



National
Imaging
Facility

Exploring Inner Space

NIF Quarterly • Q1, 2014

PET/CT imaging of an EphA2 specific antibody in glioblastoma

- PI A/Prof. Stephen Rose,

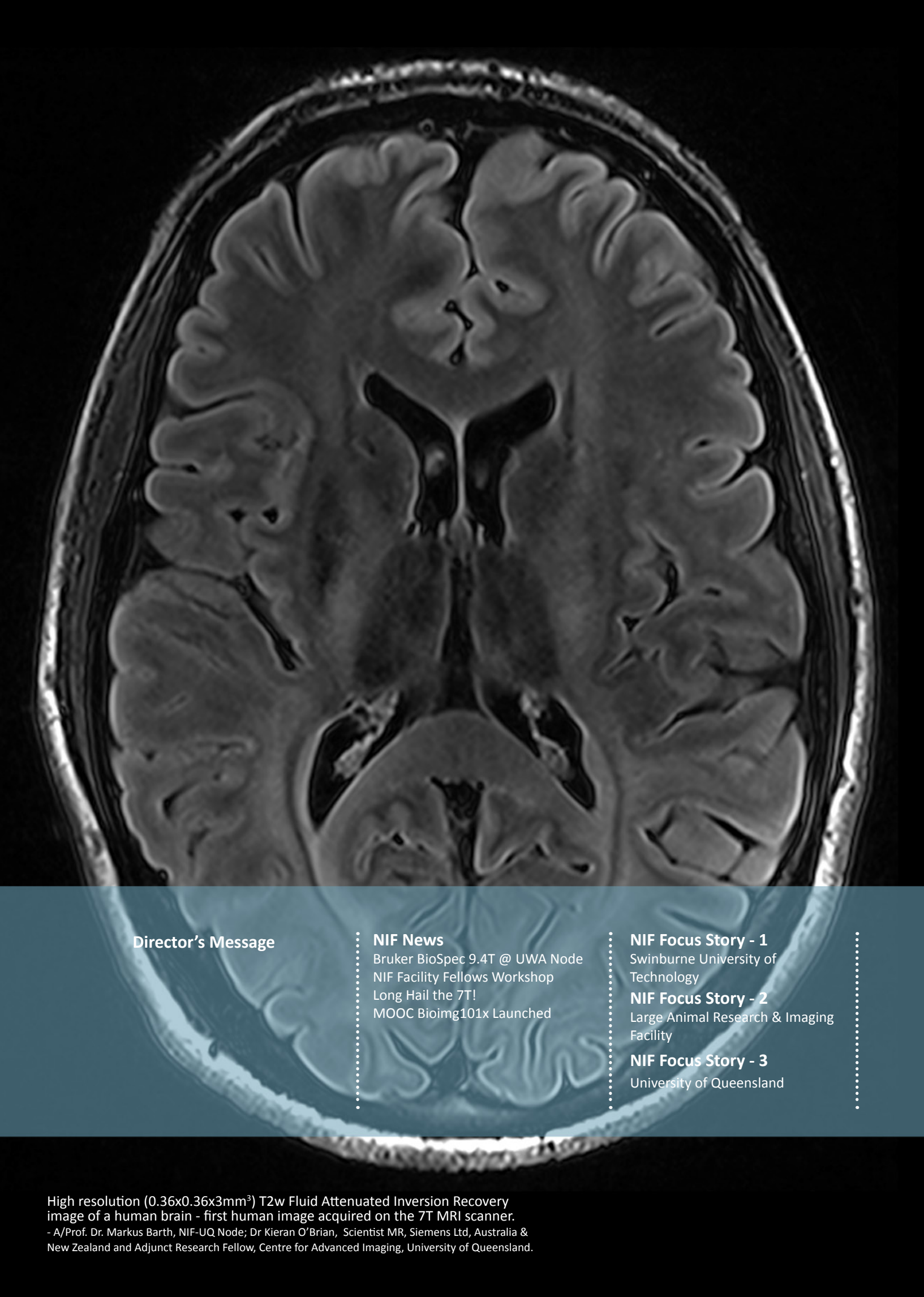
Imaging Dr Simon Puttick, in collaboration with

Dr Karine Mardon, NIF-University of Queensland node;

Inveon PET/CT.



www.anif.org.au



Director's Message

NIF News

Bruker BioSpec 9.4T @ UWA Node
NIF Facility Fellows Workshop
Long Hail the 7T!
MOOC Bioimg101x Launched

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Technology

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Large Animal Research & Imaging
Facility

NIF Focus Story - 3

University of Queensland

High resolution ($0.36 \times 0.36 \times 3 \text{ mm}^3$) T2w Fluid Attenuated Inversion Recovery image of a human brain - first human image acquired on the 7T MRI scanner.
- A/Prof. Dr. Markus Barth, NIF-UQ Node; Dr Kieran O'Brian, Scientist MR, Siemens Ltd, Australia & New Zealand and Adjunct Research Fellow, Centre for Advanced Imaging, University of Queensland.

DIRECTOR'S MESSAGE

Collaborative Research Infrastructure – what is it and what does it mean for you? Have a look inside this quarterly newsletter to get insights into both questions.

Collaborative Research Infrastructure is world-leading capability: instrumentation and people. The National Imaging Facility is part of Australia's national research infrastructure. Since the last newsletter, we have installed two new MRI scanners. One is a 9.4T animal MRI system, the first in the west. Hosted and operated by the Centre for Microscopy, Characterisation and Analysis at the University of Western Australia, it is located in the midst of the Harry Perkins Institute for Medical Research, ready to support a wide range of pre-clinical, biology and material science projects. And read about Valentine's Day at the University of Queensland, where Australia's first Ultra-High Field Human MRI was installed, with plans for research across the disciplinary boundaries.

And what about you? Wherever you work in Australia, you are entitled and encouraged to use NIF's newest additions, along with one of the most comprehensive ranges of imaging capability in the world. All under

one umbrella, albeit many rooves. That is what collaborative research infrastructure is all about – Enabling your research by providing infrastructure for YOU.

And there is more. NIF offers expertise, to help you get the most out of all this kit. Each newsletter, we introduce you to part of the team, as they share the projects in which they are involved. So read about how magnetoencephalography (MEG) and functional magnetic resonance imaging (fMRI) help us to understand schizophrenia in a project bringing together the expertise at Swinburne University of Technology with a researcher from Newcastle University. Or how about a multi-national study (UK, USA, New Zealand, Australia), working together with the team at the Large Animal Imaging and Research Centre, in Adelaide, in which they are using animal models to follow gene therapy in Huntington's Disease, or the progression of neurodegenerative disease.

And, what would a research facility in Australia be, without having a sporting angle. Yes, researchers at Queensland University of Technology are using the facilities at neighbour, UQ, to understand how specific training protects against injury. Whatever your research interest, there is a good chance that NIF has something for you.

So, NIF has the kit, and we are ready to support your research. Enjoy these great stories, and we'd love to share your exciting research in future newsletters.

Professor Graham Galloway
Director of Operations

"You are entitled and encouraged to use NIF's newest additions, along with one of the most comprehensive ranges of imaging capability in the world."



NIF News

Bruker BioSpec 9.4T @ UWA Node

Flagship imaging instrument for NIF-UWA Node, preclinical Bruker BioSpec 9.4T MRI scanner has arrived, installed, and ready to party! It is a high performance multi-nuclear system for non-invasive high-resolution imaging and spectroscopy in preclinical, preserved sample, plant, and materials research. A range of volume, surface, and phased array imaging coils are available to accommodate specific preclinical needs, in addition to planar surface coils for materials applications. Three sizes and strengths of imaging gradients are available to best tailor the imaging capabilities to the diverse and individual needs of both preclinical and materials researchers.

The NIF-UWA Node is hosted by the Centre for Microscopy, Characterisation & Analysis. For more updates please go to: <https://www.facebook.com/UWACMCAofficial?filter=1>

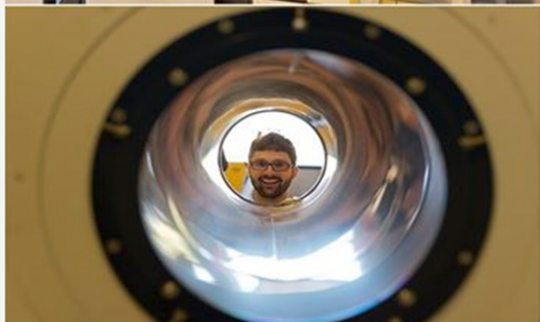
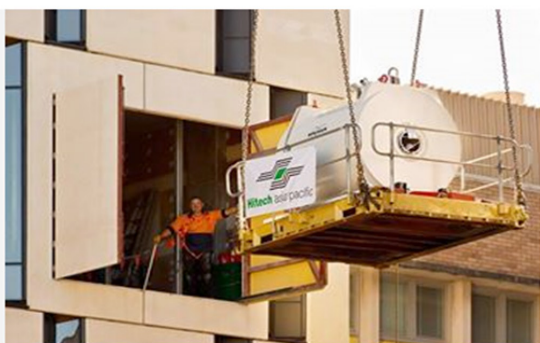


UWA Centre for Microscopy, Characterisation & Analysis

March 21 • Edited

9.4T MRI Arrives at CMCA

We have just taken delivery a 9.4 T Bruker BioSpec research MRI scanner, CMCA's flagship instrument as WA's sole node of the Australian National Imaging Facility (anif.org.au). The MRI scanner is located in CMCA's new space on the third floor of the Harry Perkins Institute of Medical Research building at the QEII Medical Centre. The BioSpec will soon be available to researchers, with projects already planned for studying cancer, genetic disorders like muscular dystrophy, drug delivery systems, evolutionary neurobiology of sharks, and engineering applications including desalination membranes. Interested users are welcome to contact Assoc/Prof Kirk Feindel for informal project discussions.



Like · Comment · Share

4 1

NIF Facility Fellows Workshop 26th - 27th March, 2014

For two days in March, the annual NIF Facility Fellows Workshop was held at the UQ Node, in the newly constructed Centre for Advanced Imaging. The workshop was a great networking opportunity, introducing and welcoming new scientists who have joined the NIF team over the last 12 months. The workshop was also a platform for all Fellows to update the events at their home nodes, showcase their research work, and share expertise with fellow scientists. As the last few NIF flagship research infrastructure are commissioned in 2014, the workshop also provided opportunity for inter-node collaborations.

The workshop also focused on 'Building Collaborations with Users'; topics discussed included:

- Facility Fellow's role in negotiating collaborations,
- Research Project Management (SOP for access to facilities, analysis tools available, reporting, and promotional activities), and
- Career Development and Training Opportunities.

The workshop was very well attended by all Fellows from all nodes, and was very productive. Thank you to all Fellows for two very exciting days!



NIF News

Long Hail the 7T!

'Strongest in Southern Hemisphere'

After long long long anticipation, the first 7 Tesla whole body MRI scanner in southern hemisphere is now ready to rock and roll! Located at the Centre for Advanced Imaging, University of Queensland, the Siemens Healthcare '7T Magnetom' system is a flagship imaging capability for the NIF-UQ node; it provides the most powerful imaging quality for visualising anatomical detail and functional information. Key technical features of the system include a high-performance gradient with multi- receive/transmit radiofrequency capabilities, which further increases sensitivity. The 7T will be used for a broad range of applications, including neuroscience, engineering, imaging, and theranostics.

Nerdy facts about the 7T:

- After weeks of floating over the ocean, the system was delivered to NIF-UQ Node on the 27th November 2013.
- The 7T weighs 38.6 tonnes (~128667 packs of ANZAC biscuits!).
- Bore size 60cm.
- System length 317.5 cm.
- Magnet field strength is 140,000 times stronger than Earth's magnetic field.
- 20,000L of liquid Helium were used to cool down the magnet to -270°C!
- First human image was acquired on the 14th February 2014 - *the dream Valentine's Day present for NIF*.

For more information about accessing the instrument, collaborative opportunities, and it's host institution, Centre for Advance Imaging, please go to: www.cai.uq.edu.au.

MOOC Bioimg101x Launched!

MOOC (Massive Open Online Courses) for Bioimaging 101x was officially launched on the 7th of April, 2014! It is a 10-week course delivered by the edX platform. The course is targeted at general public - high school level science background is all that is required.

"Most people will have a need for advanced imaging sometime during their life. With the misinformation sometimes portrayed in TV dramas, which can exaggerate the benefits or over-emphasise the risks, it is important to give people an understanding of what to expect if their doctor sends them for a PET scan, for example." Says NIF's Director, and Bioimg101x Course Coordinator Prof. Graham Galloway.

Bioimg101x is designed by a number of Facility Fellows at the UQ Node. The course provides an introduction to modern imaging modalities, the scientific principles behind imaging, and key applications of the technologies, from neurological diseases to cancers. The course also offers advanced modules for professional development, particularly across health, engineering and IT industries.

Congratulations MOOC Bioimg101x team! The course launch was a success with 10,000+ enrolments. Find out more about the course https://www.edx.org/course/uqx/uqx-bioimg101x-introduction-biomedical-1429#U127Yk2_nL-

Imaging Facility @NIFAus · Oct 10
Exciting! The magnet of the World First 7T human MRI is floating its way across the ocean to NIF Aus Oct 27th! @uqnewsonline @Siemens_Aus

Imaging Facility @NIFAus · Oct 30
Australia 1st 7T #MRI magnet will be delivered to @NIFAus UQ node @UQnewsonline on 3rd Nov! cant wait! anif.org.au

Imaging Facility @NIFAus · Nov 25
NIFs magnet for 7T MRI all settled in at cai.uq.edu.au UniQLD! only a few more wks to make it all pretty... ow.ly/3P8RO



Imaging Facility @NIFAus · Dec 3
So pretty! Oz 1st human 7T #MRI @UQ is ready2b energized! Should be ready to rock'n'roll early 2014! @uqnewsonline pic.twitter.com/fLrbJeapy4



Imaging Facility @NIFAus · Feb 17
Long hail the 7T!! MT @gbsmrt @nifaus Director Prof Graham Galloway accept Siemens Human 7Tesla MRI UQ @uqnewsonline pic.twitter.com/PRuRKEtjge



Do you have news?!

Published a paper? Formed new collaborations? Discovered something?

Any updates from your Node — we need to know!

Email: communications@anif.org.au

Or tweet us @NIFAus



NIF Focus Story - 1

Swinburne Node:

Improving our understanding of 'hearing voices' - investigation into Schizophrenia

Schizophrenia is a complex brain disorder, characterised by disruptions to thinking and emotions, and a distorted perception of reality [1]. The World Health Organisation classifies schizophrenia as the world's top ten enduring disabilities, affecting 24 million people worldwide [2]. In addition to the profound emotional cost to families, schizophrenia costs the Australian community ~\$2.6 billion per annum in medical costs and loss of productivity [3]. To date, there is no known cause or cure for this illness [1, 2]. Amongst the many symptoms, Auditory Verbal Hallucinations (AVHs) are the core symptom of schizophrenia [4], and arguably the most distressing. Current treatments yield only modest improvements, with one third of AVHs patients remaining treatment resistant. Hence, it is imperative to understand the mechanisms involved in AVHs which may inform treatment development.

By employing both magnetoencephalography (MEG) and functional magnetic resonance imaging (fMRI) imaging technologies available at the Swinburne University of Technology, the NIF-Swinburne team aims to use MEG to further our understanding of 'hearing voices' in schizophrenia. The research team, led by Prof. Susan Rossell (NIF-Swinburne Node Director) and NIF Facility Fellows Dr Will Woods and Dr Matthew Hughes, along with Dr Neil Thomas (clinical psychologist) and E/Prof Pat Michie (Newcastle University), were recently awarded NHMRC funding to explore AVHs phenomena in patients with schizophrenia ('Improving our understanding of hearing voices': \$446,093). As the flagship imaging research infrastructure at the NIF-Swinburne Node, the MEG scanner is the most sophisticated in the Southern Hemisphere, with 306 sensors in addition to a high-field 3T MRI scanner, enabling the research team to better characterise the temporal dynamics of the voice experience in schizophrenia patients.

The core aims of the project are to understand the contribution to AVHs phenomena of two cognitive mechanisms that are impaired in schizophrenia (intentional inhibition and self-monitoring). To this end, the research team will gather and analyse fMRI and MEG data from hallucinating and non-hallucinating schizophrenia patients and healthy controls performing: (1) an AVH task; (2) an intentional inhibition task; (3) a self-monitoring task. While fMRI affords good spatial resolution, the temporal resolution of this technique

is limited. By contrast, MEG affords millisecond temporal resolution enabling precise determination of when brain regions activate during cognitive events.

The temporal resolution of MEG is demonstrated in the time-frequency plot (Figure 2) from an MEG sensor over the right inferior frontal gyrus (IFG, Figure 1) of a participant performing an intentional inhibition task; notably, right IFG is thought have a critical role in intentional inhibition and AVHs phenomena. The participant responded upon presentation of a go response stimulus ('Go') and attempted to inhibit the response when a stop-signal stimulus ('SS') was presented after the go stimulus (note that 'Fix' = 500 ms fixation period). Go task only trials are termed 'no-signal' trials, unsuccessful stop-signal trials are termed 'signal-respond' trials while successful stop-signal (inhibition) trials are termed 'signal-inhibit' trials. For right IFG to be truly relevant in intentional inhibition it must become active between the onset of the stop-signal (SS) and the finishing time of inhibition processes ('SSRT') during signal-inhibit trials. Critically, the plot shows a broad spectrum neuro-magnetic response during this interval of signal-inhibit



Figure 1: MEG sensor over the right inferior frontal gyrus (IFG).

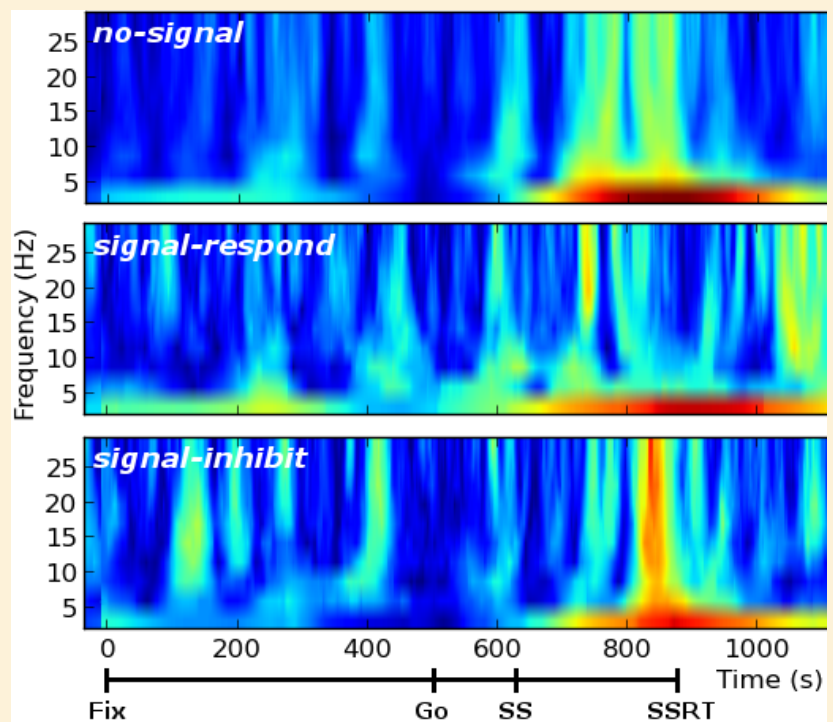


Figure 2: MEG time-frequency plot.



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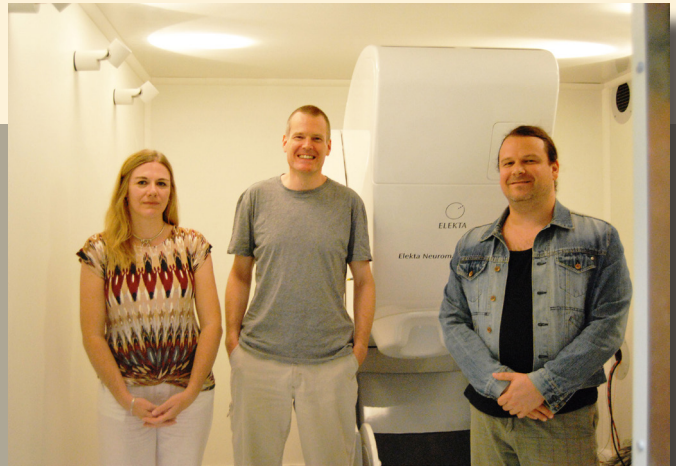
trials only (hot colours), hence demonstrating the power of MEG analyses to link brain activity to behaviour.

This is an ongoing research theme at the NIF-Swinburne Node. For further information on the research project and collaborative opportunities, please contact Prof. Susan Rossell srossell@swin.edu.au.

1. Mental Health Research Institute - Schizophrenia www.mhri.edu.au/schizophrenia
2. World Health Organization, Mental Health – Schizophrenia www.who.int/mental_health/management/schizophrenia/en/
3. Schizophrenia Research Institute www.schizophreniaresearch.org.au/schizophrenia/about-schizophrenia/
4. Horga, G., *et al.*, Differential brain glucosemetabolic patterns in antipsychotic-naïve first-episode schizophrenia with and without auditory verbal hallucinations, *J Psychiatry Nerosci.* Sep 2011; 36(5): 312-321.

MEET THE TEAM:

At the Swinburne University of Technology node there are three NIF staff members - Prof. Susan Rossell (Node Director, left), and NIF Facility Fellows Dr William Woods (middle), and Dr Matthew Hughes (right).



As the Director for NIF-Swinburne Node, Prof. Susan Rossell is a Professorial Research Fellow at the Brain and Psychological Sciences, Swinburne University of Technology, and at the Monash Alfred Psychiatry Research Centre. Having held numerous prestige academic positions at the Functional Imaging Lab (UK), Macquarie University, and Mental Health Research Institute of Victoria, Susan focuses her research on the understanding of cognitive and neurobiological process involved in psychosis and related disorders. Prof. Rossell was awarded both the International and European Award for Young Investigators into Schizophrenia Research.

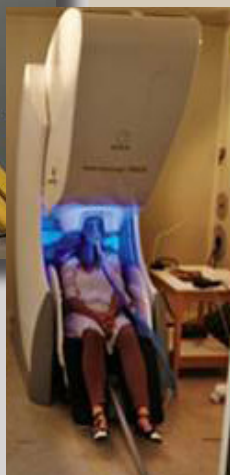
Dr Will Woods is the NIF Facility Fellow for the flagship MEG scanner at the Swinburne Node. Having previously worked as the Head of Data Analysis at York Neuroimaging Centre, UK, where he was involved in the installation and commissioning of what was at the time only the second MEG system in the UK. His research focuses on inverse modelling and statistical analysis of MEG data. Will is a Senior Lecturer at the Swinburne University of Technology.

Dr Matthew Hughes is the NIF Facility Fellow for 3T MRI scanner at the NIF-Swinburne Node.

ABOUT MEG (MAGNETOENCEPHALOGRAPHY)

MEG is a safe, non-invasive human brain imaging technique. Using hemispherical grid that covers the head, MEG technology can easily detect instantaneous changes in brain activity by measuring very small magnetic fields produced by the active brain. Applications of MEG include basic research into perceptual and cognitive brain processes, localizing regions affected by pathology before surgical removal, and determining the function of various parts of the brain.

As the only MEG scanner in the National Imaging Facility network, NIF-Swinburne node possess a Neuromag TRIUX, which is a new magnetoencephalography (MEG) platform from Elekta. It addresses key MEG requirements that are critical for robust functional mapping studies. The system features higher tolerance for magnetic interferences, new user interface features and patient comfort enhancements. For more info about accessing the imaging facilities at NIF-Swinburne Node, please go to www.swinburne.edu.au/lss/bpsyc/neuroimaging/meg.html, or through NIF at www.anif.org.au.



NIF Focus Story - 2

LARIF Node:

Exploring Neurodegenerative Disorders Using Large Animal Models *- a collaborative approach*

Located at Gilles Plains, Adelaide, NIF-LARIF Node (Large Animal Research & Imaging Facility) is a unique facility of its type. LARIF houses a fully serviced operating theatre complex complete with a 1.5T Siemens Sonata MRI and CT, which are available exclusively for researchers using large animals. LARIF is supported by a team experienced in imaging, research, initiation and project management, experimental surgery, full operating theatre operations, specialised veterinary care and quality control. Collectively this enables the execution of a diverse range of large animal studies to high standards. The unique research setting available at LARIF provides the ideal site for research using large animal models, attracting collaborations across the globe.

One of the major collaborative research support partners for LARIF is the CHDI Foundation. The CHDI Foundation is a not-for-profit biomedical research organisation devoted to developing treatments that will slow the progression of Huntington's Disease (HD) and manages a diverse portfolio of research projects, including several studies in sheep models.

Gene Therapy for Huntington's Disease

Huntington's disease (HD) is a neurodegenerative disorder caused by a genetic abnormality which manifests as progressively debilitating movement, cognitive and behavioural deficiencies. The onset of symptoms of the disorder can occur at any time from infancy, but most commonly commence between the ages of 30 and 50. There are currently no disease-modifying treatments available for HD.

Two of the major challenges to developing successful treatments for HD are the limited knowledge of biomarkers of disease progression and the inadequacy of small animal models for studying HD. In contrast to small animal models, sheep have a larger brain that is amenable to imaging and intracerebral therapy, longer lifespan, and a more human-like neuroarchitecture.

An ongoing study at LARIF, supported by CHDI, is aimed at evaluating a gene therapy designed to interfere with the expression of the Huntingtin gene for the treatment of HD. This collaborative study is headed by Professor Neil Aronin



Fully serviced operating theatre for large animals at LARIF.

who leads a team of expert researchers at the University of Massachusetts Medical School (UMMS; USA). Key contributors to the study, include Prof. Guangping Gao (Director, Gene Therapy Center and Vector Core) and Prof. Richard Moser (Professor of Surgery & Chief of Neurosurgery), as well as Erica Mondo (UMMS), Dr Edith Pfister (UMMS) and Dr Suzanne Reid (University of Auckland, NZ) who are all integral for sample collection and analysis.

A line of genetically-modified sheep that express copies of the the human HD gene and produces the mutant huntingtin protein in the striatum of the brain looks to be a promising model of HD in which to evaluate the potential of gene therapy. These sheep were engineered by reproductive biologists at the South Australian Research and Development Institute (SARDI), and a collaborating group in Auckland (NZ). Prof. Jenny Morton, who is Professor of Neurobiology at the University of Cambridge (UK), has been studying the behaviour and structural brain changes in the HD sheep with funding from CHDI. Using state-of-the-art surgical techniques the therapy was injected directly into the brain of the sheep. Immediately following injection CT and MRI scans were performed to confirm the location and spread of the gene therapy. The behaviour of the sheep was closely monitored in the facility post-operatively for three days following the surgery, to assess any potential brain injury, and subsequently in outside yards. All of the sheep recovered favourably with no signs of brain injury observed.

Studying the Progression of a Neurodegenerative disease

Batten's disease is a neurodegenerative genetic disease occurring in childhood. In many neurological disorders, changes in the brain structure are often detectable prior to the appearance of symptoms. In Batten's disease, it is known that significant changes occur in specific brain regions including the cortex, leading to the progressive rapid deterioration of motor function. In sheep there is a naturally occurring recessive



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mutation that causes Batten's disease. Supported by CHDI, Prof Morton has been using the Batten's disease sheep as a model of brain abnormality to develop tests and analyses that might be useful for the assessment of HD sheep.

The unique facilities at LARIF allowed the longitudinal collection of MRI images paired with close monitoring of the behaviour of the sheep. This is enabling Prof Morton to compile a detailed picture of features and dynamics of brain degeneration and how this correlates with physical manifestations of movement, cognitive and behavioural deficiencies.

It is anticipated that research into the progression of this neurodegenerative disease will facilitate improved evaluation of therapeutic agents for HD.

For more information on the projects, please contact Dr Tim Kuchel at tim.kuchel@sahmri.com.

For the more information on accessing the LARIF, PIRL, and SAHMRI capabilities, please go to <https://www.sahmri.com/research-support/research-facilities-and-equipment/research-services/sahmri-irl>.

ABOUT

LARGE ANIMAL RESEARCH & IMAGING FACILITY (LARIF):

The NIF-LARIF Node is hosted by the Preclinical, Imaging and Research Laboratories (PIRL), which is part of the South Australian Health and Medical Research Institute (SAHMRI).

Officially opened on the 22nd May 2013, LARIF provides cutting edge research services by utilising MR, CT and other imaging modalities for research using large animal models of human disease. Many current neurodegenerative disease and neurotrauma models use sheep. Sheep have gyrencephalic brains, which are similar to humans in structure and size and therefore are a stepping stone in neurological and pharmacological research between the lissencephalic brain of rodents and the human brain.

The NIF-LARIF Node has a 1.5 T clinical MR scanner with ample coils and software, a 16 slice CT scanner, flat detector digital C-ARM, mobile X-ray equipment as well as two dual-energy X-ray Absorptiometry (DXA) scanners and anaesthesia equipment. Image

files can be downloaded remotely via a password access system. Access to fully staffed operating surgical suites and support operations, animal accommodation and office accommodation for external researchers is also provided. In addition, off-site researchers have access to a large range of animal models of human disease. The imaging modalities, surgical suites and supporting services are linked to a large animal holding facility with CCTV monitoring equipment with remote access capability. LARIF can also provide experimental rooms, tissue collection facility, a range of on-site options for temporary storage of samples, animal holding rooms for groups housing or individual pens, and rooms to hold sheep in expandable metabolism crates.



In front of the Phillips Large Animal CT scanner L - R: Raj Peruman (Radiographer and NIF Facility Fellow), Loren Matthews (Theatre Supervisor), Dr Marianne Keller (Imaging Scientist and NIF Facility Fellow), and Dr Tim Kuchel (Node Director).



Dr Tim Kuchel, LARIF Node Director

Dr Tim Kuchel, is the director of the Preclinical, Imaging and Research Laboratories (PIRL) of the South Australian Health and Medical Research Institute (SAHMRI). It is PIRL which hosts the NIF funded Large Animal Research and Imaging Facility (LARIF). Dr. Kuchel also is the Node director of the Australian Phenomics network (APN).

Dr. Kuchel has more than 30 years' experience in animal research with a special interest in imaging modalities, experimental surgery and comparative anaesthesia. The capacity to provide or help develop Large Animal Models of human disease is the core business of LARIF and PIRL, and interactions with industry to add to existing translational medicine capacity are being actively pursued by Dr. Kuchel and his team.



1.5T MRI

Official Launch





NIF Focus Story - 3

UQ Node:

fmMRI study of the Nordic Hamstring Exercise - keeping our Aussie sports favourites on the field for longer

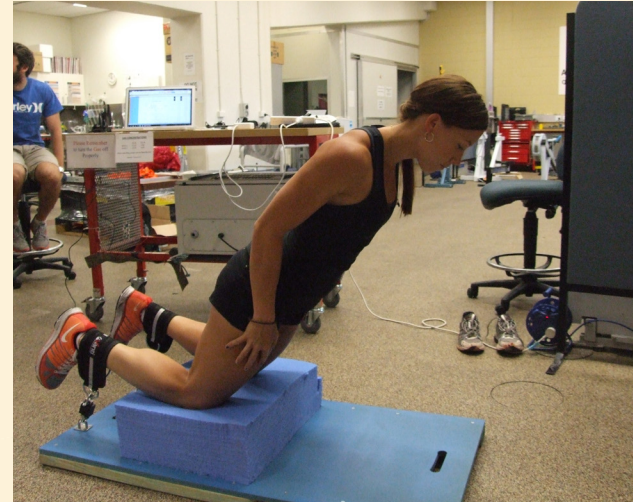
Hamstring strains are the most common injury in running-based sports, such as track and field, rugby, soccer and Australian Rules Football. They occur frequently and, frustratingly, exhibit high rates of injury recurrence suggesting that something important is being missed in the standard rehabilitation protocols that athletes complete. Furthermore, it costs AFL clubs an estimated \$1.5M annually in wages paid to sidelined footballers while English Premier League teams spend ~£74M on players whose hamstrings won't let them play.

Hamstring injuries that occur in running most often involve the biceps femoris as the primary site of injury and the Nordic Hamstring Exercise (image above) has been shown, in a number of studies, to increase hamstring strength and reduce hamstring injury rates in soccer players. Nevertheless, it is still unclear whether the Nordic Exercise powerfully activates the biceps femoris muscle and the effects of prior injury on biceps femoris muscle use are unknown.

To answer these questions, a research team from the Queensland University of Technology (QUT) led by Dr Anthony Shield and carried out by PhD candidate, Matthew Bourne, has studied the effects of prior injury on hamstring muscle activation patterns during the Nordic hamstring exercise. Their aim is to develop better rehabilitation protocols that prevent first time injuries and improve the rehabilitation of players who do suffer hamstring strains.

Through National Imaging Facility (NIF)'s Subsidised Access program, QUT research team has collaborated with MRI expert Mr Aiman Al Najjar (MRI Facility Manager, NIF - University of Queensland node) to perform functional MRI (fMRI) scans on the thighs of athletes with a history of unilateral hamstring injury before and after they performed 60 repetitions of Nordic hamstring exercise. Importantly, all the athletes had completed a standard rehabilitation and had returned to full training and competition schedules. Transverse (T2) relaxation times of all hamstring muscles (biceps femoris long head, biceps femoris short head, semitendinosus, semimembranosus) were measured at rest and immediately after the Nordic hamstring exercise and cross-sectional area (CSA) was measured at rest.

Utilising the facilities available at the NIF-UQ node, the QUT research team led by Dr Anthony Shield (Senior Lecturer, Faculty of



Health) was the first to employ fMRI to detect persistent differences in the muscle usage patterns between previously injured and never injured limbs.

Previously injured biceps femoris muscles were recruited significantly less powerfully than the same muscles in the never injured limbs, suggesting a persistent alteration in motor control. In uninjured limbs, the semitendinosus muscle was activated significantly more than the other hamstring muscles. The current study suggests that current rehabilitation practices and a return to training and competing typically do not return muscle usage patterns to their pre-exercise levels. This may contribute to the high rates of hamstring injury recurrence which plague athletes in running sports. Furthermore, athletes with a history of strain injury to the biceps femoris long head may benefit more from exercises other than the 'Nordic' and more fMRI work is planned to discover which exercises are best.

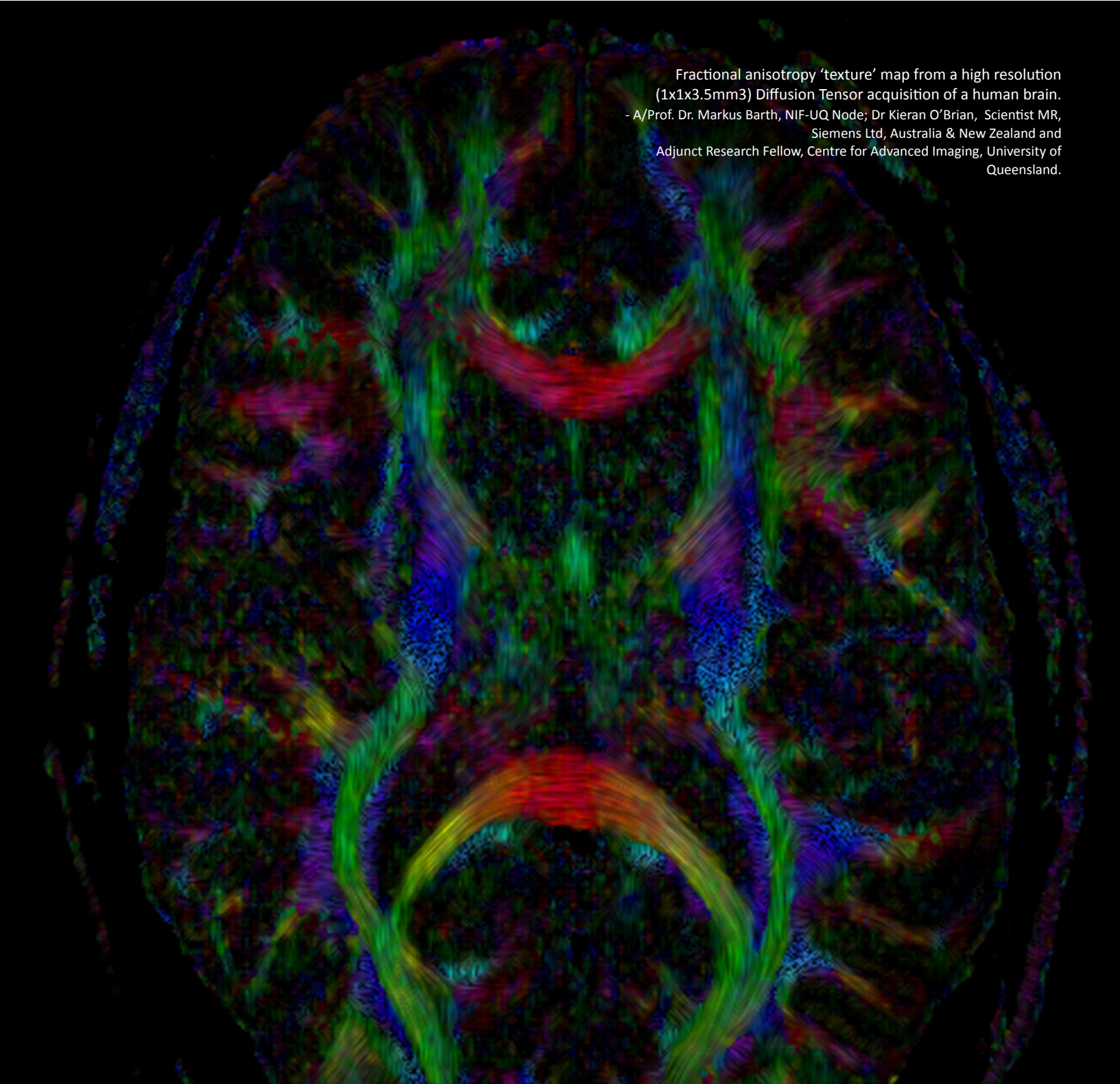
Dr Shield and his team currently work with athletes from track and field, 9 AFL teams, 3 Australian Super 15 Rugby Union and will soon embark on a large scale study of soccer's A-League. It is anticipated that these and other international teams will benefit significantly from the changes in rehabilitation practices that this NIF funded research will stimulate.

For more information on this invention, please refer to TheQUTube: <http://www.youtube.com/watch?v=88wAQqUalzo&app=desktop>

For more information on the project, please contact Dr Anthony Shield aj.shield@qut.edu.au.

For the fMRI imaging component, please contact Mr Aiman Al Najjar aiman.alnajjar@cai.uq.edu.au.

This project is funded by the Centre of Excellence at the Queensland Academy of Sport; fMRI imaging component is supported by NIF through Subsidised Access Program.



Fractional anisotropy 'texture' map from a high resolution (1x1x3.5mm3) Diffusion Tensor acquisition of a human brain.
- A/Prof. Dr. Markus Barth, NIF-UQ Node; Dr Kieran O'Brian, Scientist MR, Siemens Ltd, Australia & New Zealand and Adjunct Research Fellow, Centre for Advanced Imaging, University of Queensland.

NIF Nodes:

University of Queensland

University of Western Australia

University of New South Wales

University of Sydney / ANSTO

University of Western Sydney

University of Melbourne

Monash University

Florey Institute of Neuroscience and Mental Health

Swinburne University of Technology

Large Animal Research & Imaging Facility

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