

The Third International Workshop on Metabolic Imaging

Philadelphia, PA
July 25–27, 2012



Organized by:

- The Functional and Metabolic Imaging Group
- Department of Radiology

*The Deadline for Submitting Abstracts, Early Registration
and Request for Trainee Financial Support is
June 25, 2012*

Organizing Committee:

Rahim R. Rizzi
Masaru Ishii
Stephen Kadlcek
Nicholas Kuzma
Kiarash Emami

Jerry D. Glickson
Mitchell Schnall
R. Nick Bryan
Chi Van Dang

International Scientific Committee:

Warren S. Warren
Douglas Rothman
Joachim Bargon

John P. Mugler
Jan Henrik Ardenkjaer-Larsen
Kevin Brindle

University of Pennsylvania
421 Curie Boulevard
Biomedical Research Building II/III
Philadelphia, PA 19104

Registration Information

Online: <http://bit.ly/Carbon13Workshop>

Application for Financial Support: Please submit your request, along with PDF copies of your **abstract** and **CV** to: fmig.upenn@gmail.com by June 25, 2012.

The length of the abstract is limited to one page (letter size or A4) with ½" margin including figures, tables and references. A minimum font size of 10 (Arial or Times New Roman) should be used. The abstract title, author's name, affiliation and address should be provided on top of the page. A sample template is enclosed with this brochure.

Hotel Accommodations

Sheraton University City

36th & Chestnut Streets

Philadelphia, PA

A block of rooms has been reserved at the Sheraton University City Hotel located on the University of Pennsylvania campus and within walking distance of our meeting location. The group rate is \$159 (single or double occupancy) per night plus applicable taxes, currently 15.2%. This rate will be available two days before and after the conference on a space availability basis. Our room block will be released for general sale on July 22, 2012, though the block could fill up sooner.

To book online go to:

<https://www.starwoodmeeting.com/StarGroupsWeb/booking/reservation?id=1204133510&key=724DF>

or call: 888-627-7071 (toll free); 215-387-8000 (local). You must identify yourself with Metabolic Imaging Workshop.

Check-in time: after 3:00 pm

Check-out time: before 12 noon

Overnight parking for hotel guests: \$25.00/day

Transportation Information

Transportation from Philadelphia International Airport:

Lady Liberty Transportation Service: \$10/person each way (Baggage Claim, Zone 8) Individual reservations may be made by calling Lady Liberty directly at 215-714-8888.

Taxi's are easily found outside baggage claim. Current rate is \$28.50 flat rate to University City/Central Philadelphia, excluding gratuity.

Office of Organizing Committee :

Lori Ehrich

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Foreword

On behalf of the organizing committee, I would like to welcome you to *The Third International Workshop on Metabolic Imaging*. Over the course of this three-day workshop, leading experts from a variety of fields will present their current research and discuss how significant biological problems can be probed with polarized carbon-13 technology.

The academic sessions of this workshop will cover a wide range of clinically relevant topics including, but not necessarily limited to, molecular pathways, systems biology of the mitochondria, and metabonomics utilizing both hyperpolarized and thermally polarized carbon-13 MRI/MRS. In addition, discussion of the most recent advances in hardware development and pulse sequence design will be included.

In planning this workshop, the organizing committee has sought to unify aspects of molecular biology, medicine, physical chemistry, and engineering with the intention of appealing to a broad audience of investigators, post-doctoral fellows, clinical fellows, and students at all levels interested in metabolic imaging. This workshop will bring its audience to the forefront of cutting edge research involving a new and exciting technological breakthrough and emphasize the power of modern interdisciplinary science.

It is my utmost pleasure to welcome you to our campus.

Rahim R. Rizi, Ph.D.
Professor of Radiology
University of Pennsylvania

Program Schedule

Wednesday, July 25, 2012

7:00 – 7:50 AM

Continental Breakfast

7:50 – 8:05 AM

Program and Workshop Remarks

Rahim R. Rizi, Ph.D.

University of Pennsylvania

8:05 – 8:20 AM

Welcome Remarks

Mitchell Schnall, M.D.,Ph.D.

University of Pennsylvania

Special Lecture

8:20 – 9:00 AM

Cancer Insights from NMR Studies of Yeast Metabolism

Robert Shulman, Ph.D.

Yale University

General Session

Moderator: Jerry Glickson, Ph.D.

9:00 – 9:35 AM

Systems Biology of the Mitochondria

Robert Balaban, Ph.D.

National Institutes of Health

9:35 – 9:50 AM

Refreshment Break

9:50 – 10:25 AM

Cancer Imaging and Metabolic Therapy

Chi Van Dang, M.D.,Ph.D.

University of Pennsylvania

10:25 – 11:00 AM

¹³C NMR Studies of Human Metabolism

Gerald Shulman, M.D.,Ph.D.

Yale University

11:00 – 11:35 AM

Imaging Disease Processes In Vivo: Uncommon Opportunities for Discovery

Cheryl L. Marks, Ph.D.

National Institutes of Health

11:35 – 12:00 PM

Discussion

12:00 – 12:45 PM

Lunch

Translation from Preclinical to Clinic Study - Panel Session I

Validation, Harmonization, Standardization of Methodologies

Moderator : Huiming Zhang, Ph.D.

12:45 – 2:00 PM

Larry Clarke,
Cheryl L. Marks,
Chi Van Dang,
Mitchell Schnall,
Jonathan Murray,
C.T. Tan,

NIH/NCI
NIH/NCI
University of Pennsylvania
University of Pennsylvania
General Electric
Isotec Inc.

Graduate Student and Postdoctoral Presentations - Part I
Moderator : Stephen Kadlecsek, Ph.D.

2:00 – 3:00 PM

Quantitative Markers of Real-time Cancer Metabolism Using Metabolic Activity Decomposition

Christine Leon
University of California San Francisco

Kinetic Modeling of Hyperpolarized ^{13}C Pyruvate Metabolism in Tumors Using a Measured Arterial Input Function

Samira Kazan, Ph.D.
University of Sheffield, UK

Improved Quantitative Measures of Renal Pyruvate-to-Lactate Conversion Using Diffusion Gradients

Jeremy Gordon
University of Wisconsin-Madison

Dynamic ^{13}C -MRS Reveals Metabolic Markers of Metastatic and Non-Metastatic Phenotype in Two Isogenic Breast Cancer Cell Lines

Rui Simoes, Ph.D.
Memorial Sloan Kettering Cancer Center

Quantative Metabolic Spectroscopy of Perfused Lungs Using Hyperpolarized [$1\text{-}^{13}\text{C}$]Pyruvate

Sarmad Siddiqui
University of Pennsylvania

In Vivo Hyperpolarized Imaging of Hypoxia Inducible Factor-1 Activity in Murine Sarcoma

Ryan Davis
Duke University

Applications of Carbon-13 in Metabolism - Part I
Moderator: R. Nick Bryan, M.D.,Ph.D.

3:00 – 3:35 PM

Hyperpolarized Carbon-13 MR Studies of Cancer in Preclinical Models and Initial Human Studies

Daniel Vigneron, Ph.D.
University of California San Francisco

3:35 – 4:00 PM

Investigation of Metabolism in the Diseased Heart Using Hyperpolarized MRI

Damian Tyler, Ph.D.
Oxford University, UK

4:00 – 4:25 PM

Sampling Strategies for Carbon-13 Metabolic Imaging

Ralph Hurd, Ph.D.
General Electric

4:25 – 4:50 PM

Hyperpolarized Metabolic Imaging of Rat C6 Glioma: Looking Beyond Lactate

Dirk Mayer, Ph.D.
SRI International

4:50 – 5:00 PM

Discussion

5:00 – 7:00 PM

Poster Session

Reception

Thursday, July 26, 2012

7:15 – 8:15 AM

Continental Breakfast

Technological Advances in Hyperpolarized Carbon-13 - Part I **Moderator: Joachim Bargon, Ph.D.**

8:15 – 8:45 AM

In Search of Long-T1 Biosensors

Dean Sherry, Ph.D.
University of Texas at Dallas

8:45 – 9:15 AM

Maintaining Hyperpolarization Using Singlet States

Malcolm H. Levitt, Ph.D.
Southampton University, UK

9:15 – 9:45 AM

Long-lived Spin States with Equivalent Spins

Warren S. Warren, Ph.D.
Duke University

9:45 – 10:00 AM

Discussion

10:00 – 10:15 AM

Refreshment Break

Metabolism and Metabolic Imaging - Part I **Moderator: Mitchell Schnall, M.D.,Ph.D.**

10:15 – 10:45 AM

^{13}C and $^1\text{H}[^{13}\text{C}]$ MRS Studies of Neuroenergetics and Neurotransmission

Douglas Rothman, Ph.D.
Yale University

10:45 – 11:15 AM

^1H , ^{31}P and ^{13}C NMR Studies of Breast Cancer Metabolism

Jason A. Koutcher, M.D.,Ph.D.
Memorial Sloan Kettering Cancer Center

11:15 – 11:45 AM

Hyperpolarization of Liquids and Field Dependence of SABRE Experiments

Christian Griesinger, Ph.D.
Max Planck Institute for Biophysical Chemistry, Germany

11:45 – 12:00 PM

^{13}C MRS Techniques for Studying the Turnover of Carboxylic and Amide Carbons in the Brain

Jun Shen, Ph.D.
National Institutes of Health

12:00 – 12:15 PM

Discussion

12:15 – 1:00 PM

Lunch

Graduate Student and Postdoctoral Presentations - Part II **Moderator : Masaru Ishii, M.D.,Ph.D.**

1:00 – 1:45 PM

Dynamic Metabolic Imaging of Rat Hearts at 9.4T Using Spectral-Spatial Excitation and Single-Shot EPI

Andreas Sigfridsson, Ph.D.
ETH Zurich, Switzerland

Model Free Approach to Kinetic Analysis of Real-Time Hyperpolarised ^{13}C MRS Data

Deborah Hill
The Institute of Cancer Research, UK

Quantification of pH in the Rat Thorax Using Hyperpolarized ^{13}C -bicarbonate

Kundan Thind
Robarts Research Institute, Canada

Construction and Advantages of DNP System at High Field

Mehrdad Pourfathi
University of Pennsylvania

Optimal Control Singlet State Storage of Hyperpolarized Compounds

Christoffer Laustsen
Aarhus University, Denmark

Translation from Preclinical to Clinic Study - Panel Session II

Resources, Dissemination, Training

Moderator : John Kurhanewicz, Ph.D.

1:45 – 3:00 PM

Dean Sherry,	University of Texas at Dallas
Daniel Vigneron,	University of California San Francisco
Damian Tyler,	Oxford University, UK
Daniel Spielman,	Stanford University
Rahim R. Rizi,	University of Pennsylvania
Mark A. Rosen,	University of Pennsylvania

Applications of Carbon-13 in Metabolism - Part II

Moderator: Douglas Rothman, Ph.D.

3:00 – 3:35 PM

Hyperpolarized ¹³C MR of Prostate Cancer - From Cells to Man
John Kurhanewicz, Ph.D.
University of California San Francisco

3:35 – 4:00 PM

In Vivo Measurement of ALDH2 Activity in Rat Liver Ethanol Model Using Dynamic MRSI of Hyperpolarized [1-¹³C] Pyruvate
Daniel Spielman, Ph.D.
Stanford University

4:00 – 4:20 PM

¹³C-labeled Molecules as Markers of Cancer Therapy
Mikko Kettunen, Ph.D.
Cambridge University, UK

4:20 – 4:40 PM

Metabolic Imaging of Pulmonary Disorders with Polarized Carbon-13
Stephen Kadlecsek, Ph.D.
University of Pennsylvania

4:40 – 4:55 PM

Technological Advances for Using Magnetic Resonance to Study Metabolism
Daniel J. Barabino, Ph.D.
Agilent Technologies Inc.

4:55 – 5:05 PM

Discussion

5:05 – 5:15 PM

Break

Lessons from Other Hyperpolarized Nuclei

Moderator: Kai Ruppert, Ph.D.

5:15 – 5:45 PM

Challenges in Quantification of Dissolved-Phase Xe-129 in the Lung
John P. Mugler, Ph.D.
University of Virginia

5:45 – 6:05 PM

Polarizing ¹²⁹Xe with DNP Method
Nicholas Kuzma, Ph.D.
University of Pennsylvania

6:05 – 6:25 PM

Hyperpolarized Xe-129: A Very Useful Biophysical Probe
Ivan Dmochowski, Ph.D.
University of Pennsylvania

6:25 – 6:40 PM

Discussion

Friday, July 27, 2012

7:00 – 8:00 AM

Continental Breakfast

Metabolism and Metabolic Imaging - Part II Moderator: Dean Sherry, Ph.D.

8:00 – 8:25 AM

High Resolution Functional Metabolic Imaging
Fahmeed Hyder, Ph.D.
Yale University

8:25 – 8:50 AM

**Monitoring Human Metabolism with Stable Isotopes:
Studying Children with Urea Cycle Defects**
Marc Yudkoff, M.D.
Children's Hospital of Philadelphia

8:50 – 9:15 AM

The Control of Hepatic Metabolism
Morris Birnbaum, M.D., Ph.D.
University of Pennsylvania

9:15 – 9:30 AM

Discussion

9:30 – 9:45 AM

Break

Pulse Sequences and Hardware for NMR of Hyperpolarized Nuclei Moderator: John P. Mugler, Ph.D.

9:45 – 10:05 AM

Strategies for Accelerating MR Spectroscopic Imaging
Stefan Posse, Ph.D.
University of New Mexico

10:05 – 10:25 AM

**Metabolic Activity Decomposition with Stimulated-echoes:
Principles and Validation**
Peder Larson, Ph.D.
University of California San Francisco

10:25 – 10:45 AM

**Multiband Spectral-Spatial RF Pulse Design for
Hyperpolarized C-13 Applications**
Adam Kerr, Ph.D.
Stanford University

10:45 – 11:00 AM

Discussion

11:00 – 11:15 AM

Break

Applications of Carbon-13 in Metabolism - Part III Moderator: Warren S. Warren, Ph.D.

11:15 – 11:35 AM

**Quantitative Measures of Kidney Metabolism Using ¹³C Pyruvate
and Application in Obstructive Nephropathy**
Sean Fain, Ph.D.
University of Wisconsin

11:35 – 11:55 AM

**Substrate Competition Demonstrates Negligible Control of
Hepatic PDH Flux**
Matthew Merritt, Ph.D.
University of Texas - Southwestern

11:55 – 12:15 PM

**Validation of the In Vivo Assessment of LDH-A Inhibition in
Pancreatic Tumor Xenografts Using ¹³C-MRS of Hyperpolarized
Pyruvate**
Prasanta Dutta, Ph.D.
University of South Florida

12:15 – 12:30 PM

Discussion

12:30 – 1:30 PM

Lunch

General Submission Presentations
Moderator: Sean Fain, Ph.D. , Matthew Merritt, Ph.D.

1:30 – 2:30 PM

Imaging the Metabolic Stress Response in Hepatocellular Carcinoma

Terence Gade, M.D., Ph.D.
University of Pennsylvania

In Vivo Affordable Parahydrogen Induced Polarization

Shawn Wagner, Ph.D.
Cedars-Sinai Medical Center

Non-invasive Quantification of Intracellular Redox State in Tissue by Hyperpolarized ^{13}C -NMR

Lin Li, Ph.D.
University of Pennsylvania

Effects of Tumour Oxygenation on ^{13}C 1-Pyruvate Metabolism

Steven Reynolds, Ph.D.
University of Sheffield, UK

Probing Tumor Early Response to Radiation Therapy Using Hyperpolarized $[1-^{13}\text{C}]$ Pyruvate in a Breast Cancer Model

Albert Chen, Ph.D.
General Electric

Singlet State of Nitrous Oxide

Rajat Ghosh, Ph.D.
University of Pennsylvania

2:30 – 2:45 PM

Discussion

Technological Advances in Hyperpolarized Carbon-13 - Part II
Moderator: Nicholas Kuzma, Ph.D.

2:45 – 3:00 PM

Relaxometry of Hyperpolarized ^{13}C -labelled Endogenous Compounds

Timothy Scholl, Ph.D.
Robarts Research Institute, Canada

3:00 – 3:15 PM

Solid-to-liquid State DNP of Large Molecules

Christian Hilty, Ph.D.
Texas A&M University

3:15 – 3:30 PM

On the Importance of Timing and Protocols in In Vivo Real-time Metabolic Studies Using ^{13}C Hyperpolarized Substrates

Arnaud Comment, Ph.D.
École Fédérale de Lausanne, Switzerland

3:30 – 3:45 PM

PHIP Polarizing and Imaging Strategies for ^{13}C -Lactate and ^{15}N -Choline

Eduard Chekmenev, Ph.D.
Vanderbilt University

3:45 – 4:00 PM

Delineating Molecular and Metabolic Signatures of Disease via Contrast-Enhanced Magnetic Resonance Imaging

Andrew Tsourkas, Ph.D.
University of Pennsylvania

4:00 – 4:15 PM

DB1 Melanoma Metabolic Network and Fluxome Revealed by Metabolic Modeling and ^{13}C MRS/Bioreactor Technique

Alexander Shestov, Ph.D.
University of Minnesota

4:15 – 4:30 PM

Discussion

4:30 – 4:45 PM

Final Remarks

Rahim R. Rizzi, Ph.D.
University of Pennsylvania

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