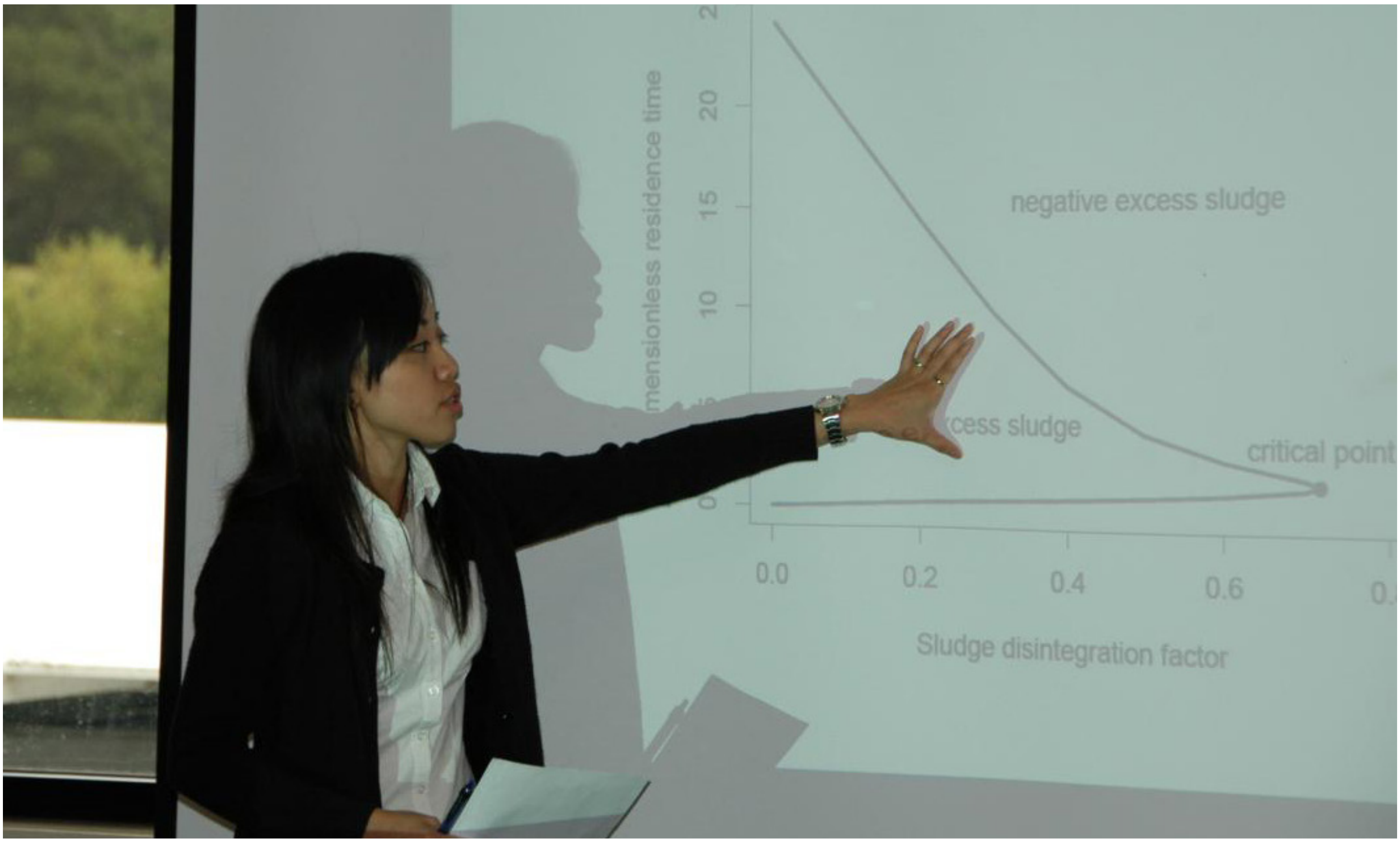


2012/13

AMSI Vacation Research Scholarships

AMSI
AUSTRALIAN MATHEMATICAL SCIENCES INSTITUTE
CSIRO
Australian Government
Department of Education

INTRODUCTION

Inspiring the next generation of researchers

Each year undergraduate students are funded by AMSI to complete six-week research projects over the summer holidays under the AMSI Vacation Research Scholarship program. Scholarships are awarded on a competitive basis.

Students complete their research project under the supervision of academics at their home institution. At the end of summer, students meet with CSIRO Vacation Scholars to present their findings at Big Day In.

The projects aim to inspire students to take up research careers and the opportunity to present to their peers at Big Day In provides students with invaluable professional development in communication and networking skills.

For many students the Vacation Research Scholarship project leads to their first academic publication.

AMSI thanks CSIRO for continued support of the Vacation Research Scholarship program.

"I thought I wasn't cut out for research, because I didn't have amazing grades like my friends. The Big Day in allowed me to prove to myself that I have the communication skills necessary to pursue an academic pathway. It was also fantastic meeting fellow maths and CSIRO students from around the country and getting different perspectives on study and industry."

-Thomas Brown, University of Adelaide

RESEARCH PROJECTS

41 students were awarded 2012/13 AMSI Vacation Research Scholarships.

FIRST NAME	LAST NAME	UNIVERSITY	PROPOSED PROJECT TOPIC
Joel	Alroe	Queensland University of Technology	Modelling the evaporation of a liquid droplet
Sarah	Armatys	Queensland University of Technology	Turing Patterns on Growing Domains
Benjamin	Babao	University of Queensland	Solving Prescribed Ricci curvature equation on a solid turus
Rebecca	Barter	The University of Sydney	Performance of Bayesian estimation and inference for log-ACD models
Simon	Bowly	Monash University	Evolving Hard Instances for graph colouring
Lydia	Braunack-Mayer	The University of Adelaide	Using Indirect Inferance to estimate parameters in models of infectious diseases spread on networks
Thomas	Brown	The University of Adelaide	Agent based models of cell aggregation
Mitchell	Brunton	University of Melbourne	Numerical exploration of multiple zeta values
Mark	Bugden	Australian National University	Quantisation Law and K-Theory in Quantum Field Theory
Brett	Chenoweth	The University of Adelaide	Euler's Theorm
Aaron	Chong	University of Melbourne	Models of systems of interacting, randomly moving agents
Tanzila	Chowdhury	University of Western Sydney	Three dimensional reconstructions of coronary blood vessles
Peter	Crowhurst	Charles Sturt University	Numerical solution of one-dimensional shallow water equations.
Nathan	Eizenberg	Monash University	Climate Change Situations with the *Monash Simple Climate Model*
Jake	Fountain	University of Newcastle	PID controller design and optimisation for humanoid dynamic kick
Brody	Foy	Queensland University of Technology	Travelling wave solutions for cell invasion driven by a velocity jump process
Alexander	Gerhardt-Burke	University of Wollongong	Self-similar solutions of the surface diffusion flow
Montek	Gill	The University of Sydney	Cross ratios and Thurston's gluing equations over rings
Adrian	Hecker	RMIT University	Random Graph Prototypes for Noisy Biometric Graphs
Brock	Hermans	The University of Adelaide	Application of Approximate Bayesian Computation to estimate parameters in model of infectious diseases spread on a network
Timothy	Hyndman	Monash University	Conical duality and constrained optimisation
Harry	Jack	The University of Sydney	Integrable systems related to the two dimensional Euler fluid flow on a rotating sphere.
Patrick	Laub	University of Queensland	Teletraffic Theory - Fixed Point Methods for Loss Networks
Lachlan	MacDonald	University of Wollongong	Self-similar actions of groups on graphs
Rheanna	Mainzer	La Trobe University	Spectrum quality assessment in Mass Spectrometry Proteomics
Cody	McRae	Monash University	Bayesian network inference in systems biology
Gemma	Moran	The University of Sydney	Theory for Gaussian Variational Approximation of Bayesian Generalised Linear Models.
Alexander	Mundey	University of Wollongong	Applications of Bass-Serre Theory to C*-algebra
Mitchell	O'Sullivan	Queensland University of Technology	Experimental design for intractible likelihoods

RESEARCH PROJECTS CONTINUED

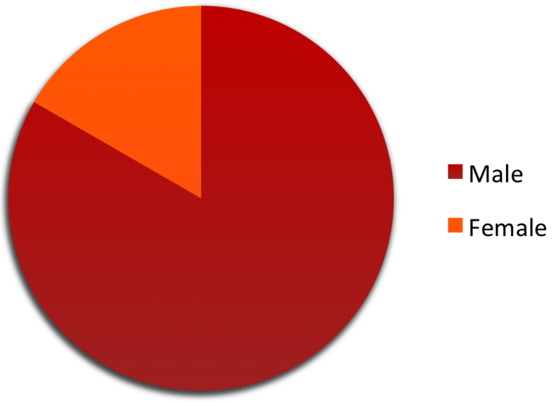
FIRST NAME	LAST NAME	UNIVERSITY	PROPOSED PROJECT TOPIC
Shrupa	Shah	RMIT University	Statistical Models for wildlife contact networks – confronting theory with data!
Jesse	Sharp	Queensland University of Technology	Data-driven moment closure schemes for interacting particle systems
Ewan	Short	The University of Adelaide	Modelling wave-ice interactions
Mahasen Alexander	Sooriyabandara	Monash University	How many ways are there to cover a Torus
Benjamin	Stott	RMIT University	A study of information sharing in deterministic swarms
Ben	Szcezesny	The University of Sydney	Differentiable Manifold and De Rham Theorem
Christopher	Taylor	La Trobe University	True but not provable
Christopher	Thornett	The University of Sydney	Hausdorff measures and applications
Nguyen Thanh	Tung	La Trobe University	Geodesics in four-dimensional unimodular Lie algebras
Iokuan Allen	Vong	University of Melbourne	Poisson Process: Theory and Application to Modelling of the Distribution of Traffic Accidents
David	Wakeham	University of Melbourne	Connections to 3-manifold invariants and TQFT & quantum field theory
Ragib	Zaman	The University of Sydney	Group actions on the cohomology of algebraic varieties.

All student project reports can be viewed on the AMSI website: http://www.amsi.org.au/VRS13.php

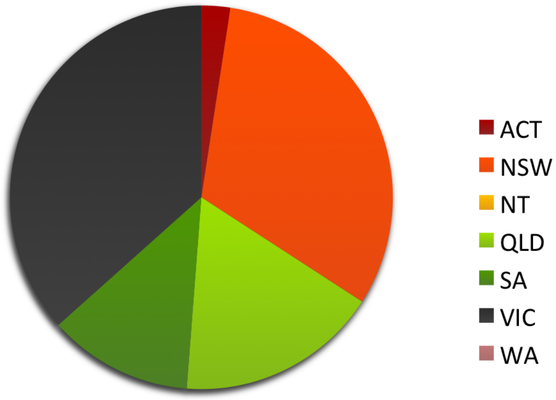
Student blog posts are being posted throughout the year on the Mathematics of Planet Earth Australia website: www.MoPE.org.au

PARTICIPANTS

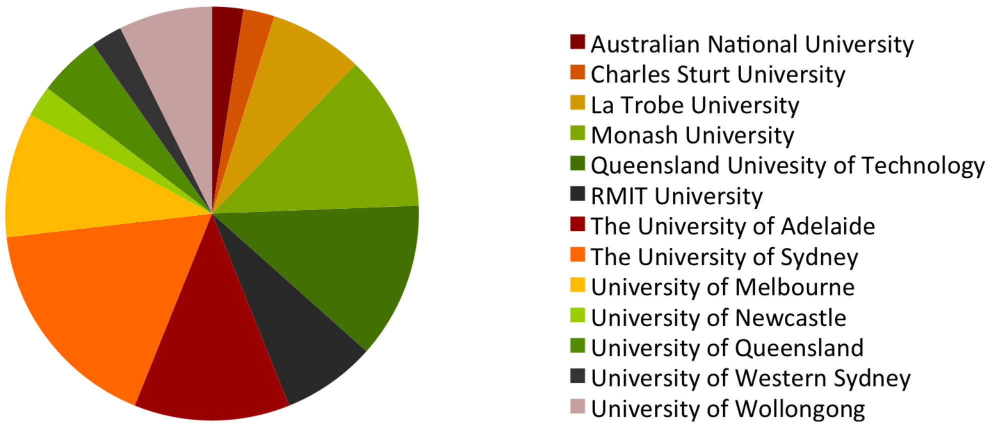
BREAKDOWN BY GENDER



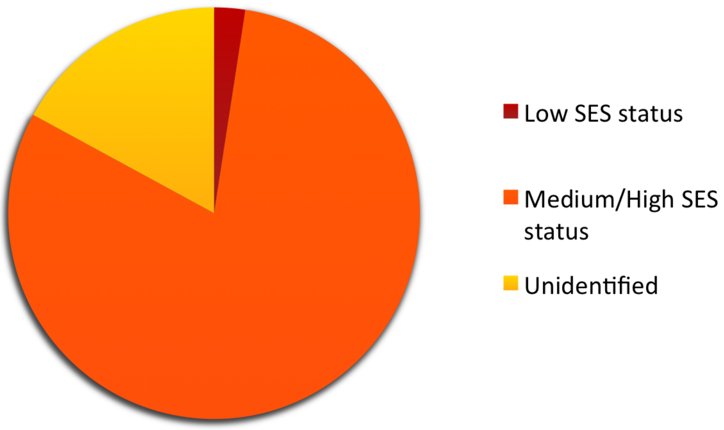
BREAKDOWN BY STATE



BREAKDOWN BY UNIVERSITY



BREAKDOWN BY SOCIOECONOMIC STATUS



FEEDBACK

I gained valuable experience in presenting research outcomes in front of a national audience. I now feel a lot more confident about attending future conferences. I enjoyed the opportunity to network with fellow students and supervisors. The event was very well organised from an administrative/event management level!

- Joel Alroe

So many exciting projects. Gave me ideas for some of the topics that I am interested in.

- Tanzila Chowdhury

Wide range of presentation topics - it was great for AMSI students to be involved with the CSIRO event so we could hear about projects from other disciplines.

- Simon Bowly

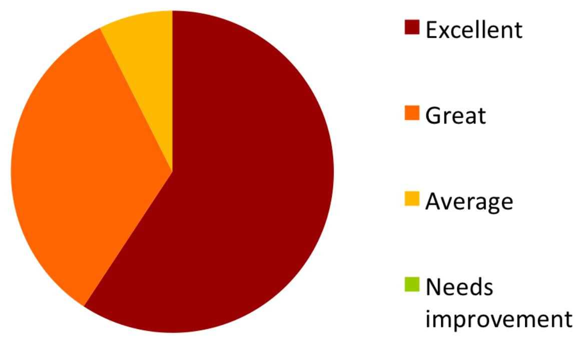
I really enjoyed doing my own talk and seeing the variety of research that was undertaken by other students. It was a great opportunity to talk to people who were undertaking similar sorts of studies.

- Christopher Taylor

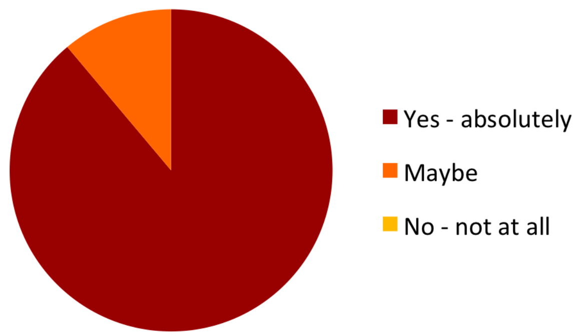
I was very impressed with the presentation techniques of my colleagues and would love to incorporate their styles in my presentations. Often I see lecturers collaborating with each other in their research, the Big Day In provided an opportunity for students, like myself, to get to know other students who will be conducting research in the same field as I. I made new friends that someday I wish to work with. I am very happy that our lecturer attended the Big Day In and supported us, for our first major presentation outside university.

- Shrupa Shah

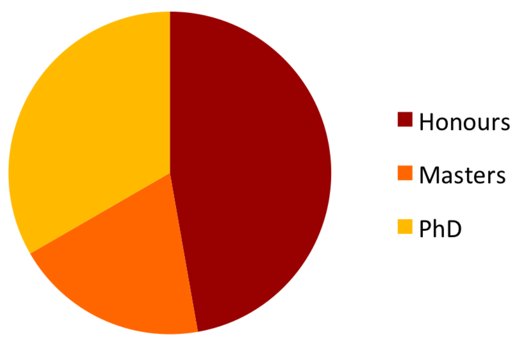
HOW WOULD YOU RATE OVERALL THE SCHOLARSHIP PROGRAM?



WOULD YOU RECOMMEND THIS PROGRAM TO A FRIEND?



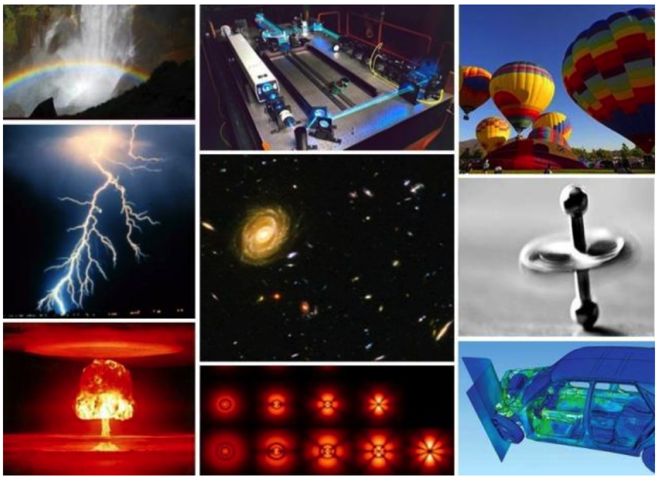
THE PROGRAM IS DESIGNED TO GIVE YOU A TASTE OF ACADEMIC RESEARCH, AFTER YOUR EXPERIENCE THIS SUMMER DO YOU EXPECT TO COMPLETE



STUDENT BLOG

A Braney Summer

Physics. It describes what we know about the universe on a fundamental level. Physics describes the motion of planets, the production of Nuclear power, the efficiency of engines, the reflection and refraction of light and countless other everyday phenomena.



The two pillars of modern physics are Quantum Mechanics and General Relativity. Quantum Mechanics describes the very small – it tells us how subatomic particles move and interact. On the other hand, Einstein's General Theory of Relativity describes the massive – it describes the curvature of space-time around heavy objects like black holes and neutron stars. Together, these two theories completely describe the known universe.

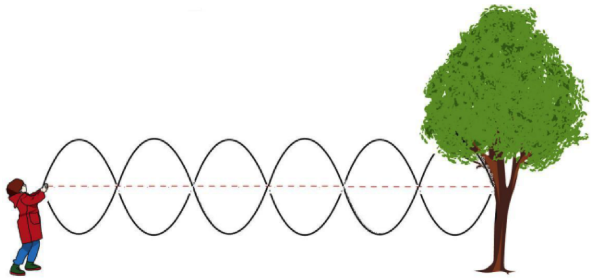
Well…

Almost.

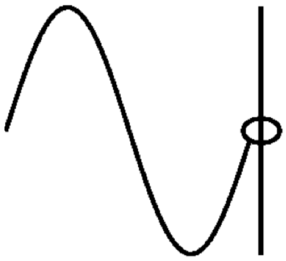
There is a slight problem. Quantum Mechanics and General Relativity are incompatible theories! General Relativity is what physicist's call a 'Classical Theory', as opposed to a 'Quantum Theory'. In order to unify Quantum Mechanics with General Relativity, we would need to turn General Relativity into a Quantum Theory – In physics terms we would be quantizing gravity. This is where we run into a problem. Whenever we try to quantize gravity using the standard method, quantities become infinite and everything starts to break. Clearly, another approach is needed.

Enter String Theory. String Theory is a branch of theoretical physics which attempts to unify Quantum Mechanics with General Relativity by modelling subatomic particles inside atoms as tiny vibrating strings. A standard analogy to describe string theory is musical, referring to the strings on a guitar. On a guitar string, different modes of vibration give rise to different musical notes. By analogy, the different vibrational modes of the string give rise to different particles, with different mass and electric charge. Poetically, String Theory describes the 'Cosmic Symphony' of the Universe.

My project over the summer was based around some of the mathematics relating to String Theory. Specifically, the project focused on objects in String Theory called D-Branes. To understand what a D-Brane is, imagine that I hold one end of a rope in my hand, and tie the other end to something solid, like a tree.



Although the rope moves in the middle, at the endpoints to rope is fixed. One end has to stay in my hands (provided I hold on tight enough), and the other end has to stay tied to the tree. Now to mix things up a bit, lets tie the rope to a ring, and put that ring around a pole so that the endpoint of the string can slide up and down the pole

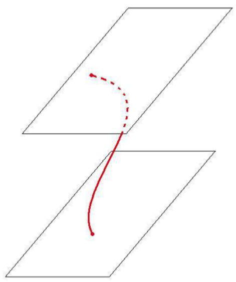


Now the endpoint of the string is free to move up and down along the pole – it's not just fixed in the one position.

A string stretched between two parallel two-dimensional D-Branes.

In String Theory, the endpoints of the strings are confined onto certain objects we call D-Branes. The ends of the string can move around on the D-Branes, but can't break off it.

A zero-dimensional D-Brane would be a point, which the endpoint of the string must stay on (like the tree example). A one-dimensional Brane would be a line to which the endpoint of the string is confined (like the example with the ring and the pole), and so on.



D-Branes are interesting objects with a variety of cool properties, and my project was focused on investigating some of these.

For more student blogs see: www.MoPE.org.au

Australian Mathematical Sciences Institute

Simi Henderson
Research and Higher Education Manager
c/o University of Melbourne VIC 3010

simi@amsi.org.au
www.amsi.org.au