



# The Bulletin 370

The Royal Society of New South Wales

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September 2013

## Future Events

Lectures in Sydney are held on the first Wednesday of the month at 6:30pm.

**Wednesday 2 October 2013**

**6:00 pm for 6:30 pm**

**1215th OGM**

***Astrobiology: the latest from 'Curiosity'***

**Delivered by:**

Professor Malcolm Walter UNSW

**Union, University and Schools Club**

25 Bent St, Sydney

Members and Fellows: \$5.00

Non-members: \$10.00

**Wednesday 6 November 2013**

**6:00 pm for 6:30 pm**

**1216th OGM**

***Re-thinking science education in Australian schools: development and implementation of the National Science Curriculum***

**Delivered by:**

Dr Mark Butler, Department of Education and Communities

**Union, University and Schools Club**

25 Bent St, Sydney

Members and Fellows: \$5.00

Non-members: \$10.00

***More future events listed on page 2.***

Southern Highlands Branch

**Thursday 17 October 2013**

**6:00 pm for 6:30 pm**

***The Dynamic Brain***

**Delivered by:**

Dr Peter Robinson

**The Performing Arts Centre**

Chevalier College, Bowral

Members and Fellows: \$5.00

Non-members: \$10.00

**Wednesday 2 October 2013**

**How early life on Earth guides the search for life on Mars: the latest results from *Curiosity***

Presented by Prof Malcolm Walter

Union, University & Schools Club, 25 Bent St, Sydney City

**6:00 for 6:30 pm**



It might be disappointing that there are no canals, pyramids or faces on Mars, despite the enthusiasm of observers past and present, but the great goal of searching for life beyond Earth remains alive and very healthy.

With regard to Mars we are searching for microbes. The quest is to find evidence of microscopic objects when we have a whole planet to search. We know how to do it. The Earth always was, and even now still is, dominated by microbes. Our anthropogenic perspective leads us astray. Macroscopic life, plants and animals, is but a tiny proportion of the diversity of life.

Science being a conservative endeavor we build incrementally on what we know. Our model for Mars is life on Earth. Everything we know about life is based on this sample of one. Are we closing in on finding life on Mars? I think so.

**Malcolm Walter is Professor of Astrobiology at the University of New South Wales, Australia.** He is the Founding Director of the Australian Centre for Astrobiology. He has worked for 50 years on the geological evidence of early life on Earth, including the earliest convincing evidence of life. During 1999 his book "The Search for Life on Mars" was published by Allen & Unwin. He has published more than 130 articles and several other books. In 2004 he was elected a Fellow of the Australian Academy of Science, and in 2005 he was made a Fellow on the Geological Society of Australia.

**Dress code: jacket and tie.**

## Patrons of The Royal Society of NSW

Her Excellency Ms Quentin Bryce AC CVO, Governor-General of the Commonwealth of Australia

Her Excellency Professor Marie Bashir AC CVO Governor of NSW

Wednesday 23 October 2013

The Royal Society of NSW and the University of Sydney in conjunction with the Australian Institute of Physics present

## The Pollock Memorial Lecture for 2013

Quantum computing in silicon and the limits of silicon miniaturisation

delivered by

**Professor Michelle Y Simmons**

Director, ARC Centre of Excellence for Quantum Computation and Communication Technology, University of New South Wales

Wednesday 23 October 2013

6:00 for 6:30 pm

Eastern Avenue Auditorium,  
University of Sydney



Professor Simmons

Down-scaling has been the leading paradigm of the semiconductor industry since the invention of

the first transistor in 1947. However miniaturization will soon reach the ultimate limit, set by the discreteness of matter, leading to intensified research in alternative approaches for creating logic devices. One of the most exciting of these is quantum computation. We will present devices that address the ultimate limit of device miniaturization in silicon where we have patterned dopants in a crystalline environment with atomic precision to act as one dimensional leads, single electron transistors and control gates. In particular we demonstrate precision single atom

transistors and spin-read-out in a silicon quantum computing architecture that is inherently scalable. We will discuss the benefits of donors as qubits and address some of the challenges to achieving truly atomically precise devices in all three spatial dimensions.

### Professor Michelle Y Simmons

Professor Simmons is the Director of the Australian Research Council Centre of Excellence for Quantum Computation and Communication Technology, a Federation Fellow and a Scientia Professor of Physics at the University of New South Wales. Following her PhD in solar engineering at the University of Durham in the UK she became a Research Fellow at the Cavendish Laboratory in Cambridge, UK, working with Professor Sir Michael Pepper FRS in quantum electronics. In 1999, she was awarded a QEII Fellowship and came to Australia where she was a founding member, and now the Director of the Centre of Excellence.

Since 2000 she has established a large research group dedicated to the fabrication of atomic-scale devices in silicon using the atomic precision of

scanning tunneling microscopy. Her group has developed the world's thinnest conducting wires in silicon and the smallest transistors made with atomic precision. She has published more than 300 papers in refereed journals and presented over 80 invited and plenary presentations at international conferences. In 2005 she was awarded the Pawsey Medal by the Australian Academy of Science and in 2006 became the one of the youngest elected Fellows of this Academy. In 2008 she became a dual citizen of Australia/UK and she was awarded a second Federation Fellowship by the Australian Government and was named the NSW Scientist of the Year in 2011.



THE UNIVERSITY OF  
SYDNEY

## The AIP NSW Branch 2013 Postgraduate Awards + RSNSW Jak Kelly Awards & Annual Dinner

Each New South Wales University is invited to nominate one student to compete for the \$500 prize and Postgraduate medal. *The Royal Society of NSW will also award the Jak Kelly Scholarship prize of \$500 as a separate award category for this event.*

Students are asked to make a 20-minute presentation on their postgraduate research in Physics, and the presentation will be judged on the criteria: (1) content and scientific quality, (2) clarity and (3) presentation skills.

Students nominated for the awards will also be invited as guests for the NSW AIP Branch annual dinner that follows the

presentations. These awards have been created to encourage excellence in postgraduate work, and all nominees who participate in the Postgraduate Awards Day will receive a special certificate recognising the nominee's high standing.

This event is proudly sponsored by the Australian Institute of Physics, the Royal Society of New South Wales and the CSIRO. Your support of a student nomination is very important by Friday 11th October 2013. Please email the title and abstract of your nominated student presentation by Friday 11th October 2013 to the Awards

Coordinator: Dr Frederick Osman at [fred\\_osman@exemail.com.au](mailto:fred_osman@exemail.com.au)

### Schedule:

- 2 - 10pm Tuesday 19 November 2013
- 2 - 6pm: Student presentations (Slade Lecture Theatre, University of Sydney)
- 6 - 6.30pm: AGM (Slade Lecture Theatre, University of Sydney)
- 6.35pm: Guest speaker Professor Martin Green: "The Physics of High Efficiency Photovoltaic Solar Energy Conversion". (Slade Lecture Theatre, University of Sydney)
- 8 - 10pm: Annual dinner at the Buon Gusto.

**F**rederick Osman

# Southern Highlands Branch

Report of September Meeting 2013

## Our Galaxy, the Milky Way, Dark Matter

Dr Ken Freeman FAA FRS, Duffield Professor of Astronomy, Australian National University

Dark matter is now thought to make up as much as 97% of the Milky Way and 84% of the universe overall. Ken Freeman was the first to calculate that the luminous, visible matter in galaxies is only a small fraction of their overall mass.

He began this lecture with the history of understanding of our place in the Milky Way, then progressed to a description of its most important features which have been gradually discovered, including its dark matter content. He then ended with some of the recent findings of the inner region of the Milky Way – its bulge and the massive central black hole.

A compelling piece of evidence that dark matter exists in large quantities comes from the study of the rate of approach to each other of the Andromeda Galaxy (M31) and the Milky Way Galaxy. The Milky Way and M31 are now approaching each other at 118 km/s. To acquire this rate of approach in the life of the universe means that the total mass of the Milky Way Galaxy is at least  $120 \times 10^{10} M$ . The stellar mass is approximately  $6 \times 10^{10} M$ , therefore the ratio of dark to stellar mass is of the order of 20. The dark halo extends out to at least 120 kpc, far beyond the visible galaxy disk of approximately 20kpc.

Freeman cited this example as a discovery which had come too early. Kahn and Woltier's result was presented in 1959. It was simple and correct, and no one argued with the result. It just did not fit into the framework of thinking at the time,

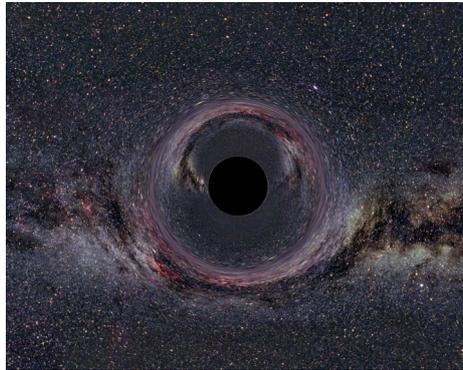


Image sourced from Internet (not supplied by Dr Freeman).

and so was effectively ignored. Merging of galaxies is still happening now with the end product of the merger often being an elliptical galaxy. In a few Gyr, the Milky Way will probably merge with M31.

Further evidence that dark matter dominates the mass budget of the universe comes from the rate of formation of galaxies after the Big Bang. The Big Bang occurred 13.7 Gyr ago. Galaxies were already forming 0.5 Gyr after that. Without dark matter, this could not have happened – galaxies would have taken much longer to form.

Professor Freeman noted that most spiral galaxies, including the Milky Way, have in addition to their readily observed thin disk, a second thicker disk component or bulge. The Milky Way's thick disk is significant, being about three times the thickness of the thin disk, and was discovered via star counts at the South Galactic Pole. Its mass is about 10% of the mass of the thin disk, its stars are old (>12 Gyr) and have less metals than the thin disk. They are enriched in alpha-elements (Mg, Si, Ca) which come from exploding massive stars, so

formation was rapid (1Gyr). Once the thick disk stars were formed, there was a pause in star formation, until the thin disk stars started to form about 10Gyr ago. Thin disk star formation has continued at a more-or-less constant rate up to the present time.

Professor Freeman's research is exciting and ongoing. He is using chemical element abundance patterns to probe the formation of the Galactic thick disk, in a process known as chemical tagging. It needs a huge number of stellar spectra, data which does not yet exist. With the advent of the HERMES project at the AAT however, all that will soon change. Professor Freeman is planning to have the chemical abundances of many elements determined for over one million stars, mostly in the thin and thick disks.

The 54 person audience responded enthusiastically when Dr Freeman agreed to present further talks to the Southern Highlands Branch as his new data came to hand.

Anne Wood

### Paperless Bulletin?



If you have the capability to read the Bulletin digitally please email the office.

royalsoc@royalsoc.org.au.

# From the President



It is with great pleasure that the Society is recognising Professor Peter Doherty AC, the winner of the 1997 Nobel Prize in Medicine

or Physiology, by appointing him a Fellow of the Royal Society of New South Wales. We are delighted that Professor Doherty has accepted the nomination. Professor Doherty's research focused on the immune system and his Nobel Prize was for discovering how T-cells recognise their target antigens in conjunction with major histocompatibility complex (MHC) proteins. Their research found that in order for T-cells to recognise infected cells, they had to recognise both the virus antigen and the MHC protein.

The next couple of months will be busy for the Society. In addition to our regular monthly meetings, the Pollock lecture, in conjunction with University of Sydney, the Jak Kelly Award in conjunction with the Australian Institute of Physics and the Dirac lecture, in conjunction

with University of NSW will take place.

The Pollock Lecture will be delivered on Wednesday 23 October at Sydney University by Professor Michelle Simmons, a Fellow of the Society and Director of the Centre for Quantum Computation and Communication Technology at the University of NSW. She was elected to the Australian Academy of Science in 2006, one of its youngest fellows ever. This promises to be a very interesting talk – I encourage you to be there.

On Tuesday 19 November, in conjunction with the Australian Institute of Physics, the Jak Kelly award will be determined. This award is for young physicists and the winner will be invited to present to the Society at the December meeting.

The Dirac lecture will be held at the University of NSW on Thursday 21 November and delivered by Sir Michael Pepper. Sir Michael is a British physicist notable for his work in semiconductor nanostructures. He is founder and former head of

the Semiconductor Physics Group at the Cavendish laboratory, Cambridge.

As I mentioned last month, the Council is nearing completion of a substantial review of the Rules and Bylaws of the Society to modernise them and make some changes that we expect will give further opportunities to grow our membership. We expect to call a general meeting of the Society to consider and vote on these proposals before the end of the year. I expect to be able to give you further information in the next couple of weeks.

**D**onald Hector

## New Members of the Society

We welcome the following new member to the Society:

- Robert Ernest Marks
- Astrid Elizabeth Toscan

For information about membership please contact the Society's office or visit the Society's website or contact Emma at royalsoc@royalsoc.org.au

We encourage members to introduce new members to the Society.

## Contact your office bearers

<b>Dr Donald Hector President</b>	<b>02 9484 9007</b>	<b>Em. Prof Heinrich Hora Vice President</b>	<b>02 4627 7769</b>
<b>Mr John R Hardie Vice President</b>	<b>02 9036 5282</b>	<b>Em. Prof D. Brynn Hibbert Vice President</b>	<b>02 9398 9134</b>
<b>Mr Colin Bradley Hon. Secretary</b>	<b>0421 478 670</b>	<b>Prof. Michael Burton Hon.Secretary (Editorial)</b>	<b>02 9036 5282</b>
<b>Mr Shakti Ram Hon. Treasurer</b>	<b>02 9036 5282</b>	<b>Dr Frederick Osman</b>	<b>0418 444 477</b>
<b>Mr Brendon Hyde</b>	<b>02 9498 3520</b>	<b>Ms Janette Searle</b>	<b>02 9036 5282</b>
<b>Mr Hub Regtop (SHB rep)</b>	<b>02 4872 4713</b>	<b>Dr William Kneprath</b>	<b>02 9581 6000</b>
<b>Professor Richard Banati</b>	<b>0408 121 362</b>	<b>Mr David Beale</b>	<b>02 9036 5282</b>
<b>Em. Professor Roy MacLeod</b>	<b>02 9036 5282</b>		

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121 Darlington Rd, Building H47, UNIVERSITY OF SYDNEY NSW 2006 Australia

**Office hours: 11:00am - 4:00pm Mon - Wed and Fridays.** [www.facebook.com/royalsoc](http://www.facebook.com/royalsoc)

Executive Officer: Emma Dallas t: 02 9036 5282 e: royalsoc@royalsoc.org.au w: www.royalsoc.org.au