



ANU College of Medicine, Biology & Environment
ANU College of Physical & Mathematical Sciences

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Organising Committee

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Friday 22nd October, 2010
Peter Baume Building



Venue: Seminar Room, Peter Baume Building [42a]

Date: 22/10/2010

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Schedule of events

<i>Time</i>	<i>Event</i>
9:15-9:30	<i>Welcome and opening address</i>
9:30 -10:15	Keynote Speaker: Prof Ian Chubb
10:20-10:40	Sashika Richards Chloroquine resistance in the malaria parasite
10:40-11:00	Myles O'Neill Investigating Diversity in Eucalyptus Terpenoid Synthase Pathway Genes
11:00-11:10	Video by Richard Dear Cross-Disciplinary Experiences on the ANU/NUS Joint Degree Programme and the ANU X-Disciplinary Students Academy
11:10-11:20	<i>Break</i>
11:20-11:40	Boon Quan Lee Evaluation of Atomic Radiation in Nuclear Decay
11:40-12:00	Emmanuel Malikides / Harry Slatyer Lock! A Mach-Zehnder Interferometer!
12:00-12:20	Jiahao Dong Ordering and characteristics of quasi two-dimensional magnetic materials -- the MM'PS3 family
12:20-12:40	Sharmila Sane Quantum-Classical Hybrid Theories
12:40-13:20	<i>Lunch—BBQ at BaMBi Courtyard</i>
13:20-13:40	Simon Kenny The Size Effect in the US Markets
13:40-14:00	Amitesh Datta The Approximation of Continuous Periodic Functions by Trigonometric Polynomials and it Implications
14:00-14:20	Cameron Cairns A numerical investigation of the Duffing oscillator
14:20-14:30	<i>Break</i>
14:30-14:50	Kaili Zhang Biological roles and biosynthesis of pyrazines
14:50-15:10	Charlotte Petersen A piston-rotaxane molecular motor fuelled by light.
15:10-15:20	Award presentation

Full Program

Session A: 9:15 - 12:40

<i>Time</i>	<i>Event</i>
9:15-9:30	<i>Welcome and opening address</i>
9:30 -10:15	Keynote Speaker: Prof Ian Chubb
10:20-10:40	<p><u>Chloroquine resistance in the malaria parasite</u> Sashika Richards</p> <p>Until the emergence of resistant parasites, chloroquine (CQ) was commonly used to effectively treat malaria. CQ-resistance is predominantly associated with mutations in the protein PfCRT, the 'chloroquine resistance transporter' present on the membrane of the malaria parasite's digestive vacuole. Bioinformatic analysis of PfCRT and preliminary data have shown that PfCRT appears to exist as a homodimer. The ability of the protein to form homodimers is decreased under strongly reducing conditions, suggesting that disulfide bonds may contribute to dimerisation. This project set out to achieve two aims: 1) to explore the importance of conserved cysteine residues in the formation of the PfCRT dimer; and 2) to determine whether PfCRT functions as a homodimer.</p>
10:40-11:00	<p><u>Investigating Diversity in Eucalyptus Terpenoid Synthase Pathway Genes</u> Myles O'Neill</p> <p>This project aimed to analyse a range of genes involved in the terpenoid synthase pathways of eucalypts and to compare diversity in these genes across species. This was unique as the genes had not previously been looked at in eucalypt species. Hence an essential part of this project revolved around gene discovery, relying on known protein sequences of these genes in the model organism <i>Arabidopsis</i> and data from the Eucalyptus Genome Project. Once the genes were identified, primers were designed to map their lengths, taking care to avoid matching pseudogenes or other unrelated parts of the genome. These primers were then tested in the laboratory and PCR variables were modified to optimise the efficiency of the primer efficiency. Finally, sequencing of the genes in different individuals was possible. Unfortunately sequencing problems have prevented any in depth analysis between species – but the groundwork is now laid for future research on these genes.</p>
11:00-11:10	<p><u>Cross-Disciplinary Experiences on the ANU/NUS Joint Degree Programme and the ANU X-Disciplinary Students Academy</u> Video by Richard Dear</p> <p>As a Joint Degree Student in my final semester in Singapore, I have some experiences to share on how cross-disciplinary interaction can deeply enrich our undergraduate studies - particularly for those students who find themselves asking 'so what is it I <i>really</i> want to study?'. The key idea is that at the undergraduate level, disciplines are relevant not so much as bodies of knowledge but more as ways of thinking, perspectives through which to approach problems. Cross-disciplinary interaction is thus a powerful way not only to recognize the value in our own discipline, but also to discover new avenues of inquiry within it. Building on this idea, I will then introduce the ANU X-Disciplinary Students Academy, an initiative to foster interaction between intellectually curious students from across the disciplines at ANU, especially between the Arts and Science PhB Programmes.</p>
11:10-11:20	<i>Break</i>



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11:20-11:40	<p><u>Evaluation of Atomic Radiation in Nuclear Decay</u> Boon Quan Lee</p> <p>Atomic shell data is relevant when it comes to the study of reorganization of atomic shells after a radioactive decay. The decays involve electron capture and electron conversion processes will lead to creation of vacancies in the atomic shells. When a vacancy is created in an inner atomic electron shell, the residual atom is left in an excited state. This leads to atomic relaxation via radiative and non-radiative processes. The radiative process involves the emission of characteristic X-rays associated with vacancies being filled while non-radiative process ("The Auger Effect") involves the emission of an atomic electron ("Auger electron") from atomic shells. A program was developed to improve the existing programs such as EMISSION (E. Schonfeld,1996), IMRDEC (Jiri Stepanek,1996), etc. The program uses as its primary input nuclear decay data in Evaluated Nuclear Structure Data File (ENSDF) format with the recently developed internal conversion database, BrIcc as its database foundation. The evaluation of atomic radiation is important in medical research, trace element analysis and etc. Trace elements could be found by detection of characteristic K x-rays which require the knowledge of fluorescence yield. Other than that, x-rays fluorescence and auger analysis are important in the medical research.</p>
11:40-12:00	<p><u>Lock! A Mach-Zehnder Interferometer!</u> Emmanuel Malikides / Harry Slatyer</p> <p>A laser interferometer is an immensely complex befuddling discombobulation of perplexing (possibly multicoloured) light that bounces around in ways that result in the intensity of the light at a point to be extremely sensitive to the distance between some mirrors. This high degree of sensitivity can be utilised further than is humanly possible through the feeding of feedback to an automated non-human mechanism, possibly computational by nature, and preferably not running windows, which then controls the distance between the mirrors to cancel possible noise and improve measurement. This process is called locking.</p> <p>In our vastly superior project, an interferometer was constructed, aligned and locked using two distinct algorithms. The algorithms both yielded excellent results, behaving in agreement with theory, and could be used in as varied situations as guiding intercontinental ballistic missiles to the accurate measurement of the shockwaves from an intercontinental ballistic missile.</p>
12:00-12:20	<p><u>Ordering and characteristics of quasi two-dimensional magnetic materials - the MM'PS₃ family</u> Jiahao Dong</p> <p>One well-studied group of such material is the MM'PS₃ family, where M and M' stands for different 2+ metal ions. Conventional examples of M and M' includes, Fe, Ni, Mg, Mn, Co and Zn. The fifty-fifty mixture of Fe and Ni was found to have very interesting behaviour in that it has two transition temperatures shown from the magnetic susceptibility/temperature curve. Furthermore it has a property of magnetic spin glasses -- the higher transition temperature is different for field cooled warming and field cooled cooling, even though when applied field is the same. This was originally found by Daniel James in his honours project in 2009 and this result has been verified. Electron microscopy was then used to try and find out the atomic ordering of this family of materials. The fifty-fifty mixture of Mg and Ni was used as they have a stronger contrast in scattering power.</p>
12:20-12:40	<p><u>Quantum-Classical Hybrid Theories</u> Sharmila Sane</p> <p>A longstanding problem in Physics has been to try and explain the nature of the relationship between Quantum Mechanics and Classical Mechanics. This is considered a fundamental issue, as many scientists believe that a single theory should govern all objects. There have been many</p>

	<p>unsuccessful attempts to combine quantum and classical mechanics into such a theory. Some such attempts have been successful only for limited cases, while some others are computationally convenient but fail on a more fundamental level.</p> <p>A recent theory by Michael Hall and Marcel Reghinatto overcomes these previously encountered issues, and is consistent with quantum mechanics on a small scale and classical mechanics on a large scale. Specifically, the theory gives a way to model interactions between quantum and classical particles. This has enormous applications in fields such as measurement theory and quantum chemistry.</p> <p>My ASC begins further investigation of quantum classical interactions using this theory. Such investigation has the potential to answer fundamental questions that range from quantum computing to the quantization of gravity.</p>
12:40-13:20	Lunch—BBQ at BaMBi Courtyard

Session B: 13:20 - 15:20 pm

13:20-13:40pm	<p><u>The Size Effect in the US Markets</u> Simon Kenny</p> <p>The existence of a size effect in global financial markets, whereby smaller firms tend to produce higher returns, is well documented. The existence of this phenomenon is of great interest to researchers as it represents an anomaly to many widely accepted theories governing the behaviour of these financial markets. Despite the wealth of empirical evidence for the size effect, there is currently no widely accepted theoretical explanation.</p> <p>My ASC this semester proceeds with an examination of the existence of a size effect in US Markets through extensive regression models, looking at both the magnitude of this effect, and possible causes and explanations of this market anomaly.</p>
13:40-14:00	<p><u>The Approximation of Continuous Periodic Functions by Trigonometric Polynomials and its Implications</u> Amitesh Datta</p> <p>A trigonometric polynomial is typically defined to be a (finite) linear combination of certain trigonometric functions with varying periods. Physically, the graph of a trigonometric polynomial is a superposition of sine and cosine waves of varying frequencies and amplitudes. In this talk, I will prove the amazing mathematical fact that any continuous periodic function can be "approximated" as well as desired by trigonometric polynomials. If time permits, I may discuss the implications of this fact by briefly sketching the theory of Fourier series on the L^2 space of a closed interval.</p>
14:00-14:20	<p><u>A numerical investigation of the Duffing oscillator</u> Cameron Cairns</p> <p>The Duffing equation is a non linear second-order differential equation that can be used to model many interesting physical phenomena. It is an example of a dynamical system that exhibits chaotic behaviour. Several different tools can be used to study the transition into chaos of this system. The method and results of some of these including a bifurcation diagram, where an estimate of the Feigenbaum constant will be made, and Lyapunov exponents will be presented.</p>
14:20-14:30	Break

14:30-14:50	<p><u>Biological roles and biosynthesis of pyrazines</u></p> <p>Kaili Zhang</p> <p>Pyrazine is a nitrogen containing heterocyclic compound. Substituted pyrazines are encountered frequently in various biological systems. Several pyrazines are utilized by aposemctic insects and plants as a component of their warning odours. Some pyrazines are also found to be crucial to herbal medicine. Recently, a few pyrazines are speculated to be the components of the odour emitted by a number of Australian orchids of the genus <i>Drakaea</i> to attract insect pollinators by mimicking the sex pheromones of the insects. Unfortunately, the biosynthetic pathways of these prevalent substances are not well understood. Several conjectures involving various intermediates have been advanced. A recent work on this topic using gene deletion techniques suggested that, in certain bacteria, the pyrazines are synthesized enzymatically via a route connected with those of several branched amino acids. This talk will discuss the occurrence of pyrazines in nature, briefly describe the recent work in the elucidation of the biosynthetic pathway and introduce the project as part of a wider effort to understand the role of pyrazines as allelochemicals.</p>
14:50-15:10	<p><u>A piston-rotaxane molecular motor fueled by light.</u></p> <p>Charlotte Petersen</p> <p>Piston-rotaxanes are a relatively new class of molecule whose behaviour is dominated by entropy. They consist of cyclic molecules threaded on a stiff polymer rod that is attached to a surface at one end, and capped at the other to prevent the rings from sliding off. The rings are free to move along the rod in one dimension, contributing to the molecules translational entropy. When one of these rings is attached to another stiff polymer rod, the positions of the rings can be controlled or measured. When force is exerted on the rod, the entropy of the free rings resist compression, essentially acting as a molecular version of an automobile shock absorber. This project was concerned with the modelling and understanding of these systems computationally, with the goal of simulating a system to use piston rotaxanes to convert light energy to mechanical energy.</p>
15:10-15:20	<p><i>Award presentation</i></p>