AGQ STUDENT CONFERENCE 2026

Algebra Geometry & Quantum Fields

PostDoc Talks

MON 14:00

Einstein 4-Manifolds and Special Geometry

Dr. Bernardo Araneda (UoE)

Einstein manifolds are one of the fundamental objects of study in Riemannian geometry. The 4-dimensional case is particularly rich due to the existence of unique phenomena. We will review this subject with emphasis on open problems, recent developments, and the role of these spaces in twistor theory and quantum gravity.

MON 15:30



Finite Quotients and Profinite Rigidity of Spherical Type Artin Group

Dr. Federica Gavazzi (HWU)

A nice and convenient way to understand a group is by looking at its finite quotients. This "profinite" approach, under some assumptions, can help us distinguish some groups up to isomorphism. A widely studied class of groups for which the isomorphism and rigidity questions are particularly interesting is the one of Artin groups, introduced in the sixties by Jacques Tits. After giving some preliminaries about profinite completions of groups and Artin groups, I will talk about smallest finite quotients and profinite rigidity of irreducible spherical type Artin groups. This is a joint work with Igor Haladjian and Luis Paris.

TUE 10:00



Hecke Algebras and Some of their Habitat

Dr. Stefan Dawydiak (UofG)

Representation theory is the study of group actions on vector spaces. For the last hundred years it is had many applications, notably in physics and in number theory. Especially in the latter case, the vector spaces in question are usually infinite-dimensional. A zoo of algebras, going by the umbrella name of Hecke algebras, has been cultivated to help reduce infinite-dimensional representations to finite-dimensional ones, but are also natural objects of study in and of themselves. I will give a tour of the Hecke algebras related to representations of p-adic groups, some of what their appearance in this context can tell us about them, and some of what they can do for us.

AGQ STUDENT CONFERENCE 2026

Algebra Geometry & Quantum Fields

PhD Talks

MON 10:00



A Milnor-Schwarz Lemma for Inverse Monoids

Francesco Tesolin (HWU)

Where groups can be thought of as sets of symmetries, an inverse semigroup is a set of partial symmetries, that is, each element has a "local" inverse such that their composition produces an idempotent element. The Cayley graph of a finitely generated inverse semigroup has the structure of a presheaf of metric spaces. We describe a generalisation of the Milnor-Schwarz lemma, such that if an inverse monoid acts properly and coboundedly on a presheaf of metric spaces, its Cayley graph is quasi-isometric to that presheaf.

MON 10:50



Cobordism and Concordance of Surfaces in 4-Manifolds

Simi Hellsten (UofG)

Cobordism and concordances are two important equivalence relations on compact surfaces properly embedded in 4-manifolds. Despite having very similar topological definitions, they have very different flavours: cobordism is simple and algebraic, while concordance is delicate and geometric. In this talk, I will discuss both notions, survey the current classification results, and explain why such similar definitions yield such different behaviours.

TUE 11:05

Cosmological Perturbation Theory and the Bondi-Sachs Formalism

Vijay Nenmeli (UoE)

The Bondi-Sachs formalism is a key tool for handling asymptotically flat spacetimes, which model the gravitational physics of localised objects. First introduced as an attempt to precisely quantify the loss of mass and angular momentum by gravitational radiation, the formalism has seen several successes, both new and old, and has been instrumental in understanding subtle aspects of low-energy or soft physics in these spacetimes. Recently, a few attempts have been made to replicate these successes for a different class of spacetimes - those that are asymptotically Friedmann-Robertson-Walker (AFRW). These spacetimes model the physics of our early universe between the inflationary epoch and the present-day dark energy-dominated era. However, it is becoming clear that they are sufficiently complex to warrant some tweaks to the traditional Bondi-Sachs framework. Specifically, the standard radial expansions that drive this formalism are generally incapable of yielding non-trivial mass and angular momentum aspects. While modifications that address this issue have been proposed, the exact nature of the resulting radial expansions remains unclear. In this talk, I will first provide a gentle introduction to relevant aspects of the Bondi—Sachs formalism and its proposed extensions to AFRW spacetimes. I will then present new results from ongoing work which uses tools from cosmological perturbation theory to construct concrete realisations of AFRW spacetimes at linear order in Newton's constant. These provide good examples of the non-trivial radial expansions expected of AFRW spacetimes and allow us to clarify several features thereof. Time permitting, I will outline how the mass and angular momentum of such spacetimes can be read off from these modified expansions.

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Algebra Geometry & Quantum Fields

Breakout Session – Algebra Room

MON 12:00



Tangent Bundles for Categories of Algebras

Lucy Spouncer (UoE)

Infinity categories admit a tangent bundle construction, which allows us to define cohomology groups on their objects. Cohomology groups for algebras can be computed using the cohomology of the associated operads (algebraic theories). I will talk about particularly nice categories of operads and their tangent categories that can be described as (categorified) polynomial rings.

MON 12:30



Marked Tableaux and Lie Superalgebras

Willoughby Seago (UofG)

The representation theory of many Lie-theoretic objects is controlled by semistandard tableaux. I will discuss a generalisation of these which appears in the context of Lie superalgebras, and their associated quantum groups. I will make use of a lattice model, a modification of the six vertex model, inspired by statistical mechanics.

MON 16:45



E2-Algebras from Families of Algebras

Jakub Hampl (University of Aberdeen)

Given a family of algebras A_n that has nice inclusions $A_n \to A_{n+1}$ and that receives homomorphisms from the group algebras of the braid groups, and given families of modules over these algebras, there is a way to assemble this data into the structure of an E2-algebra. The goal of this talk is to explain the above construction and show how it is related to a recent paper of Guy Boyd, Rachael Boyde, Oscar Randal-Williams, and Robin Sroka on the homology of the Temperley-Lieb algebra.

TUE 15:00



How often is $x^2+y^2+z^2$ prime?

Alistair Severn (UofG)

The prime number theorem is one of the most famous results in Number Theory. It says that there are approximately x/(log x) primes of size less than x. An extension to this is the Siegel-Walfisz theorem, which says that for every pair of coprime integers (a,b), the number of primes p of the form p=an+b with p<x is approximately C x/(log x), where C=1/phi(a) - (phi denotes the Euler totient function). A natural generalisation of these types of results would be to ask, for some irreducible polynomial f with integer coefficients, "how often" f(n) is prime, as n varies amongst all integers of size < x. Bateman and Horn conjectured a general asymptotic formula - and the prediction in the special case of $f(n)=n^2+1$ can be found on the side of the Glasgow maths building. The linear case is exactly given by the Siegel-Walfisz theorem, but in contrast, there are no polynomials of degree >1 for which asymptotics are known! Recently, a great deal of work has been done on studying the generalisation to multivariate polynomials. I will present my recent results which resolve the Bateman-Horn conjecture for all positive definite integral ternary quadratic forms.

TUE 15:30



Epimorphisms of Monoids

Isky Mathews (UoE)

Monoid objects can be considered in any monoidal category, with the most famous examples being monoids, rings and monads. Monomorphisms between them are easy to characterise but epimorphisms are much harder (e.g. the inclusion of Z → Q is an epimorphism of rings); I'll survey something of what is known about it and some preliminary further results in collaboration with Adrián Doña Mateo.

AGQ STUDENT CONFERENCE 2026

Algebra Geometry & Quantum Fields

Breakout Session – Geometry Room

MON 12:00



Non-Planarity of Morse Boundaries

Talia Shlomovich (HWU)

What do planar and non-planar graphs have to do with boundaries of groups? In this talk, we will explore this topic through a brief review of the existing literature as well as worked examples. Of particular interest is the Morse boundary, which roughly describes the boundary as a set of Morse geodesics. These can loosely be thought of as "hyperbolic directions" in non-hyperbolic spaces. We also discuss some obstructions: although non-planar boundaries are common among hyperbolic groups, it can be surprisingly difficult to construct them.

MON 12:30



Lamplighter Random Walks on Cayley Graphs

Ujan Chakraborty (UofG)

Consider a Cayley graph of a group, and a lamp at every vertex on the graph. If a lamplighter executes a random walk on this graph, toggling the configuration of every new lamp they arrive at, which patterns of lit/unlit lamps are guaranteed to occur, given enough time? We demonstrate finite-time switching algorithms for arbitrary local patterns scaling with the size for certain graphs, which prove that such patterns are guaranteed to occur almost surely in finite time. This is ongoing joint work with Cameron Wilson.

MON 16:45



Categorical Resolutions and Simple Normal Crossing Varieties

Brais Gerpe Vilas (University of Sheffield)

Categorical resolutions were introduced by Kuznetsov as a way of extending the theory of resolutions of singularities to the context of derived categories. The original motivation was that, although minimal resolutions do not always exist in the geometric setting, the categorical framework offers greater flexibility and could provide the appropriate language for understanding this property. In this context, various notions of crepancy have been introduced to capture, at the categorical level, aspects of the notion of minimality. In this talk, we will introduce the theory of categorical resolutions and discuss some of their properties. Finally, we will present some results obtained for simple normal crossing singularities. This is based on a joint work with Georgii Shuklin.

TUE 15:00



Symplectic Embeddings and Infinite Staircases

João Camarneiro (UoE)

In symplectic geometry there is a mysterious and intricate balance between rigidity and flexibility. In this talk I will showcase this phenomenon through various examples (all in dimension 4): Gromov's non-squeezing theorem, symplectic ball packings, and "staircases" of ellipsoid embeddings. If time allows, I will mention my results on classification of infinite staircases for embeddings of ellipsoids into polydiscs.

TUE 15:30



Almost Simple Subgroups of the Space Cremona Group

Sebastián Fuentes (UoE)

In this talk we present a classification of finite almost simple subgroups of the complex Cremona group of rank 3, that is, the group of birational automorphisms of three-dimensional complex projective space. More precisely, we show that every such subgroup is isomorphic to one of S5, S6, PGL(2,7), or PGL(2,9). We also discuss the uniqueness, up to conjugacy, of the groups PGL(2,7) and PGL(2,9).

AGQ STUDENT CONFERENCE 2026

Algebra Geometry & Quantum Fields

Breakout Session – Quantum Fields Room

MON 12:00



Shape Modes of Critically Coupled Vortices

Nora Gavrea (University of Leeds)

In this talk, I will discuss global minimizers of Yang–Mills–Higgs functionals with gauge group U(1), where the Higgs field takes values in a Kähler manifold equipped with a Hamiltonian U(1) action. At critical coupling these models admit topological solitons called BPS vortices, which solve a system of first-order PDEs, the Bogomolny equations, and saturate a topological lower bound on the energy. The best-known example, with target the complex plane, is the Abelian-Higgs model. I will then describe some geometric and spectral properties of the Jacobi operator, the second-order differential operator associated with the second variation of the energy functional. On a non-compact domain, such as R^2, it is a nontrivial question whether the Jacobi operator has any L^2-normalisable eigenfunctions. Such eigenfunctions are called shape modes, and, if present, they strongly influence the low-energy scattering of vortices. When the target is compact, we prove that all vortices have at least one shape mode, and that such shape modes can be constructed by solving a simple scalar Schrödinger PDE. This is based on joint work with Derek Harland and Martin Speight.

MON 12:30



Edge Modes in Gauge Theories: an Algebraic Perspective

Avinandan Mondal (University of York)

Boundaries of manifolds change the role of gauge transformations: transformations with nontrivial boundary action, the so-called "large gauge transformations", need not generate degeneracies of the presymplectic form. Such transformations can therefore survive gauge reduction as physical symmetries, revealing boundary degrees of freedom commonly called edge modes. By introducing suitable auxiliary surface fields, one can construct an extended theory in which the combined large gauge transformations generate degenerate directions of the presymplectic form. Using electromagnetism on spacetime regions with boundaries and corners as a concrete example, I will introduce edge modes through the covariant phase space formalism and explain their quantisation within the framework of algebraic quantum field theory. I will also briefly outline how auxiliary surface fields can serve as quantum reference frames, allowing boundary-sensitive observables to be dressed into invariant joint observables. This discussion will be based primarily on the work of Fewster, Janssen and Rejzner (arXiv:2508.20939). I will conclude with current work with Christopher Fewster and Kasia Rejzner on extending this framework to linearized gravity, focusing on a Moncrief-type bulk–boundary decomposition of the classical phase space and the remaining analytic questions, followed by a brief outlook on future directions.

MON 16:45



Gravitational Instantons

Alfie Jones (UoE)

Loosely speaking, a gravitational instanton is a solution to the Einstein equations in Riemannian signature. In this talk, I will introduce gravitational instantons and survey the breakdown of the Euclidean no-hair conjecture, from the explicit Chen–Teo counterexample to the infinite family found by Li and Sun.

TUE 15:00



Bow Varieties and the Geometry of Bad QFTs

Kuba Krawczyk (University of Sheffield)

While the Higgs and Coulomb branches of 3d N=4 theories are central to understanding strongly coupled IR dynamics, standard approaches often focus solely on the affine chiral rings of the deep IR SCFTs. In this talk, I will formulate a broader physics-geometry dictionary rooted at the level of the NLSMs, enabling a uniform geometric treatment of both "good" and "bad" quiver theories. I will illustrate this dictionary by introducing "bow theories" - a class of 3d theories generalizing quivers that is naturally closed under 3d mirror symmetry and whose moduli spaces are modelled by bow varieties. I will apply the theory to some known theories, including "bad SQCD".

TUE 15:30

The conformally flat limit of Quadratic Gravity

Maegan Anderson (UoE)

Quadratic gravity is one of a few known renormalisable theories of quantum gravity. It also enjoys asymptotic freedom, and hence is possibly UV complete, but many questions remain about its consistency. I will discuss some recent results, in which we have been studying a conformally flat limit of the theory, where the tensor and vector modes decouple and the only dynamical degree of freedom is a perfect-square scalar theory. We find that, in this limit, asymptotic freedom becomes clear since the beta function matches that of a complex scalar field with a negative quartic coupling. Moreover, we show the theory avoids the usual Euclidean IR divergences that typically plague higher-derivative systems due to its shift invariance, and its unitary behaviour appears unexpectedly well-controlled at tree level. By the end of this talk I hope to comment on how much we can expect these properties to survive beyond the conformally flat sector, and what this approach can teach us about full quadratic gravity.