2nd Workshop on MRI Phase Contrast & Quantitative Susceptibility Mapping (QSM)

July 25-27, 2013
Cornell University, Ithaca New York

Steering Committee:
Chair: Yi Wang, PhD, Cornell University
Co-Chair: Mark Haacke, PhD, Wayne State University
Co-Chair: Chunlei Liu, PhD, Duke University
Co-Chair: Jürgen Reichenbach, PhD, University of Jena
Richard Bowtell, PhD, University of Nottingham
Karen Tong, MD, Loma Linda University
Jeff Duyn, PhD, NINDS, NIH
Susan Gauthier, MD, Cornell University
Welcome

Dear Colleagues:


The workshop venue offers an elegant and relaxed environment that is conducive for scientific exchange and very affordable for everyone including students, junior scientists and senior faculty. The presentations during the day will provide insightful discussion on methods and applications of QSM. The receptions in the evening will provide intimate networking for colleagues from all over the world to form bonds.

Our mission is to provide a forum for all researchers interested in the physics, mathematics and scientific applications of tissue magnetic property MRI. Magnetic susceptibility is a major tissue property that changes with organ function, disease and intervention. Recently there have been a number of breakthroughs in the inverse problem of reconstructing tissue susceptibility for QSM. Subsequently, there has been an exploding interest to study tissue magnetic property and to develop clinical and scientific applications of QSM.

**Major goals of this QSM workshop include:**

- To provide scientists from various backgrounds the opportunity to build connections and pool knowledge.
- To catalyze the developments of QSM technology and the translation of QSM into clinical practice.
- To educate students and fellow scientists on topics including basic and advanced biophysics of tissue susceptibility, QSM reconstruction algorithms, and clinical and scientific applications.

We hope you also plan some extra time to enjoy the gorgeous Finger Lake area that offers awesome vineyards and magnificent lakes and gorges.

Sincerely yours,
The QSM 2013 Steering Committee
Sponsors

We would like to thank the following organizations for sponsoring the workshop.

Cornell University

Biomedical Engineering

National Institute of Neurological Disorders and Stroke

National Institute on Aging

SIEMENS

Endorsements

We would also like to thank the following organizations for their endorsement of the workshop.

IEEE EMB

ISMRM ONE Community for Clinicians and Scientists
Workshop Information
Steering Committee

Chair: Yi Wang, PhD, Radiology and Biomedical Engineering, Cornell University
Co-Chair: Mark Haacke, PhD, Radiology and Biomedical Engineering, Wayne State University
Co-Chair: Chunlei Liu, PhD, Radiology and Brain Imaging & Analysis Center, Duke University
Co-Chair: Jürgen Reichenbach, PhD, Medical Physics, University of Jena, Germany
Richard Bowtell, PhD, Physics, University of Nottingham, UK
Karen Tong, MD, Radiology, Loma Linda University
Jeff Duyn, PhD, Neurosciences, NINDS, NIH
Susan Gauthier, MD, Neurology and Neurological Sciences, Cornell University

Local Organizing Committee

Tian Liu, PhD, Editor of Conference Proceedings
Mitchell Cooper, MS, Director of Online Conference Communications
Rebecca Cramer, Editorial Specialist
Robert Blanco, Conference Service Coordinator
Jackie Creque, Administrative Support
Dawn Esposito, Financial Administrator
Campus Information

Interactive campus maps can be found online at: [http://www.cornell.edu/maps/](http://www.cornell.edu/maps/). An overview of the campus with relevant locations is shown below.

1. Carl Becker House (Workshop Housing)
2. Physical Science Building (Workshop Venue)
3. Weill Hall (Opening Cocktail Reception)
4. Human Ecology Building Commons Lounge (Dinner Banquet)
Conference Venue Information

Venue
Physical Sciences Building
- Conference Sessions: Room 120
  Overflow room for conference sessions Room 401
- Poster Viewing: Baker Portico and Atrium
- Speaker Ready Room: Room 401

Breakfast and Lunch
Food will be served in the South Passageway with seating in Clark Atrium. Breakfast will be available before the conference each morning at 7:15 am. Lunch times are marked in the program.

Wireless Internet
Guest access is available on the Cornell RedRover Wi-Fi network. Look for the RedRover network on your laptop/device and follow the prompts for registering the device. More information is available here:
http://www.it.cornell.edu/services/redrover/howto/rrguest/index.cfm
Housing Check-In

Thank you for registering for on-campus housing for the 2nd International Workshop on MRI Phase Contrast & Quantitative Susceptibility Mapping (QSM). Housing will be in Carl Becker House located on Cornell’s West Campus. Becker House is an air conditioned residence hall on campus and within walking distance of the Physical Sciences Building and other Conference Venues.

Check-in for your housing will be at Carl Becker House. Hours for Carl Becker are as follows:

<table>
<thead>
<tr>
<th>Date</th>
<th>Open</th>
<th>Close</th>
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</thead>
<tbody>
<tr>
<td>23-Jul</td>
<td>8am</td>
<td>8pm</td>
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<tr>
<td>24-Jul</td>
<td>8am</td>
<td>11pm</td>
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<tr>
<td>25-Jul</td>
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<td>8pm</td>
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<td>26-Jul</td>
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<td>27-Jul</td>
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<td>2pm</td>
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<tr>
<td>28-Jul</td>
<td>8am</td>
<td>12pm</td>
</tr>
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</table>

For arrivals afterhours on-call assistance can be reached by dialing 607-255-7210.

Upon arrival you will receive a door key and an access card to Carl Becker House.

Parking will be available in the West Avenue and University Avenue lots Zone 11 and Zone 1 respectively. A map can be found at the following link: http://transportation.fs.cornell.edu/file/Parkmobile%20Map_Phase1-07012013-web.pdf

For information on how to use Cornell’s Parkmobile parking system please refer to: http://transportation.fs.cornell.edu/parking/campusparking/visitors/parkmobile.cfm.

If you have any questions, concerns, or need some additional information on travel or accommodations feel free to e-mail me or contact me at the office number below.

Robert Blanco
607-255-9763

Conference Check In

If you are staying in campus housing, your conference check in will be done at the time you check into housing.

If you are not staying on campus, you can check in for the conference at the Physical Science Building between 7:00 and 9:00 am on Thursday July 25th.
**Presentation Guidelines**

**Invited Talks**
Please prepare a 15 minute PowerPoint presentation. There will be 5 minutes of discussion after the presentation.

Send .ppt files to qsmconference2013@gmail.com by 6:00 p.m. the day before your talk.

**Peer-reviewed posters**
Mount your traditional poster (maximum size: 69 inches (height) x 46 inches (width)) by noon the day of your presentation in the Baker Portico or Baker Atrium (depending on your assigned poster number).

In addition, please send a 1-slide .ppt file to qsmconference2013@gmail.com by 6:00 p.m. the day before your poster presentation. This slide will be shown for introduction before your poster viewing session.
Workshop Program
All workshop events take place in Physical Sciences Building Room 120 unless otherwise noted in the program.

**Wednesday, July 24, 2013**

7:30-9:00pm Welcome Cocktail Reception (Weill Hall Atrium)

**Thursday, July 25, 2013**

7:15 Breakfast (South Passageway/Clark Atrium)

8:00 Welcome, Prof Yi Wang, Conference Chair
David J. Skorton, MD, Cornell University President
Prof David Lee, Nobel Laureate

**Basic Principles of Susceptibility: Biology, Physics, and QSM**
**Chairs: Ferdinand Schweser PhD and Robert Turner PhD**

8:20 Iron as biomarker for inflammation in MS lesions
David Pitt, MD

8:40 Connection between biology and tissue susceptibility
Jeff Duyn, PhD

9:00 Physics of susceptibility contrast and data acquisition
Richard Bowtell, PhD

9:20 From harmonic functions to field mapping and susceptibility quantification
Lin Li, PhD

9:40 Basic steps for doing QSM
Tian Liu, PhD

10:00 Coffee and tea break (South Passageway/Clark Atrium)

**Clinical and Scientific Applications of QSM**
**Chairs: Jongho Lee PhD and Karen Tong MD**

10:20 Susceptibility changes in pediatric brain pathophysiology
Kristen Yeom, MD

10:40 Susceptibility and myelin water imaging: Providing a window into the MS lesion
Susan Gauthier, MD
11:00  Susceptibility imaging of cerebral hemorrhage, microbleeds and hypoxia.
Karen Tong, MD

11:20  Iron mapping in Parkinson's disease and neurodegenerations
Wayne R Martin, MD

11:40  Susceptibility of myelin, nerves, and white matter fiber
Chunlei Liu, PhD

12:00  Understanding anisotropic properties of MR signal phase in white matter
Dmitriy Yablonskiy, PhD

12:20  Lunch break (South Passageway/Clark Atrium)

Peer-Reviewed Presentations on QSM Applications
Chairs: Jan Sedlacik PhD and Derek Jones PhD

1:20   Introduction of posters (2 minutes each)

2:04   Poster viewing and coffee break (Baker Portico and Atrium)

Discussion and Debate on Peer-Reviewed Presentations
Chairs: Jeff Duyn PhD, Robert Edelman PhD, Susan Gauthier MD, Mark Haacke PhD, Chunlei Liu PhD, Karen Tong MD

3:30   Poster summary by session faculty

4:00   Is susceptibility change a cause or effect of diseases?

4:30   What are the current clinical applications for QSM?

5:00   Board bus in front of Physical Sciences Building for Wagner Vineyards

6:00   Dinner Reception at Wagner Vineyard
Friday, July 26, 2013

7:15  Breakfast (South Passageway/Clark Atrium)

Quantitative Susceptibility Mapping (QSM)
Chairs: Ludovic de Rochefort PhD and Jürgen Reichenbach PhD

8:00  Phase processing for QSM  
     Ferdinand Schweser, PhD

8:20  Inversion algorithms: k-space based approaches  
     Karin Shmueli, PhD

8:40  Inversion algorithm: image space based approaches  
     Ludovic de Rochefort, PhD

9:00  Pulse sequence consideration  
     Wei Li, PhD

9:20  Susceptibility tensor imaging  
     Cynthia Wisnieff

9:40  Coffee/Tea Break (South Passageway/Clark Atrium)

Frontiers for QSM
Chairs: Richard Bowtell PhD and Jeff Duyn PhD

10:00  Applications of Short Echo QSM  
       Mark Haacke, PhD

10:20  MRI oximetry for quantifying CMRO2 and vascular reactivity  
       Felix Wehrli, PhD

10:40  Neuronal connectivity, tractometry and susceptibility  
       Derek Jones, PhD

11:00  Iron metabolism  
       James Connor, PhD

11:20  Human brain atlas for quantitative susceptibility and iron mapping  
       Peter van Zijl, PhD
11:40  Electromagnetic property imaging  
       Daniel Sodickson, PhD

12:00  Lunch break (South Passageway/Clark Atrium)

**Peer-Reviewed Presentations on QSM Techniques**  
**Chairs:** Sam Wharton PhD and Yi Wang PhD

1:00  Introduction of posters (2 minutes each)

1:52  Poster viewing and coffee break (Baker Portico and Atrium)

**Discussion and Debate on Peer-Reviewed Presentations**  
**Chairs:** Richard Bowtell PhD, Jürgen Reichenbach PhD, Ludovic de Rochefort PhD, John Schenck MD, Yi Wang PhD, Peter van Zijl PhD

3:30  Poster summary by session faculty

4:00  What have we learned so far about QSM technical developments and applications? How do we standardize QSM methods?

4:30  What are the unresolved issues and immediate targets of investigation in QSM?

5:00  Break for day

6:00  **Banquet & Poster Awards at Human Ecology Building Commons Lounge**
Saturday, July 27, 2013

7:15  Breakfast (South Passageway/Clark Atrium)

**Advanced Mathematical Methods for Reconstructing QSM**
**Chairs: Tian Liu PhD and Jin Keun Seo PhD**

8:00  Large scale inverse problems in imaging  
Jillianne Chung, PhD

8:20  Optimization Techniques for Quantitative Mapping in MRI  
Ashish Raj, PhD

8:40  Compressive sensing  
Michael Lustig, PhD

9:00  Parameter choice for regularization  
Rosemary Renaut, PhD

9:20  Total generalized variation  
Kristian Bredies, PhD

9:40  Coffee and tea break (South Passageway/Clark Atrium)

**Advanced Electromagnetic Mapping and Applications**
**Chairs: Stephen Ropele PhD and Alan Wilman PhD**

9:50  MRI electric impedance tomography  
Eung Je Woo, PhD

10:10  Electric property tomography  
Ulrich Katscher, PhD

10:30  EPT updates  
Jose Marques, PhD

10:50  CISSCO method for measuring susceptibility  
Norman Cheng, PhD

11:10  Fiber susceptibility model  
Sam Wharton, PhD
<table>
<thead>
<tr>
<th>Time</th>
<th>Presentation Title</th>
<th>Presenter</th>
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<tbody>
<tr>
<td>11:30</td>
<td>Iron and metallic biochemistry in cellular and animal models</td>
<td>Michael Garrick, PhD</td>
</tr>
<tr>
<td>11:50</td>
<td>MS iron</td>
<td>Robert Zivadinov, PhD</td>
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<tr>
<td>12:10</td>
<td>Deep brain stimulation</td>
<td>Brian Kopell, MD</td>
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<tr>
<td>12:30</td>
<td>Summary</td>
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<tr>
<td>1:00</td>
<td>Boxed Lunch (South Passageway/Clark Atrium) and post-meeting activities</td>
<td>(organize/leave from Physical Sciences Building)</td>
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</tbody>
</table>
**Thursday, July 25, 2013**  
1:20-2:03 pm (2 minute PowerPoint introduction of posters in Room 120)  
2:04-3:30 pm (Poster viewing and coffee break in Baker Portico and Atrium)

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Affiliation</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Takoua Kaouana</td>
<td>CNRS UMR7225</td>
<td>Discriminating brain microbleeds using phase contrast MRI in a multicentre clinical setting</td>
</tr>
<tr>
<td>2</td>
<td>Huan Tan</td>
<td>NorthShore University HealthSystem</td>
<td>Characterizing Cerebral Cavernous Malformation with Quantitative Susceptibility Mapping: A Feasibility Study</td>
</tr>
<tr>
<td>3</td>
<td>Wei Liu</td>
<td>NICOE</td>
<td>Can Quantitative Susceptibility Mapping Be Used to Longitudinally Monitor Brain Hemorrhages in Patients with Traumatic Brain Injury</td>
</tr>
<tr>
<td>4</td>
<td>R. Ehsan Hamtaei</td>
<td>Wayne State University</td>
<td>3D Model of the Optic Radiation using Susceptibility Weighted Imaging</td>
</tr>
<tr>
<td>5</td>
<td>Michael Dayan</td>
<td>Weill Medical College of Cornell University</td>
<td>Structural and functional correlates of the cerebellum as assessed from cerebellar atrophy: a voxel based morphometry and tractography study</td>
</tr>
<tr>
<td>6</td>
<td>Huan Tan</td>
<td>NorthShore University HealthSystem</td>
<td>Feasibility of In vivo Quantitative Susceptibility Mapping (QSM) in the Kidneys</td>
</tr>
<tr>
<td>7</td>
<td>Till Hülnhagen</td>
<td>Berlin Ultrahigh Field Facility</td>
<td>Toward Probing Myocardial Microstructure Using Susceptibility Sensitized MRI of the Human Heart at 7.0 T: Assessment and Implications of Static Magnetic Field Variations</td>
</tr>
<tr>
<td>8</td>
<td>Jon Thacker</td>
<td>Northwestern</td>
<td>R2' and delta_R2’in Kidneys: Evaluation of BOLD based Susceptibility Contrast</td>
</tr>
<tr>
<td>9</td>
<td>Ying Dong</td>
<td>Texas A&amp;M University</td>
<td>Brachytherapy Seed Identification Using Susceptibility Mapping</td>
</tr>
<tr>
<td>10</td>
<td>Diego Hernando</td>
<td>University of Wisconsin-Madison</td>
<td>Susceptibility-Based Estimation of Liver Iron Concentration Using a Fat-Referenced Approach</td>
</tr>
<tr>
<td>11</td>
<td>Jean Haroldo Oliveira Barbosa</td>
<td>University of Sao Paulo</td>
<td>Are transverse relaxation rates and susceptibility maps equivalent in Parkinson’s disease studies?</td>
</tr>
<tr>
<td>12</td>
<td>Andrew D. Schweitzer</td>
<td>Weill Medical College of Cornell University</td>
<td>QSM for Characterization of the Motor Cortex in ALS and other Motor Neuron Diseases</td>
</tr>
<tr>
<td>13</td>
<td>Hongfu Sun</td>
<td>University of Alberta</td>
<td>Validation of QSM for brain iron mapping in multiple sclerosis using postmortem studies</td>
</tr>
<tr>
<td>14</td>
<td>Guochun Fu</td>
<td>Karolinska Institute</td>
<td>Iron Clusters in white matter studied by microscopic MRI and histological methods</td>
</tr>
</tbody>
</table>
**Friday, July 26, 2013**

1:00-1:51 pm (2 minute PowerPoint introduction of posters in Room 120)
1:52-3:30 pm (Poster viewing and coffee break in Baker Portico and Atrium)

<table>
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<tr>
<th>#</th>
<th>Name</th>
<th>Affiliation</th>
<th>Title</th>
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<tbody>
<tr>
<td>21</td>
<td>Saifeng Liu</td>
<td>Wayne State University</td>
<td>Rapid Background Phase Removal using Double-Echo Data</td>
</tr>
<tr>
<td>22</td>
<td>Dong Zhou</td>
<td>Weill Medical College of Cornell University</td>
<td>Removal of Background Field Using Relaxation Method</td>
</tr>
<tr>
<td>23</td>
<td>Ryan Topfer</td>
<td>University of Alberta</td>
<td>Edge-Extended Harmonic Phase Processing Incorporating Priors</td>
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<tr>
<td>24</td>
<td>Sagar Buch</td>
<td>McMaster University</td>
<td>Susceptibility Mapping of the Sinuses and bones in the Head using Short TE</td>
</tr>
<tr>
<td>25</td>
<td>Shuai Wang</td>
<td>University of Electronic Science &amp; Technology of China</td>
<td>Noise Effects In Bayesian Quantitative Susceptibility Mapping Methods</td>
</tr>
<tr>
<td>26</td>
<td>Russell Dibb</td>
<td>Duke University</td>
<td>Gd-Enhanced Susceptibility Contrast and Anisotropy in the Three-pool Model of White Matter</td>
</tr>
<tr>
<td>27</td>
<td>Rajika Maddage</td>
<td>Ecole Polytechnique Fédérale de Lausanne</td>
<td>Towards in vivo manganese quantification at 14.1T using Susceptibility Mapping</td>
</tr>
<tr>
<td>28</td>
<td>Hongchen Wang</td>
<td>Univ Paris-Sud</td>
<td>Precision Limit of Contrast Agent with R2* (Magnitude) and Quantitative Susceptibility Mapping (Phase)</td>
</tr>
<tr>
<td>29</td>
<td>Jan Sedlacik</td>
<td>University Medical Center Hamburg-Eppendorf</td>
<td>On the influence of particle size in MR iron quantification</td>
</tr>
<tr>
<td></td>
<td>Name</td>
<td>Institution</td>
<td>Title</td>
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<tr>
<td>30</td>
<td>Guochun Fu</td>
<td>Karolinska Institute, Zhejiang University, NINDS</td>
<td>Correlations among R2*, susceptibility, and FA in white matter of the human brain</td>
</tr>
<tr>
<td>31</td>
<td>Dmitriy A. Yablonskiy</td>
<td>Washington University, St. Louis</td>
<td>Structural Disordering as a Mechanism of Phase Contrast in Multiple Sclerosis Lesions</td>
</tr>
<tr>
<td>32</td>
<td>Se-Hong Oh</td>
<td>University of Pennsylvania</td>
<td>Origin of B0 orientation dependent R2* (=1/T2*) in white matter: the effects of magnetic susceptibility, magic angle, tissue iron and temperature</td>
</tr>
<tr>
<td>33</td>
<td>Jie Luo</td>
<td>Washington University, St. Louis</td>
<td>Magnetic Susceptibility Induced MR Signal Frequency Shift in White Matter - Experimental Comparison Between Lorentzian Sphere and Generalized Lorentzian Approaches</td>
</tr>
<tr>
<td>34</td>
<td>Alexander L. Sukstanskii</td>
<td>Washington University, St. Louis</td>
<td>On the role of neuronal magnetic susceptibility and structure symmetry on Gradient Echo MR signal formation</td>
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<tr>
<td>35</td>
<td>Yi Wang</td>
<td>Weill Medical College of Cornell University</td>
<td>Quantitative susceptibility mapping (QSM) forward problem: Proton, electron, lorentz correction, susceptibility and chemical shift</td>
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<tr>
<td>36</td>
<td>Petra Schmalbrock</td>
<td>The Ohio State University</td>
<td>Consideration of Echo Dependent Center of k-Space Offsets in Phase Preprocessing</td>
</tr>
<tr>
<td>37</td>
<td>Zachary Rodgers</td>
<td>University of Pennsylvania</td>
<td>High-temporal-resolution, simultaneous quantification of intravascular blood flow and oxygen saturation with BRISK k-space sampling</td>
</tr>
<tr>
<td>38</td>
<td>Dongyeob Han</td>
<td>Yonsei University</td>
<td>Multi-echo QSM using flyback readout gradients with z-shimming</td>
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<tr>
<td>39</td>
<td>Bo Xu</td>
<td>Weill Medical College of Cornell University</td>
<td>Flow Compensated Quantitative Susceptibility Mapping in Vessel Imaging</td>
</tr>
<tr>
<td>40</td>
<td>Daeun Kim</td>
<td>University of Pennsylvania</td>
<td>Direct Visualization of Short T2* Phase (ViSTa Phase)</td>
</tr>
<tr>
<td>41</td>
<td>Sung-Min Gho</td>
<td>Yonsei University</td>
<td>Radio Frequency (RF) effects in Quantitative susceptibility mapping (QSM)</td>
</tr>
<tr>
<td>42</td>
<td>Carsten Stueber</td>
<td>Max Planck Institute</td>
<td>Simulated and measured T1, T2* and Quantitative Susceptibility Maps (QSM) of human brain</td>
</tr>
<tr>
<td>43</td>
<td>Sung Suk Oh</td>
<td>University of Pennsylvania</td>
<td>An Improved Susceptibility Weighted Imaging Method using Multi-Echo Acquisition</td>
</tr>
<tr>
<td>44</td>
<td>Joseph Dagher</td>
<td>The University of Arizona</td>
<td>Robust high resolution MR phase measurement</td>
</tr>
<tr>
<td>45</td>
<td>Andreas Deistung</td>
<td>University Jena</td>
<td>Enhancement of Brain Structures by Combining Quantitative Susceptibility Mapping and Relaxometry</td>
</tr>
</tbody>
</table>
### Evening Social Events

Details on the evening social events are below:

- **July 24, 7:30 – 9:00 pm.** Welcome Cocktail Reception in Weill Hall Atrium.
- **July 25, 6:00 – 9:00 pm.** Offsite dinner reception at Wagner Vineyards. Transportation will leave from the Physical Sciences Building at 5:00 pm.
- **July 26, 6:00 – 9:00 pm.** Dinner Banquet and Poster Awards in the Human Ecology Commons Lounge.

### Saturday Afternoon Social Events

For participants staying until the 27th, we invite you to join us for post-meeting afternoon activities. Capacity for each event is limited due to transportation with the exception of the Cornell campus tour. Priority will be given to those who RSVP’d prior to the event.

- A tour of the Cornell Campus including the Cornell Plantations and Art Museum
- A wine tour of local Finger Lakes wineries
- A hiking tour at a nearby New York State Park

Tours will leave from the Physical Sciences Building at the end of the conference on Saturday.
Ithaca Area Information

Public Transportation
Ithaca’s public transportation system is called the TCAT. More information on fares and schedules can be found here: http://www.tcatbus.com/

Taxis
University Taxi: (607) 277-7777
Cayuga Taxi: (607) 277-TAXI (8294)
Yellow Cab Co: (607) 277-CABS (2227)

Groceries, Off-campus dining, and ATMS
The Cornell campus bookstore has a bank inside and some dry goods/food. For more information on the bookstore location and hours: http://store.cornell.edu/

The Collegetown area close to campus also has small grocery/convenience stores, ATMS, and various dining options.