

Translational & Molecular Imaging Institute

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Issue 7

tmii.mssm.edu

Message from the Director

I recently enjoyed reading a paper (Sci Transl Medicine April 2015) by the Director of the National Institute of Biomedical Imaging and Bioengineering (NIBIB) at the NIH, Dr. Roderick Pettigrew our Keynote speaker at our TMII Symposium on July 24. This paper highlights the amazing previous contributions of the Engineering discipline to the major medical discoveries and clinical translation. As "Precision Medicine" is now becoming a necessity, innovations and blue sky research in Imaging Science and Medicine, the theme of our 5th Annual TMII Symposium, are mandatory. I am excited about this upcoming TMII Symposium that features the most

innovative speakers and scientists in Imaging Science (more details inside this issue). We also feature in this newsletter the speakers that were selected from the submitted abstracts as standouts to the presented at the TMII symposium in the areas of neuroimaging, cancer/body imaging, cardiovascular and nanomedicine.

We also like to welcome Dr. Marc Dweck, MD, PhD a Cardiologist as a visiting scholar to TMII from The Edinburgh Heart Centre in Scotland. We are excited to work with Marc on noninvasive coronary atherosclerosis detection using novel PET/MR (see inside our Core

Spotlight) techniques.

We finally feature others News and Updates from TMII and the Brain Imaging Center (BIC). I look forward to seeing you on July 24 at the 5th Annual TMII Symposium.

I wish all a great read of the TMII Newsletter and a great Summer!



Zahi Fayad, PhD
Director, Translational & Molecular Imaging Institute
Professor of Radiology and Medicine
zahi.fayad@mssm.edu

WHAT'S NEW?

TMII News & Updates

5th Annual TMII Symposium is right around the corner. Registration is open to all. For more information see the features below and visit <https://tmii.mssm.edu/symposium/2015/>.

Congratulations to all those presented at the various imaging conferences recently. We'd like to highlight a few stand-out achievements. At the 23rd Annual International Society for Magnetic Resonance in Medicine, the ISMRM Merit Award - Magna Cum Laude was awarded TMII's own Dr. Claudia Calcagno. Also at ISMRM, Dr. Rebecca Feldman received the High Field Study Group Poster Award for her work on 7T Imaging of patients with focal epilepsy. Continuing with the conference theme, Dr.

Prantik Kundu will be joining other leaders in the field by giving a talk entitled, "Multi-Echo SMS EPI for fMRI" at the upcoming ISMRM Workshop on Simultaneous Multi-Slice Imaging: Neuroscience & Clinical Applications in Pacific Grove, CA July 19-22. Registration is open, just make sure you make it back for the TMII Symposium!

TMII would also like to congratulate Dr. Mathilde Wagner, of the Taouli lab, for successfully completing her doctorate from Université Paris Diderot. Dr. Wager thesis is entitled, "Hepatocellular carcinoma: diagnosis and characterization by magnetic resonance imaging".

In addition to twitter, [@TMIIInyc](https://twitter.com/TMIIInyc), you can also follow TMII events on facebook: [TMII.SINAI](https://www.facebook.com/TMII.SINAI)

Lastly, you know summer is in full swing when the TMII Summer Science Camp has started. The TMII SSC is a program that runs for 6 weeks and is open to all dedicated and interested students (high school through college). In this program students will learn principles of medical imaging (MRI, PET, and Optical etc.), neuro-anatomy, animal models in research and various neuro-psychiatric disorders. The training involves lectures, quizzes, hands on training in image acquisitions and data analysis and assist with ongoing projects.

UPCOMING EVENTS

- TMII Meetings
 - > 5th Annual TMII Symposium July 24, 2015. 8 am - 5 pm Davis Auditorium Hess Center for Science and Medicine
 - > New TMII Seminar Series coming soon. Check back for more details.

- BIC Meetings
 - > Technical Group Meetings - Every Monday 12 - 1 pm Hess 10-101
 - > 2nd Annual BIC Day - October 7th, 2015

For more information on these and other events go to: <http://tmii.mssm.edu/events/>

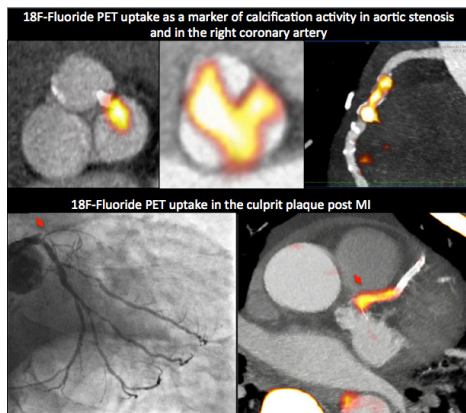
The Ring of Fire

Marc R. Dweck, MD PhD

Since June we have been joined at TMII by Dr Marc Dweck who will spend a year with us as a post-doctoral fellow in molecular imaging.

In particular he will be working on PET/MRI imaging of the coronary and carotid arteries using 18F-Fluorodeoxyglucose and 18F-Fluoride.

Marc is a British Heart Foundation Senior Lecturer and Cardiologist at The Edinburgh Heart Centre, UK with a clinical interest in multimodality imaging of the heart (CT, MRI, Echocardiography and PET) and cardiovascular device implantation. His main research interests are in the application of multi-modality non-invasive imaging



techniques to the study of cardiovascular disease in humans and his training has included fellowships at the Royal Brompton Hospital,

London and Cedars Sinai Medical Centre Los Angeles. In particular Dr Dweck has pioneered the use of 18F-NaF PET/CT to measure disease activity in aortic stenosis and to detect vulnerable high-risk atherosclerotic plaques (recently published in *The Lancet*); and has investigated how the left ventricle

decompensates in response to pressure overload using MRI and high-sensitivity troponin measurements. Dr. Dweck is principle investigator on the study "SALTIRE 2 a randomized control trial

of anti-calcific therapies in aortic stenosis". He has published in many of world's leading general medical, scientific and cardiovascular journals and is the recipient of numerous national and international awards including: British Heart Foundation Outstanding Researcher 2015, The Young Investigator Award from the American College of Cardiology (2012 and in 2015 as senior author); The Young Research Worker's Prize from the Radiology Society of North America (2011); and The William W Parmley Young Author Award from the Journal of the American College of Cardiology (2012).



Marc R. Dweck, MD, PhD
Senior Clinical Lecturer, Cardiology
University of Edinburgh
Visiting Scholar
TMII
marc.dweck@mountsinai.org

SCIENCE SPOTLIGHT

Featured Abstracts at the TMII Symposium Selected for Oral Presentations

Of the dozens abstracts submitted to the TMII Symposium this year, 4 were selected as stand-outs to be presented as a talk.

In *Cancer & Body*, from Bachir Taouli's lab; Dr. Mathilde Wagner will present, "MR Elastography of the liver: qualitative and quantitative comparison of GRE and EPI sequences". Magnetic Resonance Elastography (MRE) is a non-invasive imaging method that estimates mechanical properties of tissues. MRE has been recently shown to correlate with the degree of liver fibrosis. The most common pulse sequence used for liver MRE is based on GRE, however, the TE of GRE pulse sequence is prolonged due to the added motion encoding gradients (MEGs), thus GRE-MRE may fail in patients with iron overload. New SE based EPI MRE pulse sequences are affected by T2 but not by T2*. Due to the increased effective TE, fractional encoding concept is applied in EPI pulse sequences in order to achieve short enough TEs. In the fractional encoding method, the period of MEG is chosen to be shorter than period of mechanical motion. Expected tradeoff would be less efficient motion encoding

due to mismatched frequencies of MEG and mechanical motion, leading to lower SNR on wave images. The objective of our study is to assess the performances and variability in liver stiffness (LS) measurement using 2D-GRE and 2D-SE-EPI MRE.

In *Cardiovascular*, from Dr. Fayad's lab; Dr. Marc Dweck will present, "Systemic Atherosclerotic Inflammation Following Acute Myocardial Infarction: MI begets MI". Pre-clinical data suggest an acute inflammatory response following myocardial infarction accelerates systemic atherosclerosis. Using combined positron emission and computed tomography (PET-CT), we investigated whether this phenomenon occurs in humans.

In *Nanomedicine*, from Dr. Willem Mulder's lab; Dr. Francois Fay will present, "Modulation of nanoparticle targeting by surface-switching technology". Surface functionalization of nanoparticles (NPs) with targeting ligands such as antibodies, peptides or nucleic acids has shown significant advantages in preclinical cancer nanotherapy studies¹.

Disadvantageously, those moieties may also cause elevated NP recognition by the mononuclear phagocyte system and off-target binding. To overcome these limitations, we have developed a matrix metalloproteinase-2 (MMP-2) cleavable polyethylene glycol (PEG) coating to prevent NP/cell interaction in the bloodstream. Once exposed to MMP-2, i.e. when the NPs accumulate within the tumor microenvironment, the PEG coating will be cleaved. The resulting surface exposure of the targeting moieties (RGD peptide) facilitates NP association with $\alpha v \beta 3$ integrin expressing tumor cells.

In *Neuroimaging*, from Dr. Sophia Frangou's lab; Dr. Emma Spooten will present, "Trends and patterns in 15 years of functional MRI research in psychiatric disorders". The overall patterns of brain dysfunction within and across psychiatric disorders remain fuzzily understood. Systematically organising past research can identify true patterns, paradigm shifts and sources of bias, and will aid future study design.

5th Annual TMII Symposium



Icahn
School of
Medicine at
Mount
Sinai

Translational and
Molecular Imaging
Institute

5th Annual TMII Symposium

**Innovations and Blue Sky
Research in Imaging Science**

July 24, 2015



Keynote Speaker:

Roderic I. Pettigrew, PhD, MD

Director, National Institute of
Biomedical Imaging and Bioengineering
National Institutes of Health



Neuroimaging

Susumu Mori, PhD

Professor, Radiology
Johns Hopkins University School of Medicine



Cardiovascular Imaging

Matthias Stuber, PhD

Professor, Center for Biomedical Imaging (CIBM)
University Hospital of Lausanne (CHUV)



Nanomedicine

Chrit Moonen, PhD

Professor, Radiotherapy
University Medical Center Utrecht



Cancer & Body Imaging

Richard L. Ehman, MD

Professor, Radiology
Mayo Clinic



#TMII2015

Registration Still Open:

tmii.mssm.edu/symposium/2015

Location:
Davis Auditorium
Hess Center for Science and Medicine
Icahn School of Medicine at Mount Sinai

CORE SPOTLIGHT

Molecular MRI using MRI/PET

Siemens Biograph mMR

The 3T MR/PET is a fully integrated and capable of simultaneous whole body PET and MRI scanning. This allows more precisely coregistered functional and structural acquisition while reducing the radiation dose in PET imaging by replacing the CT scans with an MRI scan. True simultaneous acquisition of MR and PET data by the hybrid system merges the highly sensitive PET metabolic information with the highly specific MR anatomical and functional information.

The 3T MRI system is a whole body imaging system, capable of routine as well as advanced imaging of all body regions. The PET scanner will be fully integrated into the MR, utilizing state of the art solid-state technology for simultaneous PET imaging during MR image or spectrum acquisition. The 3T MR-PET is designed for the purposes of oncological and neurological diagnostic imaging. The highly integrated nature of these systems provides the capability for full spatial and temporal correlation between both modalities. The maximum gradient amplitude will be approximately 40 mT/m per axis, with a

maximum gradient slew rate of about 200 T/m/s per axis. The system's magnet has an integrated cooling system and active shielding. The shimming capabilities include: Active (with 3 electric and 5 electric nonlinear linear shim channels) and Passive shims for maintaining very high homogeneity and excellent image quality over a wide range of applications. Online shimming is performed in less than



20 seconds in order to optimize homogeneity. The RF transmit and receive system include: compact, air cooled tube RF amplifier providing 35 kW peak power; integrated electronics with cabinet water cooling; integrated circularly polarized whole body RF coil; up to 32 receive channels. The PET system include: adaptation to a work environment within high magnetic

fields including APD and LSO based detector technology; adaptation and optimization of numerous MR components to an integrated PET imaging unit; high-resolution, high-count rate, positron emission tomography (PET) imaging of metabolic and physiologic processes; high quality metabolic and anatomic image registration and fusion for optimal lesion detection and identification within the body; state-of-the-art 3D PET data acquisition and analysis tools; state-of-the-art 3D PET reconstruction, attenuation and scatter correction software. Expected PET performance specifications: spatial resolution: <6.5mm; timing resolution: < 4.5 ns; sensitivity: > 0.5%; axial FOV: > 19 cm; transaxial FOV: up to 45 cm.

The system also supports MR and PET gated scan acquisition; support for list mode acquisition, offline histogramming and reconstruction; special calibration. Alignment and quality control sources including shielding; multimodality workplace; 3D iterative reconstruction.

BIC CORNER

Please Remember the Date for the Second Annual BIC Symposium on October 7, 2015. The Brain Imaging Center is now finalizing the day's program, which will begin with Dr. Nora Volkow, Director of the the National Institute on Drug Abuse providing the keynote address. Registration, Details and Reminders are available now and will be updated on the BIC website. Please check now, and check back for developments- <https://bic.mssm.edu/blog/save-the-date-2nd-annual-bic-symposium>.

Also at <https://bic.mssm.edu/>, video and slide presentations of the first two BIC User Workshops are available for public browsing. Presentations by Dr. Paula Croxson (How to get started with brain imaging at Mount Sinai) and by Dr. Rafael O'Halloran and Dr. Prantik Kundu (So I scanned somebody. Now What? How to

access your data) are available from the user workshops page- <https://bic.mssm.edu/events/bic-user-workshops>.

Apparatus to enable complex human functional behavioral and neuropsychological experiments at the 7T MRI is now being installed. When complete this July, experimenters will have access to video and audio stimulation and fingertip responses during ultra-high field MRI scanning.

Increasing interest in the importance of white matter in the study of brain functions and disorders is a driver for improvements in algorithms for the segmentation of brain tissue into its constituent components. Rafael O'Halloran created a physical demonstration of the ability to extract and present specific

features of interest in many formats. Here, the rendered surface of isolated white matter segmented from a high-resolution T1-weighted MRI scan of a healthy volunteer scanned in a BIC study can be physically inspected in a high resolution (100 micron) liquid photo-polymer 3D printout.



CONTACTS

Zahi A. Fayad, PhD

Director, Translational and Molecular Imaging Institute

Director, Cardiovascular Imaging Program

Professor of Radiology and Medicine (Cardiology)
zahi.fayad@mssm.edu

Priti Balchandani, PhD

Director, High-Field MRI Program

Assistant Professor of Radiology and Neuroscience
priti.balchandani@mssm.edu

Prantik Kundu, PhD

Chief, Image Analysis Section & Advanced Functional Neuroimaging Section - BIC Faculty

Assistant Professor of Radiology and Psychiatry
prantik.kundu@mssm.edu

Venkatesh Mani, PhD

Cardiovascular Imaging

Assistant Professor of Radiology
venkatesh.mani@mssm.edu

Willem J. M. Mulder, PhD

Director, Nanomedicine Program

Associate Professor of Radiology
willem.mulder@mssm.edu

Rafael O'Halloran, PhD

Chief, Imaging Acquisition - BIC Faculty

Assistant Professor of Radiology and Psychiatry
rafael.ohalloran@mssm.edu

Cheuk Y. Tang, PhD

Director, Imaging Core

Associate Professor of Radiology and Psychiatry
cheuk.tang@mssm.edu

Bachir Taouli, MD

Director, Cancer and Body Imaging Program

Professor of Radiology and Medicine
bachir.taouli@mountsinai.org

Junqian Gordon Xu, PhD

Neuroimaging

Assistant Professor of Radiology and Neuroscience
junqian.xu@mssm.edu

Christopher J. Cannistraci, MS

Program Manager

Technical Operations Manager
christopher.cannistraci@mssm.edu

Ways to keep in touch

Website: <http://tmii.mssm.edu>

Youtube: <http://www.youtube.com/watch?v=IbVJMsUmin0>

Twitter: @TMIIInyc

Facebook: TMII.SINAI

Numbers: Tel: (212) 824-8466 Fax: (646) 537-9589

Address: Leon and Norma Hess Center for Science and Medicine
1470 Madison Avenue (between 101st and 102nd St) - 1st floor
New York, NY 10029