

## PROGRAM VIR DIE TWEEDE PLEGTIGHEID

### *DIE FAKULTEITE NATUURWETENSKAPPE, AGRIWETENSKAPPE, INGENIEURSWESE EN GENEESKUNDE EN GESONDHEIDSWETENSKAPPE*

*'n Vriendelike beroep word op alle aanwesiges gedoen om selfone af te skakel en nie die saal tydens die plegtigheid te verlaat nie en sodoende te verseker dat die verrigtinge sonder ontwrigting verloop.*

1. Akademiese prosesie kom die saal binne. U word versoek om te staan terwyl hulle die saal binnekom en te bly staan vir die sing van die Nasionale Lied.
2. Sing van die Nasionale Lied (kyk binneagterblad). Neem asseblief daarna u sitplekke in.  
Begeleiding: Universiteit Stellenbosch Koperblaasensemble. Perkussie, Orrel: Francisco Salies.  
Voorsanger: Lunathi Ncumani
3. Konstituering deur die Kanselier.
4. Gebed deur eerw dr Ron Phillips.
5. Verwelkoming deur die Kanselier.
6. Voorstelling van doktorandi deur die dekane van die betrokke fakulteite en toekenning van grade deur die Kanselier.
7. Sluiting deur die Kanselier.
8. Akademiese prosesie verlaat die verhoog.

*Die aanwesiges word versoek om te bly staan totdat die akademiese prosesie uitgestap het.*

## PROGRAMME FOR THE SECOND CEREMONY

### *THE FACULTIES OF SCIENCE, AGRISCIENCES, ENGINEERING AND MEDICINE AND HEALTH SCIENCES*

*To help ensure that the proceedings run their course without disruption, will all those present kindly keep their cell phones switched off, and refrain from leaving the hall while the ceremony is in progress.*

1. Entrance of academic procession into the hall. You are requested to stand while it enters, and then to remain standing for the singing of the National Anthem.
2. Singing of the National Anthem (see inside back cover). Thereafter, please be seated.  
Accompaniment: University of Stellenbosch Brass Ensemble. Percussion, Organ: Francisco Salies.  
Precentor: Lunathi Ncumani.
3. Congregation formally constituted by the Chancellor.
4. Prayer by Rev Dr Ron Phillips.
5. Welcome by the Chancellor.
6. Presentation of doctoral candidates by the deans of the respective faculties and conferment of degrees by the Chancellor.
7. Closing by the Chancellor.
8. The academic procession leaves the stage.

*Those present are requested to remain standing until the academic procession has left the hall.*

# ISICWANGCISO-NKQUBO SOMSITHO WESIBINI

## IIFAKHALTHI EYOBUNZULULWAZI KWEZOBUGQI, EYEZEEAGRISAYENSI, EYOBUNJINELI, NEYEZAMACHIZA NEENZULULWAZI KWEZEMPILO

*Ukuqinisekisa ukuba umsitho uqala ngaphandle kwesiphazamiso, bonke abakhoyo bayacelwa ukuba bacime iiselfowuni zabo, kwaye bangaphumi eholweni ngeli xesha umsitho uqhubekayo*

1. Kungena umkhosi wemithika eholweni. Niyacelwa ukuba nime ngeenyawo xa ungena, nihlale nime njalo ukuze kuculwe uMhobe weSizwe.
2. Kukulwa uMhobe weSizwe (Jonga kumphakathi weqweqwe lokugqibela). Emva koko, ningahlala phantsi. Umculo: yi-University of Stellenbosch Brass Ensemble. Umdlali wohadi: nguFrancisco Salies. Umhlabeli: nguLunathi Ncumani.
3. UMsitho uvulwa ngokusesikweni nguTshansila.
4. Umthandazo wenziwa nguMfu Gqr Ron Phillips.
5. Ulwamkelo lwenziwa nguTshansila.
6. Ukunikezelwa kwabafundi bezidanga zobugqirha ziintloko zeefakhalthi (iidin) ezichaphazelekayo nokuthweswa kwezidanga nguTshansila.
7. Ukuvalwa koMsitho nguTshansila.
8. Umkhosi wemithika uyalishiya iqonga.

*Bonke abakhoyo bayacelwa ukuba beme ngeenyawo de umkhosi wemithika ube uphume wonke eholweni.*

## KANDIDATE WAT KWALIFIKASIES ONTVANG

Hier volg 'n lys van graduandi met hul studierigtings, proefskriftitels en opsommings van die navorsing. Die grade van graduandi wat nie by die gradeplegtigheid teenwoordig kan wees nie, word in hulle afwesigheid toegeken.

## CANDIDATES RECEIVING QUALIFICATIONS

Here is a list of graduands with their fields of study, dissertation titles and summaries of research. The degrees of graduands who are unable to attend the graduation ceremony are awarded in absentia.

## ABAFUNDI ABAFUMANA IZINGQINI ZEZEMFUNDO

Nalu uluhlu lwabathweswayo kwiinkalo zesifundo, izihloko zeedizethyishini kunye nezishwankathelo zophando. Izidanga zabathweswayo abangakwazanga ukubakho ubuqu kumsitho wothweso-zidanga bathweswa bengekho benjalo.

### Fakulteit Natuurwetenskappe

### Faculty of Science

### IFakhalthi yezobuNzululwazi kwezobuGqi

#### PhD

ADERA, Gashaw Bekele (Physics)

*Relativistic distorted wave analysis of neutrino-induced strange particle production from nuclei*

A relativistic distorted wave model was developed for neutrino-induced kaon production from nuclei. The kaon distorted wave function was obtained by solving the Klein-Gordon equation with a relativistic potential. A general Lorentz invariant form of the weak current operator was derived. The invariant amplitudes were calculated, employing a Born term approximation in the  $s$ -,  $t$ - and  $u$ -channels for the elementary process. A new technique was derived to transform the multidimensional summations to a single summation, which was then calculated by using parallel-computing techniques implemented on a computer cluster. The inclusion of distortions significantly reduces the angular distributions of the cross section.

Supervisor: Prof BIS van der Ventel

Co-supervisor: Prof DR Phillips

BAMUNOBA, Alex Samuel (Mathematics)

*Arithmetic of Carlitz polynomials*

There is a well-known analogy between classical number theory and the theory of curves over a finite field. In the 1930s Carlitz pushed it further, defining his exponential function and analogues of roots of unity and cyclotomic polynomials. The Carlitz analogue of Suzuki's theorem that, in the classical setting, every integer is a coefficient of some cyclotomic polynomial was now proven. It was also proven that the set of all coefficients of the Carlitz cyclotomic polynomials is as large as possible.

Supervisor: Dr AP Keet

BARNARD, Bernardus Francis (Chemistry)

*The synthesis of selective immobilised ligands for the extraction of toxic metal ions from water doped with these contaminants*

The removal of toxic metal ions from mining waters and streams is an important challenge. Once toxic metal ions have been removed, these waters can be further purified to obtain drinking water. Ligands (molecules) were synthesised and two crown ether derivatives were separately immobilised onto four different silica supports. These immobilised systems were used to separately extract six different metal ions ( $\text{Cd}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Hg}^{2+}$ ,  $\text{U}^{6+}$ ,  $\text{As}^{5+}$  and  $\text{Cr}^{6+}$ ) from water. The extraction capabilities of the different systems were compared with each other to determine whether the substrates had any influence. Above average extraction was achieved under the conditions used.

Supervisor: Dr RC Luckay

External Co-supervisor: Prof L Petrik

BLANCHARD, Ryan (Botany)

*An assessment of the potential biodiversity impacts from biofuel production in South Africa*

The impact of biofuel production on biodiversity in South Africa caused by land-use changes and associated effects was explored. Potential biodiversity conflicts in the Eastern Cape were assessed, using species distribution models and biodiversity indicators and by assessing effects of landscape fragmentation. The main impacts of biofuel production include potential conflicts between areas of high biodiversity and areas with production potential and the effects of non-native plant species on functional structures of plant communities.

Supervisor: Prof DM Richardson

Co-supervisor: Dr PJ O'Farrell

DAVIES, Sarah (Zoology)

*Geographic range, spread and potential distribution of the painted reed frog *Hyperolius marmoratus* in the Western Cape Province, South Africa*

Biological invasions are transforming our biodiversity at an alarming rate. The recent fast spread of the painted reed frog *Hyperolius marmoratus* from the eastern and southern regions of South Africa to the Cape was investigated. The mechanisms that allow this species to

establish outside its historical range were explored. The range expansion was facilitated by the frogs' ability to adjust to warm and dry conditions via physiological and behavioural flexibility and by exploiting artificial water bodies in the novel range. The interaction of climate, landscape transformation, physiology and behaviour in determining the invasion success of this small tropical amphibian was highlighted.

*Supervisor:* Dr S Clusella-Trullas

*Co-supervisor:* Prof M McGeoch

DE VILLIERS, Anton Pierre (Operations Research)

*Edge criticality in secure graph domination*

The study investigated the combinatorial optimisation problem of determining the smallest number of guards that can be placed on the nodes of a network in such a way that each unoccupied network node  $v$  can be defended by a guard moving from an adjacent, occupied node to  $v$  to deal with a security concern there, after which each node should contain a guard or be adjacent to at least one node containing a guard. Networks requiring small numbers of guards for their protection were characterised, and a number of algorithms were designed, implemented and tested for determining this minimum number of guards for any network. Threshold information was also established in lieu of the smallest and largest numbers of network link removals that can be tolerated before the original number of guards can no longer protect the network.

*Supervisor:* Prof JH van Vuuren

*Co-supervisor:* Dr AP Burger

DU TOIT, Jacques (Operations Research)

*Decision support for threat detection in maritime surveillance*

The protection of South Africa's vast coastline is a challenging prospect considering the limited coast guard resources available. Maritime kinematic data and seafaring vessel reports may be leveraged to provide early warnings of threatening behaviour (such as piracy, collisions at sea and illegal fishing). It is typically the responsibility of human operators in a situation room to observe the maritime surveillance scene and initiate appropriate courses of action. However, processing these vast collections of maritime traffic data and separating unexplained behaviour from mundane behaviour can be overwhelming. Decision support systems play an invaluable role in assisting operators in this task. Such a system, capable of detecting specific threatening sea vessel behaviours, was designed, using data-driven and rule-based approaches.

*Supervisor:* Prof JH van Vuuren

HANSEN, Robert Neill (Geology)

*Numeric geochemical modelling, incorporating systems theory and implications for sustainable development – study on East Rand basin acid mine drainage, Witwatersrand, South Africa*

A systems theory approach combined with numerical modelling of the geochemical systems was used to understand the source and impact of acid mine drainage (AMD) in the East Rand basin. Tailings dam and waste storage are the largest contributors to AMD and the surroundings are impacted from 50 years and onwards. Pyrite oxidation

with oxygen as the oxidant is the major pathway for generation of AMD. A basic cost-benefit analysis shows that the costs for the operating mine, and society in general, are lower when mitigation measures are employed during operation.

*Supervisor:* Prof AN Roychoudhury

KHESWA, Bonginkosi Vincent (Physics)

*Impact of the  $^{138,139}\text{La}$  radiative strength functions and nuclear level densities on the galactic production of  $^{138}\text{La}$*

With the notable exception of  $^{138}\text{La}$ , most heavy nuclei are synthesised in neutron capture and photodisintegration processes, which take place in stars and supernovae. The photon strength functions and nuclear level densities of  $^{138}\text{La}$  and  $^{139}\text{La}$  have been measured below the neutron separation energies. These new data were used to calculate astrophysical Maxwellian-averaged (neutron gamma) cross sections to investigate the production and destruction of  $^{138}\text{La}$ . The results confirm the underproduction of  $^{138}\text{La}$  in the photodisintegration process compared to the observed abundances and strongly support the electron-neutrino capture on  $^{138}\text{Ba}$  as the main contributor to the synthesis of  $^{138}\text{La}$  in Type II supernovae.

*Supervisor:* Dr M Wiedekring

*Co-supervisors:* Dr F Giacompo and Prof P Papka

MATEYISI, Jacob Mohau (Physics)

*Particle diffusion in elastically coupled narrow parallel channels*

A theoretical study was made of the dynamical properties of guest particles in micro-porous host materials where long channels are coupled to each other elastically. Computer simulations indicated that in narrow coupled pores, permitting only single file motion, the current of particles driven through the host medium between two reservoirs of different densities first decreases with increasing coupling between pores, but eventually increases strongly due to cooperative effects. A mean-field calculation was presented for the regime of weak coupling. A dynamical, functional-integral calculation sheds light on the role of inter-channel interactions on the collective dynamics.

*Supervisor:* Prof KK Müller-Nedebock

*Co-supervisor:* Dr L Boonzaaier

McLAREN, Melanie Gail (Physics)

*Tailoring quantum entanglement of orbital angular momentum*

Quantum mechanics as a theory has been in existence for over 100 years now, yet experimentally it remains a challenge to engineer, or design, custom quantum states. This work has demonstrated the tools to engineer high-dimensional quantum states using the orbital angular momentum of light. The candidate has applied these tools to create high-dimensional entangled Bessel photons, and has shown that they can preserve entanglement after obstacles. The candidate produced the first entanglement experiment in Africa and her work has been published in several high-ranking journals, including *Nature*. These results will be a core resource for future quantum communication studies.

*Supervisor:* Prof A Forbes

*Co-supervisors:* Prof EG Rohwer and Dr FS Roux

NJAGARAH, Hatson John Boscoh (Mathematics)

*Modelling waterborne infections: the impact of hygiene, metapopulation movements and the biological control of cholera*

In this study new mathematical model frameworks for understanding the transmission dynamics of cholera have been developed. The impact of hygiene, metapopulation movements, optimal and biological control, using a bacteriophage specific to pathogenic *V. cholera*, were assessed. The results indicate that: improved hygiene is vital in reducing cholera infections; the spread of disease across metapopulations is characterised by synchronous fluctuations; the control measures should be optimal at the beginning of the epidemic; and biological control would avert many potential infections by lowering the concentration of pathogenic vibrios in the aquatic environment.

Supervisor: Prof F Nyabadza

NKOMO, Mpumelelo (Botany)

*Metabolomic profiling and micropropagation of Salvia africana-lutea L. potent against Fusarium verticillioides*

Metabolomic profiling of *Salvia africana-lutea* populations was performed to evaluate chemotypic variation for antifungal activity. The five chemotypes were correlated to anti-*Fusarium* bioactivity and an elite chemotype was identified. Two bioactives (carnosol and carnosic acid) were isolated and identified and for the first time were directly linked to anti-*Fusarium* activity. Conservation of this elite chemotype is possible through micropropagation and presents a novel source for the development of new plant-based fungicides for the agrochemical and pharmaceutical industries.

Supervisor: Dr NP Makunga

Co-supervisor: Prof D Katerere

READER, Paul William (Polymer Science)

*Anti-malarial polymer-peptide conjugates*

Tyrothricin is a known anti-malarial peptide, which cannot be used as a drug due to its haemolytic activity. Tyrothricin was conjugated with poly(*N*-vinylpyrrolidone) (PVP) which self-assembled into micelles. The link between peptide and PVP was designed to hydrolyse in the food vacuole of the malaria parasite (pH 5.5). The outside of the micelles was decorated with targeting ligands that triggered the uptake of the micelles into erythrocytes. An *in vitro* assay showed that the conjugate was 700 times more active than the peptide and 100 times more selective.

Supervisor: Prof L Klumperman

Co-supervisor: Prof AE Rowan

SCHULTZ, Thia (Genetics)

*Elucidating functional interactions between the Russian wheat aphid (D. noxia Kurdjumov) and bread wheat (Triticum aestivum L.)*

*Diuraphis noxia* (Kurdj.) is an important aphid pest of wheat, causing large-scale damage and yield losses. Virus-induced gene silencing, using a barley stripe mosaic virus vector, was utilised to knock down candidate genes in *Dn1*-resistant wheat. Knock-down of a phi-class

glutathione-S-transferase F6 (*TaGSTF6*) transcript had a substantial effect on aphid nymph numbers and thus may contribute to *Dn1* resistance. Silencing of a nucleotide-binding protein and resistance gene analogue 2 (*RGA2-T10rga2-1D*) resulted in susceptibility, while *T10rga2-1D*-silenced treatments died after aphid infestation, making *T10rga2-1D* a good up-stream candidate in *Dn1* resistance.

Supervisor: Prof A Botha-Oberholster

VERMEULEN, Christiaan (Fisika)

*Production of radionuclides with medium energy protons with the emphasis on targetry*

Die produksie van verskeie radionukliede van mediese belang is ondersoek d.m.v. protongeïnduseerde kernreaksies. Dit sluit in rhenium-186, die radioterbioms Tb-149, Tb-152 en Tb-155 sowel as die radio-sirkoniums Zr-88 en Zr-89, wat van spesifieke belang is vir bestaande en toekomstige diagnostiese en terapeutiese toepassings in die kern-geneeskunde. Potensiële skyfmateriale is geaktiveer met protone gelewer deur 'n siklotron. Opwekkrommedata is gemeet deur gebruik te maak van gamma-spektroskopie en is vergelyk met statistiese kernmodelberekeninge. Sulke data is belangrik om potensiële produksieroetes te optimeer en om die ontwerpparameters van skyfgerei vas te stel. Metodes om die produksiekapasiteit te verhoog is ook ondersoek.

Eksterne Promotor: Dr GF Steyn

Medepromotor: Prof AA Cowley

VISSER, Marike (Genetics)

*Small RNA profiling of virus-infected apple plants*

Commercial apple cultivars have a high degree of tolerance to apple stem grooving virus (ASGV) infection. A next-generation sequencing approach was followed to identify small RNAs (sRNAs) that are associated with virus infection in apple plants. Several sRNA species were identified and characterised. Comparisons of infected and healthy plants showed no variation in the expression of most sRNA species, except for several tRNA-derived sRNAs, which were differentially expressed. This study is the first report on the involvement of sRNAs in ASGV infection and thus furthers our understanding of virus latency in apple. The apple sRNA database generated in this study provides a platform for various future functional genomics investigation studies.

Supervisor: Prof JT Burger

Co-supervisors: Dr J Rees and Dr HJ Maree

WAHL, Helene (Chemistry)

*Development of novel supramolecular framework materials based on organic salts*

Detailed investigations of hydrogen-bonded organic framework materials are rare. In this study, charge-assisted hydrogen bonds between organic components resulted in the self-assembly of three novel framework materials that were found to exhibit unusual properties. One of the frameworks is porous and undergoes single-crystal to single-crystal guest exchange with a wide variety of guest molecules, an unusual occurrence in such materials. Kinetics of exchange were investigated for this process. Another series of framework materials

showed marked selectivity for one particular guest. The results give insights into the structural features required for framework formation.

Supervisor: Prof T le Roex

Co-supervisor: Prof DA Haynes

ZWANE, Eunice Nonhlanhla (Microbiology)

*Production, characterisation and application of a recombinant ferulic acid esterase from Aspergillus tubingensis*

The antioxidant, ferulic acid, can be extracted from plant material with the aid of the enzyme ferulic acid esterase. A genomic copy of the *Aspergillus tubingensis* ferulic acid esterase gene was expressed and characterised in a food-grade *Aspergillus niger* strain and enzyme production was significantly improved under fed-batch conditions. The recombinant ferulic acid esterase increased the extraction of ferulic acid from maize and triticale brans, as well as from rooibos material, indicating that it could improve the nutritional value of cereal bran for animal feed and also extract valuable antioxidants from other plant substrates.

Supervisor: Prof M Viljoen-Bloom

Co-supervisors: Dr K Rumbold and Prof WH van Zyl

## DSc

RAWLINGS, Douglas Eric (Microbiology)

*The biology, diversity and evolution of the broad host-range, promiscuous IncQ plasmids, with an emphasis on the IncQ2 subfamily*

Plasmids of the IncQ family are small pieces of DNA that are capable of replication within, and mobilisation between, a very wide range of microorganisms. As a result they are highly promiscuous and able to serve as vehicles of horizontal gene transfer. Studies on the mechanisms of IncQ2 plasmid replication, mobilisation and stability as well as their regulation carried out over approximately 30 years have been included in this research. A strong focus has been on how the plasmids have evolved from a common ancestor and how differences have affected the fitness of the plasmids without placing unnecessary demands on the host organisms.

Supervisor: Prof WH van Zyl

## **Fakulteit Agriwetenskappe** **Faculty of Agrisciences** **IFakhalthi eyezeeAgrisayensi**

## PhD

GROENEWALD, Berlize (Conservation Ecology)

*Discontinuous gas exchange in Orthoptera – mechanisms and hypotheses*

Understanding the mechanisms underlying insect gas exchange is of fundamental importance. This research tested the mechanistic bases of variation. At normal atmospheric conditions gas exchange is mainly diffusive, and gas exchange is most energetically efficient at these conditions. This dissertation also examined oxygen, water and haemolymph pH regulation by using a full-factorial experimental design. The

candidate developed a hierarchical framework for the different abiotic factors that influence gas exchange patterns and their variation. This work shows that modulation of gas exchange patterns is affected by multiple abiotic factors following a strict hierarchy of control, which constitutes a major breakthrough for the research field.

Supervisor: Prof JS Terblanche

Co-supervisor: Prof SL Chown

KARSTEN, Minette (Entomology)

*Population genetic structure and abundance of two Ceratitis species (Tephritidae) of agricultural importance in South Africa*

This study investigated the population genetic structure and invasion biology of two agriculturally important pest fruit fly species. Using molecular tools and geometric morphometrics methods, the candidate's research showed high connectivity between pest-occupied sites within South Africa and across the African continent. This dissertation also examined large-scale (intercontinental) movement and tested invasion pathway hypotheses using a novel Bayesian statistical method. Results showed that, apart from the initial invasion and establishment of the species outside of Africa, quarantine and interception measures have been largely successful. These results are critical to pest risk assessment and preventing further invasions by pest insects.

Supervisor: Dr P Addison

Co-supervisors: Prof JS Terblanche and Prof B Jansen van Vuuren

KLEYNHANS, Elizabeth (Entomology)

*Environmental physiology of Eldana saccharina (Lepidoptera: Pyralidae) in South Africa: implications for pest management*

This study examined the physiological ecology of *Eldana saccharina*, a major insect pest of sugar cane, to understand its geographic distribution, phenology and population abundance. The candidate found that *Eldana* has evolved physiology to match local climatic conditions across its range, that the host plant can mediate low temperature activity limits and that thermal history influences adult performance through direct physiological and indirect life history responses. A synthetic model of their population dynamics was developed and provided integrated insights into their biology and phenology. These results are critical to the management of this pest species and for understanding climate change impacts in South Africa.

Supervisor: Prof DE Conlong

Co-supervisor: Prof JS Terblanche

OOSTHUIZEN, Hamman Jacobus (Agricultural Economics)

*Modelling the financial vulnerability of farming systems to climate change in selected case study areas in South Africa*

Integrated climate change models were linked to farm level models in order to simulate the impact of climate change at farm level. The models simulate the projected impact of climate change on crop yield and quality, availability of irrigation water and changing crop irrigation requirements. New modelling techniques were developed to assess these impacts on the financial vulnerability of different farming systems. The adaptation strategies followed by farmers were then incorporated

in the models and financially appraised. The Crop-critical Climate Threshold (CCCT) technique and several modelling interphases contribute to the field of integrated climate change modelling.

Supervisor: Dr JP Lombard  
Co-supervisor: Dr DB Louw

SITAS, Nadia Ellis (Conservation Ecology)

*Opportunities and challenges for mainstreaming ecosystem services in decision making*

Through an extensive transdisciplinary, stakeholder-driven approach which explored the information needs, responsibilities and capacities of decision makers in the Eden District of South Africa, this study identified both opportunities facilitating the integration of ecosystem service information in decision making, and challenges impeding integration, in order to bridge the gap between science and practice.

Supervisor: Prof B Reyers  
Co-supervisors: Prof KJ Esler and Dr H Prozesky

### PhD (Agric)

MOSTERT, Glaudina (Plant Pathology)

*Characterisation and distribution of Fusarium oxysporum f. sp. cubense in Asia*

*Fusarium oxysporum f. sp. cubense* (Foc) causes banana Fusarium wilt worldwide. The diversity and distribution of Foc in Asia was determined in this study. Foc TR4 was found mainly in Southeast Asia where it severely affects Cavendish bananas, and Foc race I in the Indian subcontinent on non-Cavendish banana varieties. Five new multi-member vegetative compatibility groups (VCGs) and eight single-member VCGs were described. New generation sequencing enabled the development of molecular markers that could be used for rapid pathogen characterisation. The study provides important baseline information for use by quarantine officials and for employment of resistant banana varieties.

Supervisor: Prof A Viljoen  
Co-supervisor: Dr L Mostert

SERRA-STEPKE, Ignacio Marcelo (Viticulture)

*Grapevine (Vitis vinifera L., cv. Pinotage) responses to water deficit modulated by rootstock*

The main aim of this study was to improve the understanding of the rootstock/scion-cultivar interaction in the regulation of grapevine water use and leaf stomatal behaviour. The study was conducted on Pinotage, an important cultivar for South Africa. The results showed that one possible mechanism of Pinotage leaf adaptation to water constraints was structural during leaf growth, with a reduction in pore size to reduce plant water loss. The results also showed that the rootstock regulates the cultivar's stomatal size (anatomical changes during leaf growth) and functioning (stomatal regulation) through a complex signalling process.

Supervisor: Prof A Deloire  
Co-supervisor: Dr P Myburgh

### PhD (Food Science)

GELDENHUYS, Greta (Food Science)

*Egyptian geese (Alopochen aegyptiacus): sensory, biochemical and physical meat quality as affected by gender, diet and aging*

In South Africa, there is an opportunity to utilise wildfowl meat. Crop farmers incur major financial losses due to the feeding activities of Egyptian geese (*Alopochen aegyptiacus*). Consequently the geese are hunted in an attempt to reduce the damage caused. This study provides essential baseline data regarding the basic sensory, physical and chemical quality of Egyptian goose meat. The extent to which the meat quality is influenced by season, gender and portion has also been explored. In attempting to elucidate the toughness of the meat, possible causes have been proposed. Ultimately, this research provides substantial proof that the commercial utilisation of Egyptian goose meat is feasible.

Supervisor: Prof LC Hoffman  
Co-supervisor: Me N Muller

## Fakulteit Ingenieurswese Faculty of Engineering IFakhalthi yezobuNjineli

### PhD

ANDRIAMBELOSON, Joely Andrianina (Electronic Engineering)

*Reverberation chamber time and frequency metrology for MeerKAT systems shielding evaluation*

South Africa successfully attracted two thirds of the Square Kilometre Array (SKA) to this continent through its Karoo Array Telescope project. The SKA, described as the scientific project of the century, will be the most sensitive radio telescope ever. Joely Andriambeloston's research has refined techniques for electromagnetic shielding evaluation of MeerKAT systems. Shielding levels 100 000 times more demanding than commercial systems are required to support the science aspirations. Joely has developed two methods, exploiting time domain measurement advantages, which allow clear pictures of equipment shielding to be determined. Research such as this contributed significantly to our robust pan-African SKA bid.

Supervisor: Prof HC Reader

BEZUIDENHOUT, Gert Adrian (Extractive Metallurgical Engineering)

*Pyrometallurgical refining of high-grade platinum group metal leach residues prior to precious metals separation*

Existing hydrometallurgical refining techniques for platinum group metals are complicated by the control of impurities prior to or during separation of the metals. A novel pyrometallurgical process to remove impurities from high-grade platinum group metal residues prior to separation was developed and studied through modelling and experimentation. The process consists of roasting, smelting and atomisation steps, and can increase the precious metal content from 40% in a

pressure leach residue to 88% in an alloy phase. The new process experienced low metal losses (mostly ruthenium) and is a viable alternative to current refining methods.

*Supervisor:* Prof G Akdogan

*Co-supervisors:* Prof SM Bradshaw and Prof JJ Eksteen

BRAND, Tobias Gerhardus (Elektroniese Ingenieurswese)

*Sintese tegnieke vir multiband-gekoppelde resoneerderfilters*

Die intreefilters van moderne kommunikasietoerusting moet voorsiening maak vir veelvoudige frekwensiebande, sonder om die ontvangers fisies groter te maak. Klassieke ontwerp tegnieke maak egter slegs voorsiening vir enkelbandfilters en is baie moeilik om uit te brei. Hierdie projek bied nuwe wiskundige tegnieke aan om baie algemene multiband-mikrogolffilters mee te ontwerp, asook nuwe implementerings wat daardeur moontlik gemaak word. Anders as ander onlangse tegnieke, is hierdie benadering nie beperk ten opsigte van die aantal frekwensiebande of die orde van die filters nie, omdat dit berus op eksakte transformasiefunksies. Die werk is van groot belang vir die mobiele kommunikasie-industrie.

*Promotor:* Prof P Meyer

*Eksterne Medepromotor:* Prof R Geschke

DUNN, Dwain (Mechanical Engineering)

*The effect of endwall contouring on the unsteady flow through a turbine rotor*

Unsteady effects of turbine hub contouring were investigated as a means of reducing losses in an aircraft turbine engine. The rotor end-wall contour reduced the rotor exit losses, with the effectiveness proportional to the loading. No new unsteady effects were introduced by the endwall contour. The contoured rotor exit velocity profile was made more radially uniform by moving some of the high momentum flow in the hub endwall secondary flow vortex radially outwards. A new optimisation objective function (named Design Efficacy) was proposed for use in designing non-axisymmetric endwall contours.

*Supervisor:* Prof TW von Backström

GOOSEN, Neill Jurgens (Chemical Engineering)

*Investigation of potential bio-active properties and effects on production performance of aquafeed ingredients derived from fish processing waste by way of enzymatic autolysis*

New sources of ingredients for aquaculture feeds are required, since wild fisheries cannot provide increasing feed amounts for the rapidly growing industry. Wastes originating from fish processors are an underutilised source of potential feed ingredients. This study produced aquafeed ingredients from fish processing wastes through endogenous enzyme hydrolysis and validated the quality of such ingredients as aquafeed components. Feeding trials with formulations containing these ingredients showed improvements in aquaculture production performance and animal health. The evidence from this study demonstrates that a simple enzyme hydrolysis process can produce quality aquafeed ingredients to contribute to the sustainable expansion of aquaculture.

*Supervisor:* Prof JF Görgens

*Co-supervisor:* Mr LF de Wet

GOUS, Johannes Hendrik (Industrial Engineering)

*Towards a reference architecture for integrated knowledge networks*

The candidate focussed on the engineering of integrated knowledge networks (IKNs) through the use of a reference architecture. This study seeks to gain a deeper understanding of the constructional principles underlying this class of collaborative networks. The reference architecture for IKNs is developed through design science research within a pragmatic and qualitative research strategy. It was found that the reference architecture provides constructional principles in the engineering of IKNs, thus enabling the design, operation and research of this class of collaborative networks.

*Supervisor:* Prof CSL Schutte

*External Co-supervisor:* Prof A Gerber

JOOSTE, Johannes Lodewyk (Industrial Engineering)

*A critical success factor model for asset management services*

Business-to-business services relating to physical asset management are playing an increasingly important role in industry. This is in the midst of the current pressures which organisations are experiencing in realising value from their assets. The pursuit of complying with the ISO 55 000 asset management standard contributes towards the importance of these services. The problem is that there is no evidence regarding the critical success factors for collaborating successfully in asset management services. This study identifies these factors and then develops a decision support model for providing industry with access to the factors for decision making and for improving asset management services.

*Supervisor:* Prof PJ Vlok

*Co-supervisor:* Prof CSL Schutte

KOTZE, Johannes Paulus (Mechanical Engineering)

*Metallic phase change materials as a thermal energy storage concept*

Concentrating solar power (CSP) is an essential part of a renewable energy future as it offers economical energy storage. Currently CSP is the most expensive source of renewable energy and the use of supercritical steam cycles is considered an essential cost reduction strategy. The state of the art in thermal energy storage has temperature limits preventing the use of high efficiency power cycles. A new concept that utilises metallic phase change materials was developed and pioneered. This will enable thermal energy storage at sufficiently high temperatures and may lead to significant cost reductions of the levelised electricity cost of CSP.

*Supervisor:* Prof TW von Backström

*Co-supervisor:* Dr P Erens

LUDICK, Daniel Jacobus (Electronic Engineering)

*Efficient numerical analysis of finite antenna arrays using domain decomposition methods*

In this dissertation the candidate considered the efficient numerical analysis of large, aperiodic finite antenna arrays. A Method of Moments-based domain decomposition technique, the Domain Green's Function Method (DGM), was formulated to address a wide



range of array problems in a memory and runtime efficient manner. A number of practical applications for the DGFM were presented, demonstrating their usefulness for the electromagnetic analysis of large arrays. A contemporary example is the low frequency component of the Square Kilometer Array. The DGFM has been integrated as part of an efficient array analysis tool in a commercial computational electromagnetics simulation package.

Supervisor: Prof DB Davidson

Co-supervisor: Dr U Jakobus

THYSE, Elton Llyle (Extractive Metallurgical Engineering)

*Effect of iron endpoint during Peirce-Smith converting on matte mineralogy and downstream processing of base and platinum-group metals*

Lonmin considered improving smelter and extraction unit process integration and efficiency by selecting a desirable iron endpoint. However, a desirable iron endpoint had to be investigated considering that the effect of iron endpoint on matte mineralogy, mineral chemistry, solidification and downstream processing was poorly understood and therefore quantified. A novel combination of modern analytical and computational techniques and metallurgical testwork was required to unlock the effect of variable iron endpoints. A practical iron endpoint range of 1,6% to 1,0% was recommended for the production of converter matte with a mineralogical quality within the constraints of the Lonmin base metal refinery.

Supervisor: Prof G Akdogan

## **Fakulteit Geneeskunde en Gesondheidswetenskappe**

### **Faculty of Medicine and Health Sciences**

#### **IFakhalthi yezamaChiza neeNzululwazi kwezeMpilo**

##### **PhD**

CHELLAN, Nireshni (Medical Physiology)

*The effect of Cyclopa maculata extract on B-cell function, protection against oxidative stress and cell survival*

Insulin-producing pancreatic beta cells are vulnerable to excessive oxidative stress associated with type 2 diabetes. Ms Chellan investigated the protective effects of *Cyclopa maculata*, a honeybush species, against beta cell injury experimentally induced by lipotoxicity, inflammation and oxidative stress. The protective effect of a *C. maculata* extract against these beta cell stressors was demonstrated in a beta cell line and isolated pancreatic islets. In diabetic rats, the extract improved glucose tolerance, triglyceridaemia and pancreatic islet morphology associated with beta cell function. This study demonstrated that

products of *C. maculata* could potentially protect beta cells against stressors associated with the development and progression of type 2 diabetes.

External Supervisor: Dr CJF Muller

External Co-supervisor: Prof E Joubert

Co-supervisor: Prof JG Strijdom

ESSONE NDONG, Paulin (Molecular Biology)

*Development of immune-based TB tests suitable for resource limited settings*

Tuberculosis (TB) is still a major cause of deaths in poor socio-economic settings across the world and the lack of simple and rapid diagnostic tests suitable for such areas compounds the problem. For this dissertation proteins from *Mycobacterium tuberculosis* were investigated for their ability to induce cytokine production in short-term whole-blood cultures to diagnose active TB. Mass spectrometry was also employed to search for new host markers. New combinations of antigens and host markers with promising potential were found and are now being investigated in new studies. Acute phase proteins stood out for diagnostic use.

Supervisor: Prof G Walz

Co-supervisor: Dr NN Chegou

FANG, Zhuo (Molecular Biology)

*Elucidation of the structure and function of the mycosins, a family of essential subtilisin-like serine proteases of Mycobacterium tuberculosis*

*Mycobacterium tuberculosis*, the causative agent of tuberculosis, affects millions of people worldwide, and there is a dire need for new drug targets against the organism. The results showed that even though its gene was transcribed, the protein Mmpl5, a component of the mycobactin export system, was not detected in the absence of mycosin-3, a component of the Esx-3 secretion system. This suggests that abolishing mycosin-3 could disable mycobactin export, thereby ensuring toxicity from intracellular accumulation, killing *M. tuberculosis*. The study showed that mycosin-3 is an attractive drug target, thereby making a significant contribution to the field of drug discovery in *M. tuberculosis*.

Supervisor: Prof NC Gey van Pittius

Co-supervisor: Prof RM Warren

GELDENHUYS, Elsje-Marie (Morfologiese Wetenskappe)

*A morphological assessment of the health status of a cadaver population at the Faculty of Health Sciences, Stellenbosch University, with special reference to Tuberculosis (TB) lesion distribution*

Elsje-Márie Geldenhuys het die gesondheidstatus van 'n kadawerpopulasie bepaal deur histopatologie, radiologie en molekulêre biologie in die anatomiese sektor te integreer. Spesiale aandag is gegee aan tuberkulose (TB)-letselmorfologie en -verspreiding. Sy het gevind dat vroue meer geneig is om met verspreide TB-letsels te presenteer, terwyl mans 'n geneigdheid het tot pulmonêre TB-ontwikkeling. Beduidende tendense tussen TB en sistemiese patologie is waargeneem. Radiologie was geskik om kavitasies en pleurale verdikking te visualiseer, terwyl molekulêre toetse die teenwoordigheid van mikobakterië

bepaal het. Hierdie studie gee dus 'n holistiese beeld van die gesondheid-status van individue van lae sosio-ekonomiese gemeenskappe.

Promotor: Prof SH Kotze

Medepromotor: Dr EH Burger

GEORGE, Cindy (Medical Physiology)

*The regenerative and anti-inflammatory capability of Prosopis glandulosa*

The aims of the study was to evaluate the effect of an indigenous plant, *Prosopis glandulosa*, on muscle force generation and its ability to recover after stimulation to fatigue as well as its regenerative capacity and the inflammatory mediators involved, after a contusion injury. The results showed that treated rats did not exhibit altered response to fatigue. However, muscles generated significantly more force at different stimulated frequencies and throughout a 2 minute fatigue protocol. In addition, *P. glandulosa* treatment resulted in more effective muscle repair after a contusion injury, in part due to modulating effects on neutrophil infiltration.

Supervisor: Prof B Huisamen

Co-supervisor: Prof C Smith

External Co-supervisor: Prof D Dietrich

McGREGOR, Nathaniel Wade (Psychiatry)

*The identification of novel susceptibility genes involved in anxiety disorders*

Genetic and environmental factors are involved in the aetiology of anxiety disorders. However, little attention has been paid to the interactions existing between genes and the environment. Mr McGregor hypothesised that a pre-existing genetic vulnerability interacts with the impact of adverse events such as childhood trauma, resulting in the development of anxiety disorder(s). A rat model was used to identify several novel susceptibility genes and childhood trauma was confirmed as a risk for some anxiety disorders in later life. He also found significant correlations and interactions between the identified polymorphisms and haplotypes and childhood trauma. This project yielded important findings pertaining to the aetiology of anxiety disorders.

Supervisor: Prof C Lochner

Co-supervisors: Dr SMJ Hemmings and Dr C Kinnear

MOHAMED, Nadia (Community Health)

*An investigation of early childhood caries in the lower socio-economic areas surrounding Tygerberg Oral Health Centre in order to plan a community appropriate intervention strategy*

Early childhood caries is caused by a combination of lifestyle factors, feeding and oral hygiene practices. A total of 659 children under 6 years were examined at crèches, schools and community health clinics, while 366 accompanying caregivers of these children were interviewed to determine their practices and knowledge of oral health. A total of 83 health care workers at these clinics were also interviewed. Prevalence of caries in children was 71,6%. This is extremely high and needs serious intervention. Caregivers as well as nurses were ill-informed regarding child oral health care. More emphasis must be placed on prevention.

Supervisor: Dr J Barnes

Co-supervisor: Dr ED Nel

STEVENSON, Cheryl (Nutritional Sciences)

*Nutrient intake, gastrointestinal microbiota and the effect of Lactobacillus plantarum 299v in irritable bowel syndrome*

The candidate investigated nutrient intakes of patients with irritable bowel syndrome (IBS) and found them to be at risk of key nutrient inadequacies. The effect of a probiotic, *Lactobacillus plantarum* (*L. plantarum*) 299v on the management of IBS patients was also investigated through a double-blind RCT. *L. plantarum* 299v did not alleviate the gastrointestinal (GI) symptoms of IBS, nor was it associated with significant changes in the GI microbiota. However, the influence of nutrient intakes on the GI microbiota provides an attractive explanation as a potential pathophysiological factor for IBS. Three articles have been published in international, peer-reviewed journals and two are in manuscript form.

External Supervisor: Prof S Roux

Co-supervisors: Prof R Blaauw and Ms J Visser

VAN NIEKERK, Evette (Nutritional Sciences)

*The use of probiotics in the management of necrotising enterocolitis in HIV-exposed premature very low birth weight infants*

The primary objective of the study was to assess the effect of probiotics on necrotising enterocolitis (NEC) in infants <1250g born to HIV+ and HIV- women. Probiotics reduced the incidence in all infants, but not in the HIV-exposed infants. As secondary objectives the effect of probiotics on feeding tolerance and growth outcomes of HIV-exposed but uninfected very low birth weight infants was assessed. Probiotics did not affect growth or feeding tolerance in HIV exposure. The candidate also determined the oligosaccharide composition of HIV-infected mother's breast milk and its effects on the incidence of NEC in HIV-exposed infants. The study confirmed that HIV-infected mothers have higher 3'sialyllactose (DSLNT) milk concentrations. Low levels of DSLNT increase the infant's risk for NEC.

Supervisor: Prof GF Kirsten

Co-supervisor: Prof R Blaauw