Plenary Talks

Alex Bond (Natural History Museum, Tring).
Is there hope? Lessons from 20 years of understanding the impacts of plastic pollution on wildlife

Priya Silverstein (University of Coimbra).
Replication, Open Research, and Queering Science

Contributed Talk Titles and Abstracts

Dori Grijseels (Max Planck Institute for Neurobiology of Behavior).
Mole-rat chit-chat: the role of vocal communication in African mole-rats

Vocal communication is crucial for survival in social animals, as it allows animals to convey information over long ranges. Multiple species of African mole-rats (Bathyergidae) are known for their social lifestyles. Previous work describing vocal repertoires consisting of a large number of distinct vocalization types, lead to the hypothesis that their social behavior might be organised through vocal communication.

To test this hypothesis, we analysed the vocalizations of two African mole-rat species: Fukomys anselli and Fukomys micklemi. Using a large dataset of over 25k vocalizations recorded from 25 social groups, we first show that the vocal repertoires of these species are graded, lacking discrete vocalizations types. Our results further suggest that individual social groups may have distinct acoustic signatures. We identified potential vocal clusters that carried increased information about the social group identity. However, in a behavioral assay, the mole-rats showed no response to familiar or unfamiliar social signals. Furthermore, when we recorded from pairs of animals, we found that the animals preferably vocalized at close range, often immediately following a physical touch.

Although African mole-rats have rich, graded, vocal repertoires, they do not show a behavioral response to long-range vocal signals in the absence of other animals. Instead, vocal signals are preferably used at close range. Furthermore, our behavioral results do not support the hypothesis that African mole-rats use vocal signals to convey their personal or group identity. Altogether this leads us to believe that, contrary to other social mammalian species, African mole-rats convey social information through other modalities, such as smell or touch.

Greg Slabaugh (Queen Mary University of London).
Steering Generative AI: Towards Safer, Fairer and More Controllable Models

Generative AI models can produce remarkably realistic images and fluent text, but their behaviour is often difficult to control. Models may reproduce demographic biases from their training data, generate harmful or unwanted content, or associate concepts in ways that users did not request. Retraining these models to address each problem is expensive and can introduce unintended changes to otherwise useful capabilities.

This talk explores methods for controlling generative models by steering their internal representations at inference time, without retraining. Using recent work on text-to-image diffusion models, I will show how steering within cross-attention layers can selectively suppress unwanted concepts, such as harmful content or visual styles, while preserving unrelated aspects of an image. I will then discuss how the same general approach can improve demographic fairness by correcting biases in neutral prompts such as "a photo of a nurse" or "a photo of a CEO", without overriding attributes explicitly requested by the user. If time permits, I will describe how these practical methods connect to a broader theoretical framework for minimally disruptive concept removal and manipulation across generative models. Together, this work points towards more targeted post-deployment control of generative AI: changing specific behaviours while preserving the model's remaining capabilities.

Charles Eldrid (University of Manchester).
Dehydrins: Who Needs Water to Anyway?

As organisms literally rooted to the spot plants have developed an amazing host of biological responses to deal with environmental stress. Amongst these are a group of intrinsically disordered proteins (IDPs) called dehydrins, which protect cells in the plant against desiccation and water loss. While most proteins have a defined structure which gives them their biological function, IDPs are the opposite, acting as dynamic shape-shifting chains, adapting to solution conditions and various binding partners. This flexibility makes them difficult to study with classical protein biology techniques such as x-ray crystallography or cryo electron-microscopy. In addition to this, dehydrins function under extreme conditions, transitioning from a disordered chain to structured protein when water is lost, something which usually stops proteins functioning. We do not understand how dehydrins fold or how their transient structure allows them to protect cells. I explore this interface of this transition under desiccation through a gas-phase biophysical technique called native ion mobility-mass spectrometry (IM-MS). With this we have proven that we can measure these fascinating proteins in as close to their functional state as possible, better than other biophysical techniques. Combining these measurements with computational modelling we can build detailed structural models of how these proteins change shape. Understanding this transition is crucial for developing a framework of how these proteins function, opening them up to engineering and possible biotechnology applications such as seeds with higher germination rates and drought resilient crops.

Catherine Tonry (University of Greenwich).
Numerical Modelling of Ultrasonic Treatment in Metallurgical Processes

Ultrasonic treatment in molten alloys has been shown to reduce dissolved gases and increase grain refinement. Reduction of dissolved gases results in reduced porosity in cast and additively manufactured parts. Grain refinement increases the tensile strength of metals, resulting in stronger parts. This allows the production of metallic lighter parts with the same tensile strength either by using lighter metals or by reduction of material quantity. Additionally, the use of ultrasonic treatment has the strong potential to enable production of metal matrix nano-composites at larger scales.

These processes are ultimately incredibly complex leading to the development of complex Multiphysics models. Physics needing to be consider include fluid dynamics, acoustic modelling, cavitation, electromagnetism, induction heating, solidification, structural mechanics, nano and micro particles interaction, and models that couple multiple of these. These models offer insights into the processes involved, interpreting and guiding experimental work, often using in situ imaging techniques, both using optical methods and synchrotron radiation. They can also offer valuable insights into scaling processes to industry.

This presentation will give an overview of various numerical models and how they deliver insights on experimental work and can help scale up lab scale experiments to industrial applications.

Sara Wren Sorkhabi (University of Cambridge).
Adaptation to Altitude in Andean Butterflies: A natural replay experiment

Andean butterflies offer an exceptional system to study the repeatability of evolution across lineages facing similar selective pressures. Here, we investigate parallel adaptation to altitude across 11 species of the Heliconiini and Ithomiini clades to assess the extent to which adaptation is repeatable in this system. Historical constraints often limit repeatability, with the tension extending to the genetic level. Although some loci repeatedly underlie phenotypic evolution, forming "genetic hotspots" or showing gene reuse, the predictability of evolution at the genetic level varies across taxa. This predictability tends to decline with increased divergence, e.g., adaptation at the global

level. However, local adaptation to replicated climatic gradients provides a clear means of testing repeatability. Many species within our focus clades occur across a shared, extreme altitudinal gradient and are particularly well-suited for repeatability studies at the local level. Members of these clades demonstrate strong turnover in species composition and abundance across the Andean slope. This reflects climatic clines. Together, these communities form natural "replay experiments," enabling tests of whether similar genomic hotspots are repeatedly observed in adaptation to altitude and, hence, temperature gradients. Adaptive divergence has been previously demonstrated in Heliconius erato and melpomene across low- to highland populations. Utilising methods in evolutionary genomics, we extend this to study adaptive potential in response to environmental challenges in other members of these clades. The results will prove crucial in understanding Lepidopteran response to global warming and, more broadly, climate change.

Hope Duncan (University of Leeds).
A crash course in large cardinals.

Set theory is the most commonly used foundation of mathematics, providing a set of axioms (rules) we can use to prove most results in modern mathematics. Much of the research happening today in set theory centers on large cardinal axioms, assumptions about infinity which let us prove even more results in pure mathematics. I will introduce the idea of axiomatizing mathematics, and give a brief overview of Gödels incompleteness theorem, and how large cardinal axioms impact modern mathematics.

Shaun Keegan (University of Strathclyde).
Weighting serotype prevalence by mortality burden: implications for Klebsiella pneumoniae vaccine antigen priorities in Africa and South Asia

Klebsiella pneumoniae causes approximately 20% of neonatal sepsis in Africa and South Asia. A maternal vaccine covering $\geq 70\%$ of infections could avert 80,000 neonatal deaths annually. K. pneumoniae is an antigenically very diverse bacteria with over 150 capsular polysaccharide (K) loci, and at least 14 lipopolysaccharide (O) types. This means that a polyvalent vaccine is necessary to target the most prevalent, disease-associated serotypes.

We analysed 1930 genomes from 10 African countries (across 3 regions) and 3 Southern Asian countries. Kaptive v3 predicted K loci and O types from genome assemblies; putative nosocomial clusters (≤ 10 SNVs, ≤ 28 days, same site) were collapsed to single observations. To accommodate the multi-scale aspect of this dataset (site $<$ nation $<$ region) we applied a Bayesian hierarchical model to estimate the prevalence of each locus in each region, and globally. This was done with Stan, implemented via the brms R package.

We extend this framework by re-weighting the regional posterior draws by estimated regional K. pneumoniae neonatal death burden, so that coverage is expressed as the proportion of deaths a formulation would address rather than the proportion of sampled isolates it would match, with uncertainty propagated throughout. Comparing the two estimates shows how far antigen priorities derived from isolate counts diverge from those implied by mortality, and which formulation best serves a vaccine whose purpose is to prevent deaths.

Kate Mowbray (Northeastern University London).
Particle energisation in collapsing magnetic trap models for solar flares

Solar flares can be some of the most energetic and explosive events that take place in the solar system. Electromagnetic emission across the spectrum during flares provide strong signatures of particle acceleration, sometimes extending into x-ray and gamma ray emission. Strong emission across a flaring loop indicates that a significant population of high energy particles are trapped in the loop and do not precipitate into the lower, denser portions of the solar atmosphere. Collapsing

magnetic trap (CMT) models are one of a number of proposed models to explain both particle acceleration and trapping. In these models, a stretched magnetic field relaxes into a more compact, low energy state, resembling the observed contraction of magnetic loops in flares. We identify two key energization processes in these models. The first is betatron acceleration, which arises from the strengthening of the magnetic field as it relaxes into the more compact configuration and the second is Fermi acceleration, where particles pick up short, sharp boosts of energy when crossing a collapsing loop top. We find that relatively simple changes in the magnetic field model, such as the introduction of a jet, can drastically impact on the effect of these energisation processes, highlighting the importance of the specific path that a particle takes as field lines collapse.

Victor Drummond (Loughborough University London).
Care, Safety, and Trust: Rethinking AI in Community Health

The increasing use of conversational artificial intelligence in healthcare has raised critical concerns regarding patient safety, particularly in low-acuity contexts such as over-the-counter (OTC) medication advice. This doctoral research proposes the design and evaluation of a safety-constrained decision-support agent aligned with NHS community pharmacy pathways, with the aim of improving the accuracy and safety of self-care guidance.

Rather than developing a diagnostic or predictive model, the research introduces a rule-based, auditable architecture in which clinical safety is enforced through explicit red-flag detection, eligibility criteria, and escalation logic derived from NHS guidance and Pharmacy First protocols. The agent operates as a structured conversational interface that systematically elicits relevant symptoms, applies deterministic safety rules, and either delivers self-care advice or triggers escalation to appropriate healthcare services.

The system is evaluated using a set of structured clinical vignettes to assess its ability to correctly identify higher-risk presentations and prevent unsafe reassurance. This approach enables rigorous testing without reliance on patient data or machine-learning optimisation. The research contributes a novel perspective to health informatics by demonstrating that constraining AI systems - rather than increasing their autonomy - can enhance safety, transparency, and trust. Ultimately, the work aims to support patients in safe self-care, while reducing the cognitive and operational burden on pharmacists and healthcare systems.

Jacqueline Taylor (Missouri State University).
Beyond the Vineyard: An Investigation into the Ecology of a Grapevine Pathogen

Grapevines are among the world's most economically important fruit crops, supporting wine, juice, and fresh fruit production. Crown gall, caused primarily by Allorhizobium vitis, is among the most prevalent bacterial diseases impacting grapevines, leading to reduced vine vigor and productivity. Although previous research has concentrated on vineyard infections and disease management, the occurrence and ecology of Allorhizobium in natural environments remain poorly understood.

To address this knowledge gap, a statewide survey was conducted in Missouri, USA, in which Allorhizobium-associated genetic markers were detected in both vineyard and non-vineyard soils. A subsequent survey of native grape species identified these same markers in asymptomatic wild grapevines, indicating that these bacterial populations go beyond cultivated vineyards. The results prompt further questions regarding their ecology and diversity.

Ongoing research expands upon these discoveries by isolating bacterial strains from both vineyard and native habitats for whole-genome sequencing and comparative genomic analyses. These efforts intend to determine the genetic relationships among environmental isolates and to evaluate their similarities and differences with previously characterized pathogenic strains.

This research focuses on understanding Allorhizobium ecology and the genetic diversity of environmental populations. The results are expected to provide a foundation for subsequent investigations into pathogen evolution, environmental persistence, and disease management.