



NANOSCALE RESEARCH NEWSLETTER

ISSUE 8 - June 2018

The BMRF in Brief



Dr Scott A. Willis

Biomedical
Magnetic
Resonance
Facility Manager

INSTRUMENT SNAPSHOT

PerkinElmer QUANTUM GX MicroCT: This is one of the instruments in the Biomedical Magnetic Resonance Facility (BMRF)/National Imaging Facility (NIF) and provides high resolution computed tomography images – up to a resolution of 4.5 micrometre voxels. This scanner can image with a wide field of view (FOV) (e.g., 36 mm, 72 mm). Some samples this scanner has been used on include leaves, fruit, insects, coal and fossils.



The PerkinElmer Quantum GX MicroCT Scanner in the BMRF at WSU and some example images obtained by Dr Scott A. Willis for leaves with and without contrast agent. The resolution of the highest zoom images shown (i.e., the stem region) are 2.3 mm FOV at 4.5 μm voxel size

VISITING STUDENT

In March this year we had a visiting PhD student from Japan working with the BMRF and NANO. They worked with one of our local industry contacts (i.e., off site) and performed diffusion measurements here in the Biomedical Magnetic Resonance Facility (BMRF) with the assistance of BMRF Staff. The purpose of this was to both provide the student with industry experience and to build on the collaborative relationship between the company and the BMRF.

Staff member provides the necessary safety information before entering the facility). The necessary inductions can be organised by contacting the Facility Manager (either by phone (Ext 3114), in person (17.G.06 or elsewhere) or by email (Scott.Willis@westernsydney.edu.au)). In terms of training new users, whether or not a person can be trained to use the equipment unsupervised depends on what sort of user they are and their background with NMR. Not every student is/can be given unsupervised access and training, and in some situations only supervised access is allowed (after induction by the Facility Manager) with the inducted and trained supervisor usually performing the experiments on the equipment. Usually undergraduate students, e.g., project students, and visiting students are not allowed to

SAFETY, INDUCTIONS and TRAINING

Everyone needs to be inducted to enter the BMR Facility unless a BMRF Staff member is taking someone on a tour (in this situation, the BMRF

SPECIAL POINTS OF INTEREST

BMRF IN BRIEF

**NIF IN A
NUTSHELL**

SYMPOSIUM

**“TUMOR
HYPOXIA”**

STUDENT NEWS

PUZZLE PAGE

What does a
Greek cow say?



WHY SHOULD FOLLOWERS OF SPECIAL THEORY OF RELATIVITY NOT BE TAKEN SERIOUSLY? THEY FAIL TO SEE THE GRAVITY OF THE SITUATION.

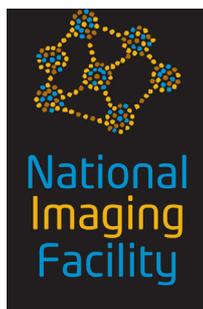
access the equipment unsupervised and it is the supervisor that performs the experiments for them (NB: the supervisor is someone that has been trained and inducted into the facility). In any case, before the person enters the facility they need to be inducted by the Facility Manager. Supervisors are reminded that swipe access to the facility will only be allowed if the inductions are complete and the user has received training on the equipment – this means that users that are not trained but have been inducted for supervised access are not allowed swipe access. Supervisors should not request swipe access without approval from the Facility Manager. Regarding users that can be trained for unsupervised use, training is organised through the Facility Manager only and several sessions are required (for a specific set of experiments). Once training is completed, access to the facility and booking sheet can be organised with the Facility

Manager but even then access is only permitted for the experiments the user has been trained to do. If any user is unsure of a parameter or if they want to do experiments that are different to those they have been shown how to do, they need to first contact the Facility Manager.

SAVE THE DATE

The Nanoscale Organisation and Dynamics Group are holding the 8th Biennial Western Sydney University Symposium on NMR, MRI and Diffusion on the 8th – 9th November this year at the Campbelltown WSU Campus. This symposium showcases the developments and research in the NMR/MRI field and brings together researchers, including those from industry, to reinforce collaborations and kick-start new ones. There is a conference dinner, workshop and poster prizes for student posters.

NIF in a Nutshell



The Western Sydney University node of the National Imaging Facility has been working with Dr Masaya Ishikawa from the Tokyo University of Science investigating freezing in cold hardy plants, in particular Fagus, Forsythia, Azalea and Cornus species. Usually, when plant tissues are exposed to subzero temperatures the intracellular freezing of water ruptures the plant cells causing extensive damage and killing the plant. The species under instigation in this ongoing study have evolved diverse strategies for surviving subfreezing temperatures including supercooling stabilizing compounds (natural antifreeze) and anti-nucleation compounds that regulate the phase change of water from liquid to ice in ways that do not damage the plant tissue.



Dr Tim Stait-Gardner

National Imaging Facility Fellow

MRI can be used to visualise water and water phase distribution in the plant tissue. A typical MRI pulse sequence will only result in an image of liquid water, with the frozen water being absent from the image. By scanning plant tissue at a variety of temperatures, including subzero temperatures, the freezing behaviour of the tissue can be visualised. Some interesting results are displayed in the figures. These colour-coded images show cross sections of Fagus stems (Figure 1a) and buds (Figure 1b) constructed from a series of MR images taken at different temperatures. Combining the images and colour-coding them to show tissues that freeze at high temperature in red and tissues that freeze at low temperature ($< -19.5\text{ }^{\circ}\text{C}$) in blue shows the order of freezing in the plant tissues. As can be seen in the figure, the interior of the stems freezes at a much lower temperature than their exterior while the opposite is observed for the leaf buds.

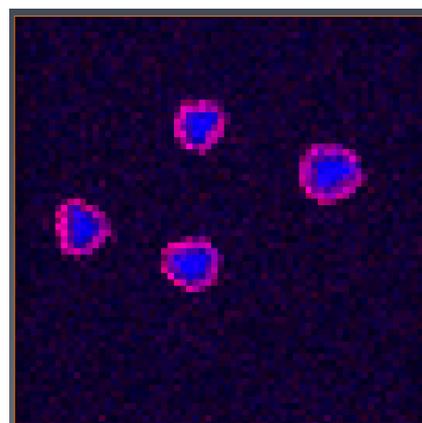


Figure 1a



Dr Masaya Ishikawa

MRI is proving to be a powerful tool for studying plant tissue freezing behaviour, enabling the identification of tissues containing freeze regulating compounds that may have other scientific and industrial uses. Dr Ishikawa has made two extended visits to WSU in December 2016 and December 2017.

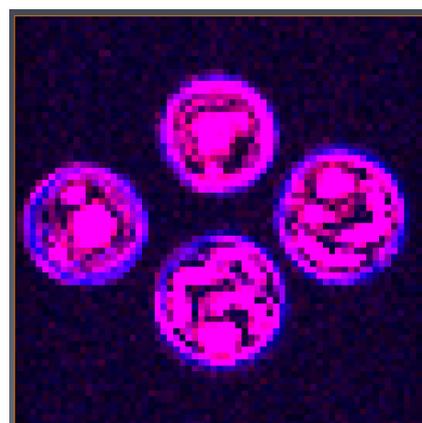
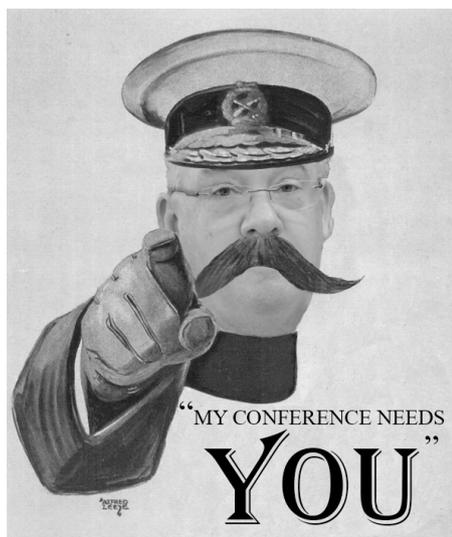


Figure 1b



8th Biennial Western Sydney University Symposium on NMR, MRI and Diffusion & Workshop

When: 8th & 9th November 2018

Where: Western Sydney University, Campbelltown

Venue: Lecture Theatre 5 (CA21. G.03)

Audience: Everyone is welcome to attend

Student Poster Prizes 3 prizes of \$200 cash

Registration \$65 (student) & \$150 (Others)

The Conference Dinner is included in the registration cost.

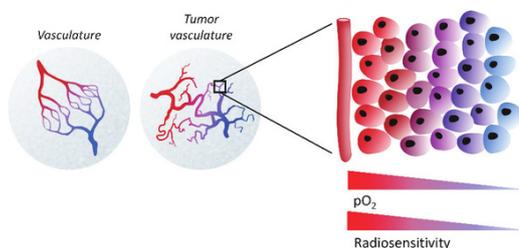
For further information contact: Nano@westernsydney.edu.au

Website and registration links will be open 31st July 2018 at;

<https://www.westernsydney.edu.au/nanoscale>

Tumor Hypoxia

Tumor hypoxia is of significant interest in oncology. It is the result of inadequate tissue oxygenation due to an imbalance in oxygen consumption and supply. In tumors, this is largely due to the increased metabolic demands of rapidly proliferating tumor cells. It is well established that cells with lower partial pressure of oxygen (pO_2) levels are less susceptible to the lethal effects of ionizing radiation. Resultantly, these hypoxic cells/regions limit the effectiveness of current radiotherapy treatment. Evidence of such treatment failure has been obtained through electrode measurements of intratumoral pO_2 in patients with cervical, breast, and head and neck cancers. However, these methods are highly-invasive, time consuming and technically difficult. Laboratory and clinical studies on hypoxia and treatment resistance are focussed on maximising the effects of radiotherapy by either minimising or eliminating the treatment-limiting hypoxic tumor fraction. Techniques such as intrinsic (e.g., carbonic anhydrase IX) and extrinsic (e.g., pimonidazole) biomarkers, tissue oxygen level-dependent (TOLD) and blood oxygen level-dependent (BOLD) magnetic resonance imaging (MRI), positron emission tomography (PET) and single photon emission computed tomography (SPECT) have also been used to study tumor hypoxia. Each technique probes different aspects of the hypoxic microenvironment, providing information on hypoxia at different locations. Oxygen electrodes (i.e., OxyLite) and electron paramagnetic resonance (EPR) predominantly measure interstitial hypoxia, whereas extrinsic markers, PET and SPECT detail intracellular hypoxia. Using deoxy-haemoglobin as an endogenous marker, BOLD-MRI allows assessment of blood oxygenation, whereas gene expressions (i.e., CAIX, GLUT1) indirectly report on hypoxia-induced molecular events. Furthermore, MRI provides easier visualisation of the heterogeneous nature of tumor hypoxia in comparison to other techniques. A robust method capable of quantifying tumor hypoxia would allow regions of different hypoxic levels to be identified and treated accordingly, thus improving patient outcomes.



Hypoxic tumors show:

- Increased aggressiveness
- Resistance to therapy
- Increased metastasis
- Poor patient prognosis



Tumor Hypoxia
article written by
Dj Wijesekera

-Johnny puts the John into Hopkins -

Johnny is currently doing his PhD on chemical exchange-based contrast technique development in magnetic resonance imaging. As part of his PhD studies, Johnny was invited by one of his co-supervisors, Dr Nirbhay Yadav, to visit the lab of Prof. Peter van Zijl at Johns Hopkins University in USA for a three-month traineeship. One of the projects he will be working on is magnetic resonance imaging of molecular binding using saturation transfer, and will be completed alongside post-doctoral researchers. During his visit, he will also further his own research on unique endogenous biodegradable contrast agents, whilst refining his experimental skills such as

phantom development, data fitting, and programming.

* Dr. Yadav completed his tertiary studies at the Western Sydney. In 2010, he obtained his PhD for developing novel NMR diffusometry methods for probing porous systems. Following his PhD, he completed a post-doctoral fellowship at the F.M. Kirby Research Center and in the Department of Radiology at the Johns Hopkins School of Medicine.



Johnny Chen

- Student Profiles -



Krishant M Deo

Krishant M Deo

Krishant M. Deo completed his B.Med. Sc. (Honours) in 2014 at Western Sydney University, where he was awarded the University Medal.

Krishant is currently undertaking a PhD at Western Sydney University under the supervision of Prof. Janice Aldrich-Wright and Dr Gang Zheng. His research interests include the development of novel platinum(IV) anticancer

agents. He hopes to continue the development of platinum(IV) complexes by increasing their selectivity towards cancer cells with the use of targeting ligands and also the ability to track these complexes via the conjugation of fluorophores.



Azy Panah

Azy Panah

Azy Panah completed her B.Med.Eng at QUT and her Masters of Research from Edinburgh University.

Azy Panah is currently undertaking a PhD part-time at Western Sydney University under the supervision of Prof. William

Price, Dr Tim Stait-Gardner and Dr Stephen Bosi (UNE). Following her bachelor degree of Biomedical Engineering from QUT, she completed her Masters of Neuroimaging for Research from the University of Edinburgh, UK with a thesis topic of: Incidental Findings in Neuroimaging. Her current research/interest includes NMR/MRI sequence

development to investigate the feasibility of replacing CT with MRI for calculation of electron density in radiotherapy treatment. The benefit of eliminating CT in radiotherapy dose calculation is not only to improve patient safety but to also reduce the costs of healthcare in terms of **queues, delays and use of infrastructure**

- Welcome to our French Student Visitors -

Introducing Coline Paget.



Coline Paget

My name is Coline and I'm a French student. I live in the centre of France in Clermont-Ferrand and I study chemistry at an engineering school.

In France, the school system is different than in Australia. I did two years of preparatory school and it was really hard! After that, we had to choose an engineering school and I chose Sigma Clermont. We have to study for three years at this school and I am in my second year. Next year is my last year of study and I will graduate.

I like organic chemistry and that's why I choose these studies. During my internship at Western University, I will do NRM experiments on wine with Gang Zheng.

Later on, I would like work in the food or cosmetic industry and do analysis. For me, this area is really interesting. We can be in contact with others persons like suppliers for example.

During my spare time, I like spending time with my friends, taking care and cooking for my family. I like reading comics, going to the cinema and doing fitness.

Coline is supervised by Gang Zheng.

Introducing Victoire Laude.



Victoire Laude

Hi ! My name is Victoire, might be hard to pronounce it but you can call me Victoria it's fine and I am French

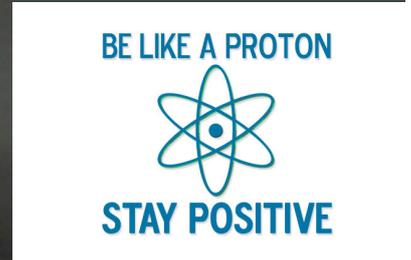
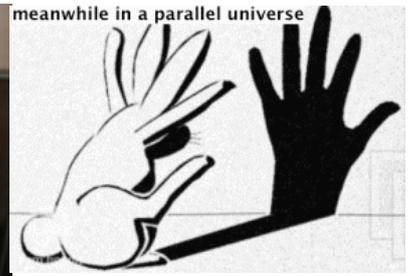
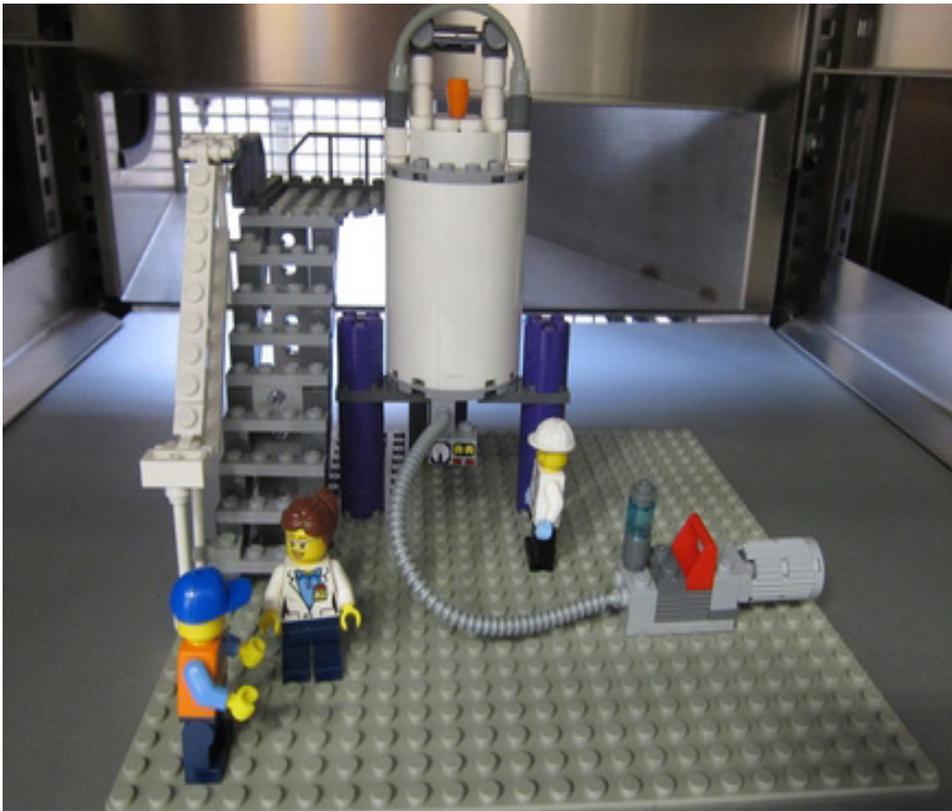
I am studying chemistry in an engineering school in Clermont-Ferrand, France (the same one as Coline) and in September I will start my final year of studies. I am here in Sydney for an internship and I will do organic synthesis, my supervisor is Christopher Gordon.

I am 21 years old and I have always liked studying chemistry. At the moment I do not really know what I want to do after my studies, so before graduating I will stop my studies for one year and do two 6 month internships in different companies and different departments to make up my mind about it.

I have lived 3 years in Hong Kong, 4 years in Vietnam, 2 years in Denmark, the rest of the time in France and moving every 2 or 3 years in the city.

During my free time I like running, spending time with friends, listening to music and watching movies. I like track and field and travelling.

Victoire is being supervised by Chris Gordon



Some easy questions to have fun with.

How well did you do?

- | | |
|---|---|
| 1. A farmer has seventeen sheep, all but nine die. How many does he have left? | 1. A farmer has seventeen sheep, all but nine die. How many does he have left? 9 |
| 2. Divide 30 by 1/2 and add 10 | 2. Divide 30 by 1/2 and add 10 = 70 |
| 3. If you were alone in a deserted house at night and there was a lamp, a fire and a candle and you only had one match, which would you light first? | 3. If you were alone in a deserted house at night and there was a lamp, a fire and a candle and you only had one match, which would you light first? The match |
| 4. Take two apples from three apples and what do you have? | 4. Take two apples from three apples and what do you have? Two apples |
| 5. If you drove a bus leaving Sydney with 40 passengers, dropped off 7 and picked up 2 at Bondi, stopped at Auburn and picked 10 up, then went on to Parramatta, dropped 8 there and picked up 5, then drove on to arrive in Richmond one hour later, what was the driver's name? | 5. If you drove a bus leaving Sydney with 40 passengers, dropped off 7 and picked up 2 at Bondi, stopped at Auburn and picked 10 up, then went on to Parramatta, dropped 8 there and picked up 5, then drove on to arrive in Richmond one hour later, what was the driver's name? Your name |
| 6. If a doctor gave you 3 tablets and told you to take one on every half-hour, how long would they last? | 6. If a doctor gave you 3 tablets and told you to take one on every half-hour, how long would they last? 1 Hour (one tablet at first, then the 2nd after half an hour, then the third after an hour) |
| 7. Which country has a 4th of July, Britain or America? | 7. Which country has a 4th of July, Britain or America? Both |
| 8. Some months have 31 days, some have 30 days, how many have 28? | 8. Some months have 31 days, some have 30 days, how many have 28? All |
| 9. How far can you walk into the woods? | 9. How far can you walk into the woods? Halfway (once you reach there, if you continue you are walking out again) |

ANSWERS

WHY CAN YOU NEVER TRUST ATOMS?

A: THEY MAKE UP EVERYTHING!

NANOSCALE ORGANISATION AND DYNAMICS

Professor William S. Price

Group Leader

- Medical Physics, MRI, NMR and diffusion

Professor Janice Aldrich-Wright

Director Research School of Science and Health

- Potent in-vivo cytotoxic agents

Professor Annemarie Hennessy

Dean of Medicine

- Preeclampsia

Assoc. Prof. Gary Dennis

Deputy Dean School of Science and Health

- Polymer and surface chemistry

Dr Tim Stait-Gardner

National Imaging Facility Fellow

- MRI and quantum physics

Dr Allan Torres

Research Instrumentalist

Senior Lecturer

- NMR and MRI

Dr Gang Zheng

Lecturer

- NMR pulse sequence development

Dr Scott Willis

BMRB Manager & Researcher

- NMR and MRI diffusion measurements

Dr Abhishek Gupta

Post Doctoral Fellow

- MRI contrast agent development and NMR relaxation

Group Meetings

I HAVE NOT FAILED.

I'VE JUST FOUND
10,000 WAYS THAT
WON'T WORK

— THOMAS
ALVA EDISON

NANOSCALE RESEARCH / GRANT MEETINGS

Nanoscale Research/Grant Meetings are held at Campbelltown.

PROFESSOR WILLIAM PRICE'S LAB GROUP

Meet every Friday at 09:30 am in CA 21.1.65

PROFESSOR JANICE ALDRICH-WRIGHT'S LAB GROUP

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