specified**

TBD

Thursday, 26 March 2026 11:50 (35 minutes)

Author: WILKINSON, Mark

Presenter: WILKINSON, Mark

Session Classification: Season 4

Contribution ID: 36

Type: **not specified**

Research Software Engineering in Lattice

Thursday, 26 March 2026 12:25 (35 minutes)

As a fully computational discipline, the quality of lattice research depends heavily on the quality of its underpinning software—including the correctness of the implementation, the ease of modification, and the speed at which it can generate results. All of these aspects can be improved both by the involvement of dedicated Research Software Engineers, and by the application of Research Software Engineering techniques. In this talk I will outline some aspects of both, including an overview of current ways of incorporating them into research, and some suggestions for effectively incorporating them into research projects.

Author: BENNETT, Ed (Swansea University)

Presenter: BENNETT, Ed (Swansea University)

Session Classification: Season 4