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Welcome

The Science Postgraduate Students Council welcomes you to the 9th Annual Science Symposium, a showcase of the diverse and high caliber research being undertaken by postgraduate students in the Faculty of Science. We believe that events such as the Science Symposium are important in promoting interaction and academic relationships between postgraduate students across different departments. In so doing, we feel that this would contribute in fostering a sense of community among postgraduate students in the Faculty of Science.

The theme for this year is Science Communication, a topic that has been increasingly recognized for its importance in engaging stakeholders outside the world of science. The first step is recognizing the general public at large as stakeholders, in the first place. Effectively relaying scientific content in a manner that affords non-scientists an accurate understanding of the issues involved plays a critical role in influencing decision-making in a variety of spheres e.g. policy making and legal issues.

We hope you will enjoy, and learn from, this event

Regards,

Science Postgraduate Student Council

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Program: Day 1

|  |  |  |
| --- | --- | --- |
| Time | Speaker | Title |
| 08:30 – 09:00  | **Registration** |  |
| 09:05 - 09:15 | Dean Faculty of Science: Prof. Anton le Roex | Welcome Address |
| 09:15-09:45 | Deputy Dean of Science:Prof. Maano Ramutsindela | Guest Speaker |
| 09:45-10:00 | Nyambura Shawa | Investigation of sleep and potential PER2 risk alleles for obesity/cardiovascular disease in previously neglected populations |
| 10:00-10:15 | Emmanuel Ocran | The Evolution of the Faint Low-Frequency Radio Source Population |
| 10:15-10:30 | Robert Tendai Nyamushosho | Hang on, are drylands really marginal? Rethinking social complexity in southern African Iron Age |
| 10:30-10:45 | Irfan Nunkoo | Does it go ‘pap’? |
| 10:45-11:00 | **Morning Tea** |  |
| 11:00-11:15 | Daniel Kusza | Chemical biology investigation into the protein targets of ajoene in cancer cells |
| 11:15-11:30 | Jivashi Nagar | Investigating Time of Search as a Feature to Improve |
| 11:30-11:45 | Ridick Takong | Understanding rainfall variability over the Drakensberg Mountain Range under Weak Synoptic Conditions |
| 11:45-12:00 | Martin Giger | Trace element based thermobarometry for on-craton peridotite xenoliths |
| 12:00-12:15 | Miguel Méndez Isla | Indirect searches in extra-dimension Dark Matter |
| 12:15-12:30 | Mélie Buyse | Development of plant-produced vaccine candidates and challenge material for beak and feather disease virus |
| 12:30-12:45 | Robin Peter George | Unlocking Small-Scale Fishery Value Chains through Information and Communication Technology (ICT) – the case studies of Lamberts Bay & Kleinmond |
| 12:45-13:00 | Juliano Ramanantsoa | Coastal upwelling south of Madagascar: temporal and spatial variability |
| 13:00-13:45 | **Lunch** |  |
| 13:45-14:00 | Khadra Ghedi Alasow | The political history of land in Kwandwe Private Game Reserve, Eastern Cape. |
| 14:00-14:15 | Sarah Saeid Pour | Efficient exploration of the Pareto Frontier Using Interactive Reference Point Methodology |
| 14:15-14:30 | Tamlyn August | Getting WISE on Star Formation |
| 14:30-14:45 | Estelle Razanatsoa | Understanding the impact of rainfall variability and human land-use on the ecosystem: Case of the spiny forest in Southwestern Madagascar |
| 14:45-15:00 | Adrien Ndamyabera | Porous metal-organic frameworks for sorption of volatile organics. |
| 15:00-15:15 | **Afternoon Tea** |  |
| 15:15-15:45 | Deputy Vice Chancellor (Research) :Prof. Mamokgethi Phakeng | Guest Speaker 2 |
| 15:45-16:00 | Dominique Gouveia | Electron Transport in Low Dimensional Semiconductor Systems |
| 16:00-16:15 | Chelsea-Joy Wardle | Milk Matters: Co-designing with and for milk donors |
| 16:15-16:30 | Vrinda Chopra | Social Enterprise for Social Inclusion: Are Ethical Markets the Answer? |
| 16:30-16:45 | Avishek Dusoye | Probing the Dark Side of the Universe through Modified gravity |
| 16:45-17:00 | Announcement and Closing |  |
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Program: Day 2

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| --- | --- | --- |
| Time | Speaker | Title |
| 08:30 – 09:00  | **Registration** |  |
| 09:05-09:30 | 2017 Famelab 1st Runner up:  Dr. Shetal Silal (Dept. of Statistics) | Guest Speaker |
| 09:30-09:45 | Justin van Blerk | The Effect of Altered Rainfall Seasonality on Fire-Prone Vegetation in the Cape Floristic Region |
| 09:45-10:00 | Razan Hassan Ahmed | Design, synthesis and evaluation of some Pyrrolo[3, 4-c]pyridine-1, 3(2H)-diones as potential antituberculosis agents. |
| 10:00-10:15 | Wanjiru Mburu | Use of Information and Communication Technologies to Support Mothers' of Preterm Infants |
| 10:15-10:30 | Emmanuel Mogende | Africa’s ‘miracle state’: translating state governance into wildlife governance in post-colonial Botswana  |
| 10:30-10:45 | Bob Senyange | Chaotic dynamics of the disordered Klein-Gordon lattice |
| 10:45-11:00 | **Morning Tea** |  |
| 11:00-11:15 | Jessica Proctor | Functional analysis of desiccation genes in the resurrection plant, Xerophyta humilis. |
| 11:15-11:30 | Nicole Moodley | Title Of NLO Dynamics of Falling Strings in AdS/CF |
| 11:30-11:45 | Kolisa Yola Sinyanya | Microbial community dynamics and microbe-nutrient interactions in the Indian Subantarctic Ocean |
| 11:45-12:00 | Kago Kebotsamang | Point exchange non-dominated sorting algorithm for constructing Pareto optimal space-filling designs |
| 12:00-12:15 | Daniel Zhigila | Molecular Phylogeny, Climate Envelope-modelling and Taxonomic Revision of Thesium L. (Thesiaceae) |
| 12:00-12:15 | Maleshigo Komane | Investigating biocharacter and mechanisms of progestins used in contraception via the glucocorticoid receptor; Implications for choice of contraception and HIV infection |
| 12:30-12:45 | Thandeka Mbambo | Exploring the use of GIS in multi-level governance assessment in the City of Cape Town |
| 12:45-13:00 | Fatima Mohamed | How Nature Treats Water: The Efficacy of Biofiltration Cells to improve the quality of urban runoff |
| 13:00-13:45 | **Lunch** |  |
| 13:45-14:00 | Sam Wolski | mK-Scale Cooling of Nanoelectronic Devices in South Africa |
| 14:00-14:15 | Etwarysing, L | Feed stimulants from green alga Ulva for sea urchin Tripneustes gratilla |
| 14:15-14:30 | Miriam Nyamai | Radio wavelength observations of Novae: Accreting Eruptive White Dwarf binaries |
| 14:30-14:45 | Zaynab Shaik | Gynomonoecy in Asteraceae: a study using Helichrysum Mill. (tribe Gnaphalieae) in South Africa |
| 14:45-15:00 | Megan Lukas | Understanding Pro-environmental Behaviour in Nyanga: Making a Case for Ethnography |
| 15:00-15:15 | **Afternoon Tea** |  |
| 15:15-15:30 | Tawanda Nhundu | Mechanisms of promoter regulation: CCL20 and the Glucocorticoid receptor |
| 15:30-15:45 | Andriniaina Rasoanaivo | Two Particle Correlations and the Deviation from Poisson |
| 15:45:16:00 | Francisco Cervantes  | Using vantage point surveys to study movements of soaring birds |
| 16:00-16:30  | Motivational Talk Director H3D Group, UCT:Prof Kelly Chibale |  |
| 16:30-17:00 | Prize Giving Vice Chancellor UCT:Dr. Max Price |  |

Oral Abstracts: Day 1

# Investigation of sleep and potential *PER2* risk alleles for obesity/cardiovascular disease in previously neglected populations

## Nyambura Shawa

### Department of Molecular & Cell Biology, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

Non Communicable Diseases (NCDs), such as heart disease, cancer, diabetes and stroke, are responsible for over half of all deaths in South Africa. Obesity, insufficient physical activity and unhealthy diet have been classified as risk factors that contribute to the development of NCDs such as cardiovascular disease (CVD) and type two diabetes mellitus (T2DM). Lack of adequate sleep negatively impacts health and has been reported to induce a pre-diabetic condition. Alarmingly, in 2013, 69.3 % of women and 38.8% of men in South Africa were overweight or obese.

Sequence variations in the core circadian genes PERIOD2 (PER2), have been found in individuals with conditions that affect/alter sleep as well to associate with reduced risk for elevated plasma glucose level, in non-African populations. PER2 was reported to have a high variability and significant difference in the geographic distribution of its polymorphisms between Africans and non-Africans. This highlights the difficulties of applying research on genetic risk alleles from the published literature to an African context while giving us the opportunity to address a gap in our knowledge about the aetiology of NCDs, the PERIOD2 locus, sleep and circadian rhythms in a South Africa population and to relate these to risk factors for T2DM and CVD.

Therefore, we propose to measure sleep objectively, using actigraphy, and subjectively through questionnaires, to sequence the PER2 locus in Southern African populations and investigate the presence of ancestral genotypes and protective/risk alleles for obesity and T2DM. We hypothesize that novel genetic variants will be identified as indicators, together with sleep and other environmental factors, for the risk of development of, or protection from T2DM and/or obesity. This research, by closely examining specific environmental and genetic factors intends to shed light on the aetiology of these NCDs that plague our society.

# The Evolution of the Faint Low-Frequency Radio Source Population

## Emmanuel Ocran

### Department of Astronomy, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

Radio continuum observations provides information on mechanical feedback produced by radio jets in AGN, and also an unbiased dust-independent measurement of star formation rates. They thus underpins our understanding of galaxy evolution over cosmic time. In this work, we study the properties of the faint 610 MHz radio source population detected by the Giant Metrewave Radio Telescope in a survey covering 1.2 square degrees down to a 10 microJy per beam rms. We match the radio catalogue to multi-wavelength imaging and optical spectroscopy to estimate their redshifts and classify them. For 1,526 sources with redshifts, 80.3% of the objects show no evidence of AGN and have multi-wavelength properties consistent with radio emission from star forming galaxies (SFG), 11.4% are classified as Radio Quiet (RQ) AGN and the remaining 8.3% as Radio Loud (RL) AGN. We finally derive the radio luminosity function of our sample.

# Hang on, are drylands really marginal? Rethinking social complexity in southern African Iron Age

## Robert Tendai Nyamushosho

### Department of Archeology, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

The general conviction in the Iron Age archaeology of southern Africa is that drylands are marginal landscapes that did not host any significant agropastoral communities in the past. Resultantly, for those civilisations that lived in these landscapes, they have been always portrayed as short-lived, vulnerable and incapable of adapting to environmental and climatic adversities, since their survival is mostly understood as by chance and not choice. However, data recovered from Mananzve one of the drylands sites we surveyed and excavated in the Shashi region of south-western Zimbabwe demonstrates that Iron Age communities continually occupied the landscape and through various strategies of indigenous dryland agriculture they maintained food security in the face of environmental and climatic risks. At a broader scale these findings show that drylands are resource rich and that Iron Age communities which occupied these landscapes had the capacity to adapt. This challenges the designation of drylands such as the Shashi region as marginal, since that term undermines the adaptive capacity and resilience of Iron Age communities.

# Does it go ‘pap’?

## Irfan Nunkoo

### Department of Biological Sciences, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

Myoliquefaction, the post-mortem breakdown of muscle tissue, is a phenomenon which negatively affects marine capture fisheries worldwide. In South Africa, the term ‘pap’ is used to describe fish affected by myoliquefaction, especially snoek (*Thyrsites atun*). This condition has been blamed on a variety of factors including poor handling, low fish condition and even specific months but is actually caused by muscle-dwelling myxosporean parasites of the genus *Kudoa*.

Members of the genus *Kudoa* typically infect the skeletal muscle fibers and employ proteolytic enzymes to digest surrounding host tissue for nutrition. Upon the host’s death, these enzymes accumulate in the muscles as a result of blood flow cessation and may induce detectable myoliquefaction. Myoliquefaction severely compromises the aesthetic appeal of fish fillets and causes customer rejection leading to economic losses.

Two species have been recorded off South Africa; *Kudoa thyrsites* and *Kudoa paniformis*. We review the infection dynamics and effects of *Kudoa* spp. in marine fishes off South Africa.

# Chemical biology investigation into the protein targets of ajoene in cancer cells

## Daniel Andreas Kusza

### Department of Chemistry, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

The garlic-derived natural product ajoene and its structural analogues are strongly cytotoxic to cancer cells.1 Investigations by Hunter and Kaschula into its mechanism of action has shown that ajoene is able to oxidise redox-sensitive cysteine residues on target proteins through a regioselective *S*-thiolation reaction involving thiol-disulfide exchange,2 as illustrated for ajoene in **Scheme 1**:



**Scheme 1:** Regioselectivity of the disulfide exchange between ajoene and a cysteine residue in the ER

A synthesis of ajoene analogues has been developed,1,3 allowing the ajoene allyl end groups to be modified, which has allowed access to a novel synthetic biotin-ajoene probe **1**. Probe **1** has been designed on the ajoene disulfide hypothesis to intercept protein targets in the ER, and using biotinylation to allow their identification as shown in **Scheme 2**:



**Scheme 2:** *In vitro* labelling of protein targets within cancer cells followed by enrichment and analysis of biotin adducts

In this presentation the details of probe synthesis as well as the proteomic data of experiments conducted on oesophageal, breast and colon cancer cells will be discussed. The aim ultimately is to identify the protein targets in the apoptotic and anti-proliferative anti-cancer signalling pathways of ajoene, so as to open up possibilities for medicinal chemistry drug discovery.

#### References

1. Kaschula, C. H. *et al.* Structure-activity studies on the anti-proliferation activity of ajoene analogues in WHCO1 oesophageal cancer cells. *Eur. J. Med. Chem.* **50,** 236–254 (2012).
2. Kaschula, C. H. *et al.* The garlic compound ajoene targets protein folding in the endoplasmic reticulum of cancer cells. *Mol. Carcinog.* **55,** 1213–1228 (2016).
3. Hunter, R. *et al.* Substituted ajoenes as novel anti-cancer agents. *Bioorganic Med. Chem. Lett.* **18,** 5277–5279 (2008).

# Investigating Time of Search as a Feature to Improve

# the Personalization of Information Retrieval Systems

## Jivashi Nagar1 and Hussein Suleman

### 1Department of Computer Science, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

Web users generally get irrelevant results when they submit an ambiguous and/or under-specified query to a search engine. The results provided are generally biased towards the popular intent. So, to obtain the desired results, a user has to re-frame queries, which can unnecessarily consume a user’s time and leads to dissatisfaction and frustration in a user’s search experience. The context of a user can be inferred from a user’s past searches. If that context is considered, the query can be disambiguated. Thus, personally relevant results can be provided to a Web user without any extra effort required by the user. A user can have multiple interests that vary with time. For instance, a computer science student may search for a query “Tag” in his studying time as well as in his leisure time. When the query is issued at studying time, the intent may be HTML tags but, at leisure time, the user may want pages related to TAG sports gear, a sporting goods brand. This study aims to disambiguate the context of a user query according to the time at which the search is made and thereby providing personally relevant results. The methodology of this research project is divided into the following steps:

(1) Identifying the long term and short term topics of interest of users from the query log.

(2) Exploring time sensitive search patterns in long-term topics of interest to construct the user profile.

(3) Develop algorithms that can be used to disambiguate the context of a user’s query and re-rank them according to the topic and the time of the search.

The outcome of the study is to provide personally relevant results, ranked higher in the order as per the time-sensitive search patterns of a user and thereby improve the user’s search experience.

# Understanding rainfall variability over the Drakensberg Mountain Range under Weak Synoptic Conditions

## Ridick Roland Takong

### Department of Environmental and Geographical Science, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

Understanding rainfall variability over the Drakensberg Mountain Range (DMR) is crucial for water resources management in South Africa and Lesotho. DMR is the source of rivers that support socio-economic activities like agriculture, mining and hydro-electric power generation. Rainfall distribution over mountains is dictated by two-way interaction between large- and local-scale synoptic processes. Under strong synoptic forcing, large-scale processes dominate but the reverse is the case for weak synoptic forcing. However, most rainfall studies over the DMR have focused only on rainfall during strong synoptic condition; hence, there is a dearth of knowledge on how the DMR induced processes (winds and mountain processes) influence rainfall variability under weak synoptic condition. The present study investigates how local scale features influence rainfall variability over DMR. For the study we analysed observation and reanalysis datasets using Self-organizing maps (SOM) and performed very high resolution simulations with the Weather Research and Forecasting (WRF) model. The SOM classification of rainfall during wet weak synoptic days revealed four major rainfall patterns. The first rainfall pattern is characterized by high rainfall all over the study domain; the second has a south-west to north-east rainfall gradient with high rainfall areas located in the north-east; the third pattern is like the second but with high rainfall areas located in the south-west; and the fourth is characterised by little or no rainfall throughout the study domain. All these rainfall patterns are associated with a low level high pressure system embedded between an inverted lee-trough in the west of the mountain range and another trough along the east coast line. Our simulation results show that downscaling the reanalysis products with very high resolution models is necessary to reproduce the observed rainfall variability over the mountain. This study has application in weather prediction and future climate projections of rainfall variability over DMR.

# Trace element based thermobarometry for on-craton peridotite xenoliths

## Martin Giger

### Department of Geological Science, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

Kimberlites are believed to be the most deeply derived volcanic rocks that erupt on the Earth’s surface. They occur in the thickest, oldest portions of the continents and are derived from depths greater than 100 km. Thereby, they provide a unique window to portions of the upper mantle that are otherwise inaccessible to geologists. During their rapid rise, kimberlites entrain pieces of the mantle and bring them, relatively unchanged, to the surface. In these mantle xenoliths, the composition of every mineral is controlled, to some extent, by the pressure (P) and temperature (T) at which the rock last equilibrated with its surroundings. Examination of the different elements in different minerals can thus be used to constrain the pressure and temperature under which they last equilibrated. In the past, these thermometers and barometers have mainly been based on major elements (present at > 0.1 wt.%) because of their greater abundance and ease of analysis. Technological advances allow us now to detect elements to much lower concentrations, opening up a new range of elements that may also be suitable for P-T estimation. Techniques based on the rare earth elements (lanthanides) have been developed but never applied to mantle xenoliths from the thickest, oldest portions of the continents (the cratonic lithosphere). UCT possesses the most extensive collection of mantle xenoliths from southern African cratons and characterising these using this new set of thermobarometers is the main goal of this study. Further, trace element distribution patterns will be used to shed light on the chemical evolution of the mantle beneath the Kaapvaal Craton and possible implications for its thermal and chemical history, particularly during the main phases of kimberlite activity in the mid-Cretaceous (≈120 to 80 Ma). To date, a selection of samples suitable for the project has been made based on (1) their mineralogy, (2) their texture, (3) whether their mineral major element compositions have already been measured and (4) their geographic distribution. Current work is focusing on determining suitability of the selected samples through an analysis of the extent to which the minerals in these samples are in chemical equilibrium. This is done by by examining replicate mineral analyses and by comparing T and P values obtained from different major element-based thermometers and barometers.

# Indirect searches in extra-dimension Dark Matter

## Miguel Mendez-Isla

### Department of Mathematics and Applied Mathematics, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

We study the possibility of dark matter detection using the Alpha Magnetic Spectrometer (AMS) by annihilation and the Square Kilometer Array (SKA) radio telescope by electron-positron emission. We shall present how to fit the fluxes data to analytic functions in order to determine the integrated fluxes. After modeling the technicalities of the SKA detectors, constraints on viable models of dark matter can be set up. We shall show how the analysis of the results remains, for instance, essential in order to determine the absence or importance of the astrophysical boost factor, the branching ratios of annihilations for dark matter particles, the compatibility of the SKA results with direct and indirect methods and finally, the number of dark matter candidates required to explain the results.

# Development of plant-produced vaccine candidates and challenge material for beak and feather disease virus

## M. Buyse,1 G. L. Regnard, I. I. Hitzeroth, E. P. Rybicki

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### 1Department of Molecular & Cell Biology, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

Beak and feather disease virus (BFDV) causes one of the most common diseases in psittacine birds and has spread rapidly worldwide due to the international trade in wild-caught birds. The disease is difficult to quarantine and there is no known cure or vaccine; therefore production of a vaccine against it is essential.

The aims of this study are to develop a plant-made BFDV capsid protein (CP) subunit vaccine candidate and assess a synthetic DNA clone of BFDV for the production of vaccine challenge material as BFDV cannot be cultured. Codon-optimised full length and truncated *cp* (including fusion to a Zera® purification tag) were cloned into a suite of plant expression vectors and expressed transiently via recombinant *Agrobacterium tumefaciens* in *N. benthamiana*. Leaf tissue was harvested on 3 dpi and expression of CP was detected using immunoblotting. Transfection into primary chicken embryo fibroblast cells (CEF) of the BFDV DNA clone was optimised and replication was assessed using rolling circle amplification.

Plant expression was determined to be succesful but differential for the various vector constructs. The truncated *cp* gave an overall higher CP expression in comparison with the full length *cp.* Fusion of the full length *cp* to Zera® in pTRAc showed a significantly higher CP expression. The BFDV replicon was successfully detected using rolling circle amplification. A DNA concentration of 2 ug (1:1 ratio transfection reagent) was determined to be optimum. There was no notable difference in replication for days two or three.

In conclusion, codon optimisation of *cp* did not increase CP expression in comparison to the wild-type. Fusion of *cp* with Zera® only increased expression in pTRAc.Detection of the BFDV replicon in CEF cells shows that the DNA clone is capable of replicating in avian cell culture. The next step will be to transfect and analyse replication in embryonated chicken eggs.

#  Unlocking Small-Scale Fishery Value Chains through Information and Communication Technology (ICT) – the case studies of Lamberts Bay & Kleinmond

## Robin Peter George

### Department of Environmental and Geographical Science, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

 This research focuses on the newly established small-scale fisheries sector and the usage of Information and Communication Technology (ICT) to unlock its value chains. The research is case study based in two Western Cape communities of Lamberts Bay on the West Coast and Kleinmond on the Southern Cape Coast. It is social science based, draws on knowledge from fisheries management, ICT and development studies among others. This research is being undertaken with the Abalobi smartphone application program in the Environmental and Geographical Science Department of UCT; an engaged scholarship project working with fisher people and related stakeholders. Through the research, fisher people, state officials, business persons and ICT specialists will be engaged in discussing various matters related to value chains of small-scale fishers. In seeking value chain solutions with small-scale fisher people, the objectives are as follows; to understand the value chain activities of the two mentioned communities; to differentiate these opportunities at local, regional and international levels and to determine how an ICT such as Abalobi can assist in connecting fisher people to their desired markets. These markets range from retail chain stores, restaurants, chefs and tourism enterprises within these communities. As some of these value chains through which fishers sell their catches are in existence, they need better coordination and through Abalobi as an ICT tool, better interactions between fisher people and their markets can be facilitated.

# Coastal upwelling south of Madagascar: temporal and spatial variability

## Juliano Dani Ramanantsoa

### Department of Oceanography, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

Madagascar’s southern coastal marine zone is a region of high biological productivity, which supports a wide range of marine ecosystems, including fisheries. The high biological productivity is attributed to the upwelling in the coastal regions south of Madagascar. This wrok provides new insights on the structure and variability of the upwelling and its generating mechanisms. Satellite remote sensing is used to characterize the spatial extent and strength of the coastal upwelling. A front detection algorithm is applied to thirteen years of Multi-scale Ultra-high Resolution (MUR) Sea Surface Temperatures (SST) and an upwelling index is computed. The influence of the winds and ocean currents as drivers of the upwelling are investigated using satellite, in-situ observations, and a numerical model. Results reveal the presence of two well-defined upwelling cells. The first cell (Core 1) is located in the southeastern corner of Madagascar, and the second cell (Core 2) west of the southern tip of Madagascar. These two cores are characterized by different seasonal occurrences, different intensities, different upwelled water mass origins, and distinct forcing mechanisms.

Core 1 is associated with a dynamical upwelling forced by the detachment of the East Madagascar Current (EMC), which is reinforced by upwelling favorable winds. Core 2 appears to be primarily forced by the upwelling favorable winds, but is also influenced by a poleward eastern boundary flow coming from the Mozambique Channel. The intrusion of Mozambique Channel warm waters could result in an asynchronicity in seasonality between upwelling surface signature and winds favorables winds.

# The political history of land in Kwandwe Private Game Reserve, Eastern Cape.

## Khadra Ghedi Alasow

### Department of Environmental and Geographical Science, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

The creation and expansion of game reserves is central to rural development strategies. This is so because ecotourism is viewed by governments and the private sector as an engine for rural development. Game reserves are therefore one of the most recent sites on which land use change is accompanied with new dynamics that impact on rural areas. Game reserves are often justified as conservation initiatives, but they can also complicate land restitution in South Africa. My starting point in this paper is that land use change has a socio-political history, which is vital for understanding contemporary land issues. It is for this reason that I explore land use change from the perspective of the political history of land. My aim is to unravel some of these histories in order to contextualise the emergence of private game reserves in contemporary South Africa.

The paper uses Kwandwe Private Game Reserve to argue that the creation of this game reserve should be understood as a result of land use under different political circumstances. To treat the reserve as a simple conservation area is to deny it its history. Game reserves are often built on places whose histories are forgotten.

# Efficient exploration of the Pareto Frontier Using Interactive Reference Point Methodology

## Sarah Saeid Pour

### Department of Statistical Sciences, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

Identification of the Pareto Frontier(PF) in many-objective optimization problems is the most challenging problem in Multi-objective Optimization. Identifying the whole PF, as an expensive and time-consuming process, is not always necessary; some specific regions that are interesting to the Decision Maker(DM) suffices. In Interactive Reference Point Methods(IRPMs), the DM is free to state and change his/her goals in terms of Reference Points(RPs). In this method, the RP is projected on the PF by means of an Achievement Scalarizing Function and an associated weight vector. So, the solution in this method is always Pareto optimal.

In existing IRPMs, in each iteration, the DM identifies only one RP, and the region of interest regarding that RP is determined accordingly. Based on the most interesting solution found in that region, the next RP for the next iteration is adjusted. But there may be some really interesting solutions outside of this area on the PF that will be missing.

We are working on a new IRPM in which the DM is able to consider Multiple RPs simultaneously. In such a way s/he will be able to get a better insight of the possible solutions which lead him/her to make his/her final decision more consciously and confidently.

Of course, there are challenges such as how to select a good spread of RPs which leads to a good sampling of the PF. To overcome this challenge, the answer of the following question might be helpful: how can a set of evenly distributed weight vectors lead to a set of evenly distributed solutions on the PF? Certainly, this is another challenge by its own. There are, of course, other questions such as how to bound on RPs based on information received from the DM? and how to benefit from Evolutionary Algorithms to speed up the computations for multiple RPs?

The efforts to address these interesting research questions has been started and is continuing. Evaluating the new method by applying it on a number of test problems and also applying simulation studies of responses to user preferences are to be worked on in the future.

# Getting WISE on Star Formation

## Tamlyn August

### Department of Astronomy, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

In order to understand the evolution of a galaxy, it is essential to determine its star formation properties over cosmic timescales.

*WISE*, the all-sky, mid-infrared telescope survey, affords us the opportunity to investigate this for a wide range of galaxy types.

In this talk, I will elaborate on what star formation is, and how *WISE* measures it.

I will also present results on the reliability of the *WISE* measurements as an indicator of star formation, introduce new star formation rate (SFR) relations based on our analysis, as well as a comparison of existing relations to our new relations.

# Understanding the impact of rainfall variability and human land-use on the ecosystem: Case of the spiny forest in Southwestern Madagascar

## Estelle Razanatsoa

### Department of Biological Sciences, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa

Environmental change is being experienced worldwide especially in hotspots of biodiversity such as Madagascar. For instance, massive extinctions and ecosystem degradation mainly associated with the human activities were recorded on the island during the last 2000 years. However, our study hypothesized that in addition to anthropic impacts, climate especially rainfall variability might have played a role in the ecological succession of the vegetation. This research aims to evaluate the relative impact of rainfall variability and human land-use in an arid ecosystem with the case of the spiny forest in Southwestern Madagascar. Using multiple proxies, past rainfall was obtained through the analysis of carbon isotope in baobab rings and the vegetation and fire activities were reconstructed with pollen and charcoal analysis in sediment cores. Preliminary results suggest that there was a variation of rainfall during the last 700 years with a tendency of increase in precipitation amount in the last century. This correlates with increasing of taxa tree rate and reduction of the dry-adapted taxa in the reconstructed vegetation. Over the last 4400 years, the vegetation has changed from savanna woodland to a diverse bush xerophytic before currently becoming a less diverse forest like an ecosystem. Additional analysis related to the human land-use along with isotope analysis and supplementary radiocarbon dates would still be performed on sediments cores to complete the analysis required for this study. The results from this research would allow locally elaborating conservation strategies that take into account the human dimension of the ecosystem and internationally predict and remediate to the impact of climate change on arid regions.

# Porous metal-organic frameworks for sorption of volatile organics

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Solid materials such as activated carbon and zeolites have been used for the control of VOCs from liquids and air. These systems are unselective, but it would be desirable to find a means to selectively remove VOCs and to recover them as feedstocks for further processing. Some metal-organic frameworks (MOFs) have been reported to have more competitive application than the solid adsorbents above, but, they are not commonly known for the application of VOCs adsorption. MOFs are flexible porous adsorbents resulting from the bridging of metal ions by organic linkers. The ligands or linkers contain oxygen and/or nitrogen donor atoms to coordinate to the metal nodes. They offer a great interest in their synthesis and applications in catalysis, drug delivery, sensing, and sorption processes. The synthesis of MOFs provides variable functionalities, large surface area, and tunable pore size. In my PhD project, I am focusing on linking metal ions such as cobalt(II) and zinc(II) with triazolyl phenylcarboxylates, benzene tetramines, and benzene tetracarboxamides. The porous metal complexes will be synthesized by combined solvothermal and slow diffusion methods. Parameters such as temperature, solvents, and time will be optimized to obtain the desired porous MOFs. Activation will be performed using vacuum drying. The synthesized materials will be characterized by methods such as Fourier Transform Infrared Spectroscopy (FTIR), thermal gravimetric analysis (TGA), Powder X-ray and single crystal X-ray analysis (XRD), and scanning electron microscopy (SEM), and their surface area and porosity determined using BET sorption isotherms. The target in these compounds is to provide high capacity to selectively adsorb gases and vapours. The kinetic behaviour of guest molecules in pores or channels will be elucidated as well. In particular we will target volatile organic compounds of environmental interest as well as molecules of interest in food safety and storage.

# Electron Transport in Low Dimensional Semiconductor Systems

## Dominique Gouveia

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 The capture and manipulation of single electrons in semiconductors are laying the foundations for the driving mechanism for future based technology that will replace current transistor based systems. The ability to provide on-demand electrons allows for the dramatic improvement in device power consumption together with the ability to exploit the quantum mechanical phenomena of individual electrons for computational purposes.

This work will focus primarily on high-frequency single electron pumping. The department of physics is one of a handful of institutes that have the capability to carry-out such precision measurements, building on a field that has a wide range of cross over applications. The work will explore further the fundamental nature of gigahertz electron pumps that have been in their current form of operation since 2007.

The work will aim to investigate further the driving mechanism behind the operation of high-frequency electron pumps by examining temperature, frequency, and device design geometry. For most applications, the requirements of on demand single electron pumping are that the current delivered is in the Nano-ampere range with an uncertainty of one part per billion.

To-date both requirements have not been achieved simultaneously. The planned work of this Ph.D. will support ongoing studies in the group in investigating the mechanism that results in the failure to achieve the desired accuracy and throughput of current simultaneously.

# Milk Matters: Co-designing with and for milk donors

## Chelsea-Joy Wardle

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Mothers have to go through a rigorous screening process as well as deposit a large quantity of breast milk at the human milk bank before they qualify to be human milk donors. The lack of feedback from Milk Matters (A human milk bank in Cape Town) and the demanding donation process deters mothers from donating especially considering the existing constraints of mother resources. The transition to becoming a mother can be very stressful, isolating and challenging, even more so as a donor. Even though they may be struggling with the same issues and share similar experiences, the donor mothers are not yet a consolidated group

In this study, I will continue the design and development of a Milk Matters mobile application, a tool developed to motivate women to donate their surplus milk to the local milk bank. Working with mothers with small babies can be challenging, designing an application for them in an environment where their primary focus is somewhere else, is even more so.

This project looks at the importance of different co-design tools (such as probes, sketching and storyboarding) to gain an understanding of your users, knowledge of how the interact with ICTs and insights into the problems they face. Specifically, this research will address issues of feedback, engagement and content creation within the Milk Matters network.

# Social Enterprise for Social Inclusion: Are Ethical Markets the Answer?

## Vrinda Chopra

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Social enterprises in management sciences are seen as an initiative for reconfiguring capitalism as a model for social change especially in reducing inequalities. This belief has led to remarkable increases in donor / investor funding in the area. Just in Africa 71 percent of donor funding will go to social enterprises, believing them to be the best tools for reducing inequalities. However, there is little empirical evidence to advise this to be true. The study, using a social constructivist framework, thus focuses on the basic theoretical problem that monetisation of development (through deployment of social enterprises) may not help in addressing deep-set problems, especially of inequalities in South Africa and India. The varied experiences of initiatives like microfinance and fair trade where the use of market principles has not led to desired development adds impetus to the study of this theoretical issue in the field. The emphasis on inequalities is necessary given that it remains a significant challenge of our time (significantly so in South Africa and India) with explicit inclusion within the Sustainable Development Goals.

Preliminary findings from qualitative interviewing in South Africa indicate that the popularity of social enterprises is on the rise despite participants indicating that impact on ground is yet to be seen, and/or impact measurement has not been implemented actively. The research presentation will include a discussion of some of these findings, suggesting that the field is being boosted by management narratives affirming social enterprises as initiatives to address the failures of the government and civil society in achieving development goals and reducing inequalities. It will also touch upon some consequences of buying into these narratives and increasing support to the sector without in-depth knowledge of impact.

# Probing the Dark Side of the Universe through Modified gravity

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 There exists a considerable amount of evidence via cosmological observations, which indicate that 95% of content of the universe is dark. The LCDM model has been very successful in the description of our universe with great precision and has passed several cosmological tests. However, the late accelerating expansion of the universe and the Tully-Fisher Relation of spiral galaxies remains unexplained. Over the past years, several alternative theories of gravity have been explored and yet there exists a degeneracy of possible models. Given that Effective Dark Matter (EDM) interacts only gravitationally, its presence should contribute into the evolution of the density perturbation equations of the baryon-photon fluid in the early universe. These effects could appear through the large-scale structure as well as the Cosmic Microwave Background (CMB) anisotropies. Therefore the analysis of these effects on the CMB can be used to constrain modified gravity theories for Dark matter (DM). We investigate several competing DM models and compute their impact on the CMB anisotropies.

ORAL ABSTRACTS: DAY 2

# The Effect of Altered Rainfall Seasonality on Fire-Prone Vegetation in the Cape Floristic Region

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In the highly diverse vegetation of the Cape Floristic Region, the interaction between anthropogenic climate-change and fire is of great concern. Fire-prone vegetation, such as Fynbos, may be particularly sensitive to climate-change because of the effect of climate on fire-frequency and on the sensitive post-fire vegetation recovery stage. These two factors both have a potentially strong influence on the diversity and demography of mature plant communities. There is much uncertainty surrounding future climate-change in the CFR, however potential changes in rainfall seasonality are likely to be a key climate factor which could impact vegetation.

We are currently performing an experiment in the CFR where we are altering rainfall seasonality in post-fire field sites using rainfall manipulation structures. These structures have been established in Fynbos and Renosterveld sites and have already been functioning for half of a year along with close monitoring of vegetation recovery patterns. We aim to discover how changes to the natural Mediterranean – climate pattern of winter rainfall and extended summer drought could affect post-fire vegetation recovery.

Initial results have revealed significant improvements in seedling survival and growth of re-sprouting plants due to irrigation in the first summer after fire, indicating the sensitivity of plants to moisture during this critical stage of growth or establishment. Physiological measurements and environmental data have shown that the performance of seedlings and re-sprouting plants closely correspond to summer soil moisture availability. Patterns appear to be similar in both Fynbos and Renosterveld biomes.

We are also exploring the use of UAV-mounted multispectral cameras to capture fine-resolution aerial imagery throughout the study period from which we will derive widely used vegetation indices such as NDVI. NDVI will then be related to our ground measurements. This ‘ground-proofing’ approach has been used in agricultural practices but has not been widely used in natural ecosystems.

Finally, we plan to use our experimental infrastructure to test the effects of seasonality change on the establishment and survivability of C4 grasses. C4 grasses generally don’t occur below the summer/winter rainfall boundary and are typically absent from the current winter rainfall zones of the CFR.

Our research will address many important issues concerning the uncertainty of future climate-change predictions and the potential effects on our unique natural ecosystems.

# Design, synthesis and evaluation of some  Pyrrolo[3, 4-c]pyridine-1, 3(2H)-diones as potential antituberculosis agents.

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**Introduction:** New tuberculosis drugs that can contribute to treatment shortening, be effective against multidrug-resistant (MDR) and extensively drug-resistant (XDR) TB, as well as be compatible with human immunodeficiency virus (HIV) treatment are urgently needed. Pyrrolo[3,4-*c*]pyridine-1,3(2*H*)-dione derivatives have been reported to possess anti-mycobacterial activity. However, these compounds have been beset by poor solubility.

 **Aim:** To optimise the Pyrrolo[3,4-*c*]pyridine-1,3(2*H*)-dione derivatives as potential antituberculosis agents.

**Method:** New analogues were synthesizedusing methods reported in literature. All synthesized compounds were then evaluated for antimycobacterial activity against the H37Rv strain of *Mtb* using the green fluorescence protein (GFP) assay. The turbidimetric solubility assay was carried out for all the compounds.

**Results**: The Structure activity relationship (SAR) exploration revealed some active compounds. Most of the synthesized compounds exhibited improved aqueous solubility.

**Conclusion:** Efforts to identify other analogues with improved aqueous solubility while maintaining or improving antimycobacterial activity are still ongoing.

# Use of Information and Communication Technologies to Support Mothers' of Preterm Infants

## Wanjiru Mburu

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Mothers of infants born prematurely often suffer from depression, grief, and guilt, which are rooted in not giving birth to a healthy baby. These mothers need continuous support to reduce maternal stress especially if they are unable to provide sufficient milk for their infants. While many communication channels are available for general infant care, none have been scientifically evaluated for their efficacy in providing support to mothers of preterm infants. Our research focuses on improving the existing communication channels at Neonatal Intensive Care Unit (NICU) with an aim of providing these mothers with information that will help them manage the stress related to premature birth. We plan to use co-design approach, to design and evaluate the Information and Communication Technology (ICT) interventions proposed by the mothers and staff at the NICU. At the end of this study, we expect to understand the challenges that mothers of preterm infants face and thereafter collaborate in the design of an intervention that will support them manage the stress related to prematurity. These may include but are not limited to: health education for the mothers, rights education, mechanisms for remote "visits" and status updates, better communication channels with the caregivers etc.

Primary contributions to knowledge will be in the area of Human-Computer Interaction for Development (HCI4D). Our contribution is twofold: (1) Methodological contribution (Designing with mothers brings new challenges for co-design methods as well as the evaluation of interventions. During the design tasks, mothers’ attention may be split between their babies and the design activities. We seek to demonstrate how we can develop new methods or alter existing ones to ensure that they are flexible (can easily be paused and re-started) and they should not require a large amount of time to complete), (2) Artefact Contribution (Artefact contributions will arise from generative design-driven activities. We plan to evaluate the tools, sketches, mock-ups and prototypes that will lead to the final artifact. We will evaluate these tools by how insightful, compelling, and innovative they are. We will give detailed information about our intervention and show how it varies from other interventions).

# Africa’s ‘miracle state’: translating state governance into wildlife governance in post-colonial Botswana

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Natural resources are often considered a curse rather than a blessing to most African states rich in natural resources. The resource curse is largely attributed to poor governance and leadership deficit in African states. It is argued that such states perform economically worse, suffer more from intrastate conflict and often have weak states. In contrast to other resource-rich African countries Botswana presents an interesting exceptional case. Natural resources, particularly mineral deposits, have been a blessing to the state. This has resulted in many assessments praising Botswana as an African ‘miracle state’, ‘model of Africa’, ‘exemplary post colony’, etc. The country has been praised not only for maintaining democracy and high economic growth rates since independence but also for its good governance record. Against this backdrop, African scholars have identified governance and leadership as central tenets to Botswana’s success story. However, the label of success and of ‘model of Africa’ has led to inadequate questioning of what occurs beneath the façade of state governance in the management of natural resources. The key question to ask then becomes what constitutes good governance in relation to both the state and its natural resources. Therefore, the key question for this study is: how does the governance of the state extrapolate into the governance of wildlife in post-colonial Botswana? The proposed study seeks to apply the theory of the state in Africa to investigate this question. In order to answer the research question I adopt a qualitative approach by which data will be triangulated. The study will focus on the effects of different political regimes on the evolution of wildlife policy; the socio-political context of wildlife management, as well as the effect of state governance on the distribution of benefits generated by wildlife.

# Chaotic dynamics of the disordered Klein-Gordon lattice

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Disordered systems are spatially extended models of many degrees of freedom trying to mimic heterogeneity in nature. Typically they are obtained by attributing to one of the system’s parameters a different, random value for each degree of freedom. It is well-known that in linear disordered systems energy excitations remain localized. This phenomenon was first studied by Anderson [Anderson, 1958] and for this reason is usually called ‘Anderson localization’.

Recent studies of the effect of nonlinearity in disordered variants of two typical one-dimensional Hamiltonian lattice models, namely the Klein-Gordon (KG) oscillator chain and the discrete non-linear Schrödinger equation (DNLS) showed that, in general, nonlinearity destroys localization [Flach et al, 2009; Skokos et al, 2009; Skokos et al, 2010; Laptyeva et al, 2010; Bodyfelt et al, 2011]. In these papers the existence of different dynamical behaviors, namely the so-called ‘weak’ and ‘strong chaos’ spreading regimes, as well as the ‘selftrapping’ regime, was revealed, their particular dynamical characteristics were determined and their appearance was theoretically explained.

Although, nowadays is common knowledge that energy spreading in disordered lattices is a chaotic process, the characteristics of this chaotic behavior have not been studied in detail. The first attempt to systematically investigate chaos in one-dimensional disordered, nonlinear lattices was performed in [Skokos et al, 2013] where the chaotic behavior of the KG model for the ‘weak chaos’ regime was studied. For this particular case it was shown that although chaotic dynamics slows down, it does not cross over into regular dynamics. These findings were also confirmed in [Antonopoulos et al, 2014].

In this work, we first construct several high order Symplectic Integrators (SIs), using well known techniques, and compare their performance for the long time integration of the equations of motion, as well as the variational equations of the KG system. Then, extending the results of [Skokos et al, 2013], we study the chaotic behavior of the KG model for different initial excitations through the computation of the most commonly used

# Functional analysis of desiccation genes in the resurrection plant, *Xerophyta humilis.*

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Desiccation tolerance is defined as the ability of an organism to lose nearly all cellular water (>95%) and recover unharmed upon re-hydration. Desiccation tolerance is common in the developing embryos of angiosperm seeds, but rare in adult vegetative tissues (i.e. leaves and roots). This trait of vegetative desiccation tolerance only occurs in 135 plant species, collectively termed “resurrection plants”. The physiological and cellular processes which provide tolerance have been relatively well studied however, our knowledge regarding the activation of genes in response to desiccation is limited. Previous work has focused on building the genomic and transcriptomic resources for *Xerophyta humilis*, a resurrection plant indigenous to Southern Africa. However, these resources are limited to correlating transcript expression profiles with stages of water loss. To overcome this limitation, it is necessary to develop experimental systems to test the functions of genes. Functional genetic tests can be done either in heterologous biological systems or in *X. humilis* itself. My research project will use *Arabidopsis thaliana* protoplasts as a cellular system for gene expression analysis. Specifically, I will investigate whether candidate *X. humilis* transcription factors, such as XhABF1, activate expression of important desiccation genes. As a first step to investigating the feasibility of functional genetics experiments in *X. humilis*, I will attempt to fill in the gaps in the genome as well as determine the number of chromosomes in *X. humilis*. In addition, I will isolate *X. humilis* protoplasts and use them to regenerate a whole plant. If this is successful, it will allow for a direct route with which mutations can be introduced into the *X. humilis* genome and the functional consequences analyzed in regenerated plants.

# Title Of NLO Dynamics of Falling Strings in AdS/CFT

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We use the gauge/gravity duality to compute the penetration depth of a quark moving through a strongly-coupled N = 4 SU(Nc) super-symmetric Yang-Mills plasma. Using numerical techniques, we study the effect of next-to-leading order fluctuations on the holographic string in AdS5-Schwarzchild.

# Microbial community dynamics and microbe-nutrient interactions in the Indian Subantarctic Ocean

## Kolisa Yola Sinyanya

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Through photosynthesis, marine phytoplankton convert atmospheric carbon dioxide (CO2) dissolved in surface waters into organic carbon, a portion of which sinks into the deep ocean. This mechanism, termed the ocean’s “biological pump”, regulates atmospheric concentration of CO2. The Southern Ocean’s macronutrients (i.e., nitrate and phosphate) are never completely consumed in surface waters due to iron limitation of phytoplankton. The Southern Ocean thus represents a “leak” in the global ocean’s biological pump as by consuming nutrients more completely, phytoplankton could lower atmospheric CO2. However, phytoplankton and heterotrophic bacterial diversity in Southern Ocean waters is not well understood, particularly their role in the region’s biological pump. Subantarctic islands supply iron, nitrogen, and phosphorus to the Southern Ocean through rainwater runoff, seal and bird activities, yet little is known about importance of island-derived nutrients for carbon export. This study aims to use microbial diversity, metabolic activity and metabolic potential, together with nutrient concentrations and isotopes, to understand the role of Subantarctic island systems in Southern Ocean productivity using Prince Edward Islands (46°46’23’’S, 37°51’09’’E) as a proxy for Subantarctic islands more broadly. Samples were collected aboard the R/V *SA Agulhas II* during the Marion Island Relief Voyage cruise (April-May 2017) for all biological and chemical variables at selected sites upstream, downstream and between the PEIs. Sampling was achieved through CTD hydrocasts between 10-2000 m for nutrients and nitrate isotopes, 10-100 m for fluorescence-activated cell sorting (FACS), flow cytometry and via the underway sampling system (~5 m) for DNA/RNA. FACS analyses are ongoing at the Institute of Infectious Disease & Molecular Medicine, University of Cape Town (UCT). Nutrient analysis for nitrite, nitrate, phosphate and silicate concentrations is ongoing at the marine biogeochemistry laboratory at UCT, and initial DNA/RNA analyses for 16S and 18S rRNA have been completed at Biochemistry and Microbiology Department at Rhodes University.

# Point exchange non-dominated sorting algorithm for constructing Pareto optimal space-filling designs

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Space-filling designs offer a great sampling approach for environmental problems when there is limited information about the process under study. They are based on geometric criteria and largely avoid specifying covariance structure of the spatial process. Efficient space-filling designs are constructed by optimizing a combination of different criteria, which is essentially a multi-objective optimization problem. As a result, Pareto optimality approach for multi-objective optimization is gaining popularity in constructing space-filling designs. This approach generates a set of designs that all satisfy a predetermined optimum definition as opposed to a single global solution. Few algorithms have been developed to construct Pareto optimal designs but most of these are inefficient for large design problems. We propose a new algorithm that uses an elitist principle and diversity mechanism for constructing Pareto optimal designs. The elitist principle ensures that superior designs are carried over to the next iterations, making the algorithm more effective and efficient.

# Molecular Phylogeny, Climate Envelope-modelling and Taxonomic Revision of *Thesium* L. (Thesiaceae)

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The protection of species and ecosystems is of concern to most naturalists, and the prerequisite of accurate information of all kinds about organisms is indispensable to the successful result of conservation strategies. *Thesium* is one of the largest genera in South African Flora comprising about 350 species, but poorly studied, possibly because of its drab morphology. Many species in the genus are Red Listed as data deficient, least concerned and others are endangered partly due to unresolved phylogenetic relationships, but conservation of the unique biodiversity is hampered in taxa with ambiguous nomenclature and classification. The goal is to address these shortfalls and to initiate a comprehensive analysis of the molecular phylogeny and to use infra-Cape clade to explore the species range, endemism, rarity and possible extinction as results of accelerating climate change. To achieve these, multiple accessions of 115 species at herbaria and our field collections were studied. Preliminary distribution data indicated that most species were observed to be in the fynbos biome with a few renosterveld and coastal form (*T. fruticulosum*), forest edges (T. *strictum*) and only *T. carrinatum* var. *pallidum* occur above 1200 m. Morphological data matrix containing 56 qualitative and quantitative characters was subjected to parsimony character reconstruction. To buttress the resultant trees, DNA from 96 samples of 59 species used for morphometric study were extracted, amplified using four DNA markers (ITS, trnL-trnF, MatK and ETS) 252 sequence reactions were generated. Molecular work on 55 species not sampled from previous studies is underway. In the end, well resolved phylogeny of *Thesium* will be constructed and a section or two from clade will be revised. Presently, we have flagged 23 species from our collections as new to science; these will be circumscribed in due course.

# Investigating biocharacter and mechanisms of progestins used in contraception via the glucocorticoid receptor; Implications for choice of contraception and HIV infection

## Maleshigo Komane

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Medroxyprogesterone acetate (MPA), the major injectable contraceptive used in the developing world is known to bind to and activate the glucocorticoid receptor, leading to the regulation of immune response genes. There is accumulating in vitro and in vivo data suggesting that MPA increases HIV infection. It is suggested that the possible mechanism for this is by binding to the GR and changing immune function. The purpose of this study is to provide more in vitro data on MPA as well as investigate the binding affinity and biological activity of contraceptive progestins Etonogestrel (ETG), Levonogestrel (LNG) and Nestorone (NES) via the glucocorticoid receptor (GR) as they are not fully understood. Previous work has failed to address the possible implications on immune function and HIV-1 infection, should these newer progestins activate the GR. In this study, we investigated the progestins ability to bind to the GR by conducting whole cell ligand binding assays. The transcriptional effects of the GR upon activation by these progestins was investigated on a synthetic reporter gene as well as endogenous GR target genes relevant to immune function. Progestin metabolism studies were also conducted to aid in analysis of all progestin related experiments. It was observed that these progestins are differentially metabolised in different cell lines. Popular reference ligands Dexamethasone (DEX) and Progesterone (P4) were metabolised by up to 50%, whereas ETG and MPA showed very little metabolism. Whole cell ligand binding assays revealed that these progestins all had a high ability to bind to the GR, with MPA and ETG exhibiting specific binding greater than that of the reference GR ligand DEX. This study also showed that MPA, LNG, ETG and NES have differential activity via the GR. Relative to DEX, MPA, ETG and NES bring about transactivation via the GR as partial to full agonists. ETG and NES bind and activate the GR in a manner similar to MPA, thus they may also be potent and increase HIV infection. These comparative molecular studies contribute to understanding the biological activity of these progestins and their possible role in HIV-1 acquisition, which will aid in identifying the criteria needed to assess the safest progestin to use in contraceptives.

# Exploring the use of GIS in multi-level governance assessment in the City of Cape Town

## Thandeka Mbambo

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The notion of governance has been the driving force of research and policy agendas (Baumgartner, 2012) intermittently. Contemporary discourse has predominantly investigated governance from the social aspect or primarily from a socio-economic development point of view. These papers have attempted to devise conceivable interventions to address many of the challenges that plague South African townships and ensure sustainable practice. Yet, limited studies have effectively demonstrated a multi-layered approach to governance in the South African context. This research paper contends that South Africa’s context of a dwindling economy and a government that is confronted with human resource issues; lack of service delivery in townships and a range of institutional deficiencies seek a multi-layered approach to governance. This paper demonstrates that a combination of the social and spatial datasets can facilitate an improved understanding of how governance operates at grassroots level. This paper maintains that a multi-layered approach to governance is essential in facilitating an improved understanding of the socio-spatial interactions in many townships in the City of Cape Town. This paper draws on four themes to explore some of the dynamics namely; 1.) Governance, 2.) Geographical Information System (GIS), 3.) Urban land-use planning and 4.) Environmental conservation.

# How Nature Treats Water: The Efficacy of Biofiltration Cells to improve the quality of urban runoff

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 Anthropogenic activities have had significant negative impacts on the quality of water bodies. High nutrient inputs into waterbodies have resulted in eutrophication, dissolved oxygen depletion and, in turn, loss of biodiversity. Biofiltration cells are an aesthetically pleasing means of reducing these impacts. They operate by filtering diverted runoff through dense vegetation followed by vertical filtration through the filer media. This study aims to investigate the way in which the biofiltration cells are able to influence the chemistry of contaminated water. The main objective of the study is to determine the ideal retention time and volume of water for treatment by the cells. Other objects involve analysing the influence of vegetation and the role of different filter media. 6 biofiltration cells will be studied in Franschhoek, South Africa. They vary in vegetative state and filter media. Ammonia (NH4+), nitrate (NO3-), nitrite (NO2-), Phosphate (PO33-) and biological oxygen demand (BOD), among other physicochemical properties, will be used to measure water quality and, hence, the efficacy of the biofiltration cells.

# mK-Scale Cooling of Nanoelectronic Devices in South Africa

## Sam Wolski

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The Nanoelectronics Laboratory at the University of Cape Town has recently obtained the first sets of results from the new ultracold helium dilution fridge. First, the general working principles of the dilution fridge are discussed, including the mechanisms which enable the cooling of samples to temperatures of around 6mK. Following this, the first set of measurements in Africa of the Quantum Hall Effect (QHE) in a 2-Dimensional Electron Gas (2DEG) system are presented. The QHE is a fundamental measurement in the study of low-temperature condensed-matter systems, and is of particular importance in metrology as the basis for the international resistivity standard. The theory of 2DEG systems is also discussed, along with the relevance of experimental results in advancing the theoretical framework. Finally, preliminary results from and outlines for future experiments with more advanced nanoscale devices are presented and analyzed.

# Feed stimulants from green alga *Ulva* for sea urchin *Tripneustes gratilla*

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Secondary metabolites play a fundamental role in mediating ecological interactions for marine plants. Much evidence of this chemical mediation comes from plant/herbivore interactions, where it is clear that some metabolites act as allelochemicals. However, other ecological interactions such as feed stimulants or attractants are less well known. Local aquacultured sea lettuce (*U. armoricana*)is known to elicit phagostimulatory responses in the sea urchin *T. gratilla*, with several studies showing a feeding preference for this alga. The present study investigated the feeding preference of *T. gratilla* for several *Ulva* fractions with the prospect to identify chemical compounds that may act as a feed stimulant or attractant. The touch and feed preferences of *T. gratilla* were investigated for nine *Ulva* fractions (F1, F2, F3, F4, F5, F6, F7, F8 and F9; obtained from step gradient SI-gel column), in a circular tank for 75 minutes using a modified version of the ‘Avicel’ plating technique from Sakata *et al.* (1984). F9 and F8 were mostly preferred in both feeding preference tests followed by F6, F5 and F4. Digalactosyl diacylglycerol (DGDG) and monogalactosyl diacylglycerol (MGDG) were isolated from F9 and F8 respectively while the presence of methyl palmitate was observed in F5 and F4.Results show clear evidence of the presence of compounds in *Ulva* that may act as a feed stimulant or attractant for the sea urchin *T. gratilla*.

# Radio wavelength observations of Novae: Accreting Eruptive White Dwarf binaries

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Astronomers are interested in light from celestial objects, e.g. stars, galaxies. The interest is in the electromagnetic waves which form various parts of the electromagnetic spectrum and are described by wavelength, frequency, and energy. Astronomical observatories hence mostly consist of telescopes which are used to collimate and detect electromagnetic radiation from the cosmos.

My research focus is to use radio telescope observations which detect radio waves to study Nova

eruptions. In order to detect and analyse radio waves from celestial objects, we make use of an antenna, receiver and a data collector. The most common radio telescopes are made of a parabolic shaped dish with a ‘nose’ and a receiver at the middle of the dish. The radio signals hit and bounce off the dish to the ‘nose’ and bounce back towards the reflector but aimed at the receiver where the signals are amplified and sent to the data collector. Construction of a single dish telescope is limited to its size and tracking capability. Astronomers have therefore embraced the concept of interferometry. This technique uses many smaller telescopes arranged in an array. An interferometry causes the signals of the same frequency to interfere with each other and sum them together thus doubling in amplitude.

A nova eruption occurs when a white dwarf (WD) star (a high-density “retired star”) extensively accretes material onto its surface from a less evolved star slightly smaller than our sun which is in a close orbit with the WD. In this case, the eruption ejects material from the surface of the WD but the star is not destroyed. Radio wavelengths are used to study basic parameters such as ejected mass, the energy of the explosion and the nature of outflow of these explosions.

# Gynomonoecy in Asteraceae: a study using *Helichrysum* Mill. (tribe Gnaphalieae) in South Africa

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Gynomonoecy is the sexual system in which individual plants bear both pistillate and bisexual flowers. Compared with its incidence in angiosperms, gynomonoecy is particularly prevalent in Asteraceae where it is the dominant sexual system. There is strong evidence supporting hermaphroditism as plesiomorphic in Asteraceae, prompting interest in the adaptive advantages of gynomonoecy. Here I investigate possible benefits conferred by gynomonoecy using *Helichrysum*, a large composite genus in which the only sexual systems are hermaphroditism and gynomonoecy. Approximately 245 of the total 500-600 *Helichrysum* species occur in South Africa. I reconstruct the sexual system ancestral to South African *Helichrysum*. I test, at the species and population level, whether gynomonoecy and the number of pistillate flowers in South African *Helichrysum* is related to life history, duration of the growing season, temperature of the coldest quarter, and precipitation of the driest quarter. I also test whether pistillate flowers are associated with larger seeds, higher ovule-to-seed conversion rates and/or reduced herbivory. Gynomonoecy appears to have evolved several times in South African *Helichrysum* and may confer an adaptive advantage in environments characterised by short moisture growing seasons, but the number of pistillate flowers in gynomonoecious species is not related to the environmental variables used at either the species level or population level in *Helichrysum leontonyx*. I argue instead that flower numbers are related to several factors affecting capitulum size, which I show is a strong predictor of the numbers of both pistillate and bisexual flowers. Pistillate flowers do not differ from bisexual flowers with respect to seed size, ovule-to-seed conversion rate, or herbivory. Gynomonoecy may confer adaptive advantages in *Helichrysum* (and more broadly in Asteraceae) in terms of accelerating seed development, limiting floral predation, and generating more seeds and genetic recombinants via more ovules per unit capitulum diameter compared with hermaphrodite species.

# Understanding Pro-environmental Behaviour in Nyanga: Making a Case for Ethnography

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Ideas about pro-environmental behaviour and what constitutes a sustainable lifestyle have been limited and little attention has been paid to the cultural practices and social institutions that promote sustainable living, particularly in my view, in areas of the Global South. My research examines the environmental engagement in the everyday lives of residents living in a black township called Nyanga, in Cape Town, South Africa, as well as community participants in two pro-environmental projects operating there. The research methodology that I used in my study was ethnography, which is about the empirical, “on-the-ground” inquiry of the everyday lives and particulars of human existence. Methods used in ethnographic study include observation, interviewing, and photographs. One of the themes emerging from my data is that context and place matter in the enactment of pro-environmental behaviour. Therefore, in this presentation, I argue that ethnography is a significant methodology to be used for the purpose of gaining a nuanced understanding of what counts as pro-environmental behaviour and how it is enacted by residents of a particular township setting. Through regular engagement, story-telling, and conversation of the people in Nyanga, I have been able to capture the meaning of pro-environmental behaviour and sustainable living practices within a South African peri-urban township.

# Mechanisms of promoter regulation: CCL20 and the Glucocorticoid receptor

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Glucocorticoids (GCs) acting via the glucocorticoid receptor (GR) play a central role in inflammation and immune function. GCs are generally anti-inflammatory and repress the expression of pro-inflammatory chemokines and cytokines in most contexts. Recent studies, however, show that GCs can increase the expression of some pro-inflammatory genes. We show that mRNA levels of the CCL20 chemoattractant gene are upregulated by GCs in an endocervical epithelial cell line. CCL20 is strongly chemotactic for lymphocytes such as T cells. In addition, GCs in combination with pro-inflammatory stimuli such as tumor necrosis factor α (TNFα), bacterial lipopolysaccharides (LPS) and phorbol 12-myristate 13-acetate (PMA) result in synergistic upregulation of CCL20 in a variety of cell lines, for both endogenous mRNA and a CCL20 promoter-reporter construct. Antagonist experiments reveal that the GR is required for the GC-induced upregulation and synergism. Reporter gene analysis of the promoter which lacks a GRE revealed that the NF-κB *cis*-element is required for the synergism. The results suggest that these GC actions in the female genital tract may increase susceptibility to infectious diseases, particularly those resulting from pathogens which enhance TNF release and target lymphocytes, such as HIV.

# Two Particle Correlations and the Deviation from Poisson

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Micro seconds after the big bang the universe was in a state known as quark gluon plasma (QGP). QGP is a deconfined state of matter which only exists at extremely high temperature and density. Produced in heavy ion collision, the QGP state provides a new arena to study the fundamental interaction between quarks and gluons in both weakly and strongly coupled regimes. In this work, we study the distribution of gluon emitted at a soft-collinear region, which is commonly approximated to be Poisson. We first assume that we are in an energy regime in which all particles are approximately massless and the interactions are weakly coupled. We also use the MHV technique to compute the multiple gluon emission currents in order to avoid redundancies from the standard diagrammatic calculation. We derive the momentum distribution for two induced gluon radiation emitted from an offshell quark. Our two-particle distribution shows an explicit non-Abelian correction to the independent emission. The corresponding two-particle correlation is highly suggestive for the correlation measured in high-multiplicity pp or pA collision, which is a tight correlation in the azimuthal but broad in rapidity.

# Using vantage point surveys to study movements of soaring birds

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Renewable energies are key players in fighting climate change and as these technologies become increasingly popular, some environmental concerns arise. Among those affecting raptors and other large soaring birds are mortality by collision or electrocution with wind turbine blades and power lines and avoidance of areas modified by infrastructure. Vantage point surveys are central to the environmental impact assessment of renewable energy projects. They are often used as point counts to collect data on bird passage rates, which are further translated into estimates of collision risk and changes in space utilization. However, some studies demonstrate that passage rates are not enough to predict these impacts and that other drivers, probably related to bird behaviour or environmental conditions, might be at play. My research focuses on extending the use of vantage point surveys for studying flight trajectories, since location, shape and heading of flights, contain relevant information on where and why birds move throughout the landscape. To estimate the accuracy of these data, we conducted an experiment in which three field observers were asked to draw on topographic maps different types of trajectories traced by a drone. I present results from a comparison of these drawings to the records of a GPS installed in the drone, revealing that the average precision of the observers in positioning the flights was close to 400 metres and that they were relatively successful at capturing their shape and headings. Considering this error in relation to the area of the observed plots (up to more than 1000 Ha), fine scale spatial analysis and movement modelling are likely to improve estimates of bird use.