

*The WSU Program for
Traumatic Brain Injury Research*

Summer School

*Neuroscience and Imaging
of Traumatic Brain Injury*

June 3rd till June 28th, 2013



**WAYNE STATE
UNIVERSITY**



TABLE OF CONTENTS

- 1 ▪ Dates of meeting and cover
- 2 ▪ Summer school chairmen
- 3 ▪ Letter from the Program Director
- 4 ▪ CME Accreditation
- 5 ▪ Wayne State University
- 6-8 ▪ WSU Program from Traumatic Brain Injury Research
- 9 ▪ Summer School 2013 – Overview
- 10 ▪ Program Options
- 11 ▪ Requirements and Admission Process
- 12 ▪ Distinguished Guest Speakers
- 13 ▪ Internal Speakers/Lectures
- 14 ▪ Laboratories and rotations
- 15 ▪ Program details
- 16 ▪ Accommodation
- 17 ▪ Acknowledgements / Sponsors

SUMMER SCHOOL CHAIRMEN

John Michael Cavanaugh, MD
Assistant Professor of Biomedical Engineering

Mathew P. Galloway, PhD
Professor of Psychiatry and Behavioral Neuroscience and Anesthesiology

E Mark Haacke, PhD
Professor of Radiology and Biomedical Engineering

Robert Welch, MD
Professor of Emergency Medicine



LETTER FROM THE PROGRAM DIRECTOR

Traumatic brain injury (TBI) has become a major medical problem in the United States and around the world. With an incidence rate of 1.7 million people each year, TBI has gained national awareness. It is the “signature wound” of soldiers in the antiterrorism wars in Iraq and Afghanistan. It has a terrible impact on families and more recently it has been recognized as causing major sport related damage to both youngsters and adults alike. With the increase of public awareness, federal funding plays a major role in supporting research in this field.



Wayne State University (WSU) has the longest history of TBI research in the nation and a long history of clinical trials. Indeed, the national standard of Head Injury Criterion (HIC), published by the National Highway Traffic Safety Administration (NHTSA), was originally based on the pioneering work from WSU. Across the country, there are several major centers in TBI research, each one with unique features such as: injury biomechanics at the cellular level; pharmacological treatment in animals; axonal injury pathology; and PET imaging of TBI for example.

Here at WSU, we have special focused programs in imaging, neuroscience and traumatic brain injury. Graduate students in a variety of departments, whether engineering or arts and science, can focus on imaging. There is a special graduate program in neuroscience in the School of Medicine, “Translational Neuroscience Program”. And in engineering, there is a major focus on the mechanical aspects of TBI, with modeling and a focus on simulating real life situations, whether car safety or blast related injury. These programs currently have funding from a variety of sources, including: the auto industry, NIH, NTSA, and NSF. Wayne State University has brought together the expertise to bring modern MR imaging and neuroscience programs to bear on translational TBI research. The University has specifically established an internal incubator support mechanism to jump start this effort and has been instrumental in integrating the TBI efforts across campus. This summer program is funded through that award.

E. Mark Haacke, PhD
WSU PTBIR Program Director



CME ACCREDITATION

Program Overview

Target Audience

This CME activity is intended to educate Neurologists, Neurosurgeons, Physicists, Interventional Radiologists and Vascular Surgeons, as well as fellows, residents, Master's students, doctoral students, post-doctoral fellows and MR Technologists.

Learning Objectives

After participating in this program, the attendees should be able to:

- Explain the differences between mild, moderate and severe TBI
- Describe the basic vascular damage in TBI
- Understand the cognitive deficits that occur in TBI

No special educational preparation is required for this CME activity.

CME Accreditation

This program has been planned and implemented in accordance with the Essential Areas and Policies of the Accreditation Council for CME (ACCME) through the Wayne State University Office.

This program has been designated to have up to 6 **AMA PRA Category 1 Credit(s)** per week for 3 weeks. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

However, this is still a draft brochure and final approval has not been obtained.



WAYNE STATE UNIVERSITY

Founded in 1868, Wayne State University is a nationally recognized metropolitan research institution offering more than 400 academic programs through 13 schools and colleges to nearly 32,000 students. Wayne State's main campus in Midtown Detroit comprises 100 buildings over nearly 200 acres; its five extension centers offer higher education to people throughout Southeast Michigan. Wayne State is dedicated to preparing students to excel by combining the academic excellence of a major research university with the practical experience of an institution that by its history, location and diversity represents a microcosm of the world we live in. Reflecting its location and the excellent international reputation of its graduate schools, particularly in the sciences, Wayne State boasts the most diverse student body among Michigan's public universities. Its students represent 49 U.S. states and more than 60 countries. As a nationally recognized urban, public research university, Wayne State's mission is to create knowledge and prepare a diverse body of students to excel in an increasingly complex and global society.

Mission Statement for the MR Research Facility (MRRF)

The MR Research Facility is committed to the development of the MR methods and their application in the preclinical and clinical subjects to better understand human physiology and disease. The MR Research Facility will promote the use of magnetic resonance-based methods to the WSU scientific community and support the implementation of MR methods through education, assistance in experimental design, and data collection and analysis. We have two full time research magnets, a 3T VERIO human system and a 7T Clincscan animal system. We also collaborate closely with the clinical site with both 1.5T and 3T scanners.

Mission Statement for the Training in Neuroscience Program (TNP)

The goal of the Ph.D. program in Translational Neuroscience is to train outstanding scientists who possess a strong background in the fundamental and applied concepts in molecular, cellular and systems neurobiology, developmental neuroscience, neuroimaging and neuropsychopharmacology as they relate to neuropsychiatric disorders. This distinctive orientation fosters the development of outstanding research scientists who are able to link advances in basic neuroscience toward the assessment and treatment of clinical problems.



WSU PROGRAM FOR TRAUMATIC BRAIN INJURY RESEARCH

Historically, Wayne State University has been recognized as a leader in TBI research. Our WSU **Program in TBI Research (PTBIR)** consists of collaborators within Radiology, Biomedical Engineering, Anesthesiology, Anatomy and Cell Biology, Psychiatry and Behavioral Neurosciences, Neurosurgery, Neurology, Translational Neuroscience, Ophthalmology, Otolaryngology, Psychology, and Physical Medicine and Rehabilitation. Our collaborators are pioneering leaders with excellence in MR imaging, neuroscience, injury biomechanics, injury pathology, molecular biology, stem cell treatment, and clinical trials of drug treatment. Together, we are poised to lead TBI research and have the potential to attract major federal and industrial funding.

The PTBIR is dedicated to campus-wide research, education and treatment of TBI involving state-of-the-art Neuroimaging techniques, innovative basic research and clinical research initiatives. We are bringing together resources from the Biomedical Engineering and Basic Science across campus at WSU, the School of Medicine and the Detroit Medical Center, to meet this challenge. Our main goal is to present a unique, yet unified Neuroimaging training environment to prospective neuroscientists who are interested in detecting, diagnosing and predicting the outcome of TBI as well as eventually treating TBI.

PTBIR has at its core both human and animal magnets (1.5T/3T human and 7T/12T animal systems) which provide state-of-the-art imaging capabilities. Ongoing research conducted within our MR Research Facility (MRRF) has been centered on advanced imaging techniques such as susceptibility weighted imaging (SWI), diffusion tensor imaging (DTI), MR spectroscopic imaging (MRSI), perfusion weighted imaging (PWI), manganese-enhanced MRI (MEMRI), morphometric imaging, functional connectivity MRI (fcMRI), quantitative volumetry quantitative EEG (qEEG), evoked and event related potentials (EP/ERP) and transcranial magnetic stimulation (TMS).

Another strength is the ready availability of blast models for war personnel. Standard methods such as molecular biology techniques, neural behavioral tests of animal models, neuropsychological and clinical assessment, are also available. The PTBIR will provide the environment for testing new technologies and new clinical translational research directions with applications in public health and in the military as well. This will allow for "bench to bedside" research with the main goal being better treatment for TBI. The framework of research at our center is depicted in Figure 1 where specific ongoing projects are listed. The



three major directions of research in TBI will include: basic science research to reveal physiological, pathological and neurobiological mechanisms of TBI with imaging; development of imaging methodology per se to better serve as biomarkers for TBI in the clinical and basic science domains; and clinical and translational research to improve clinical and functional outcome prediction and enhance treatment with imaging.

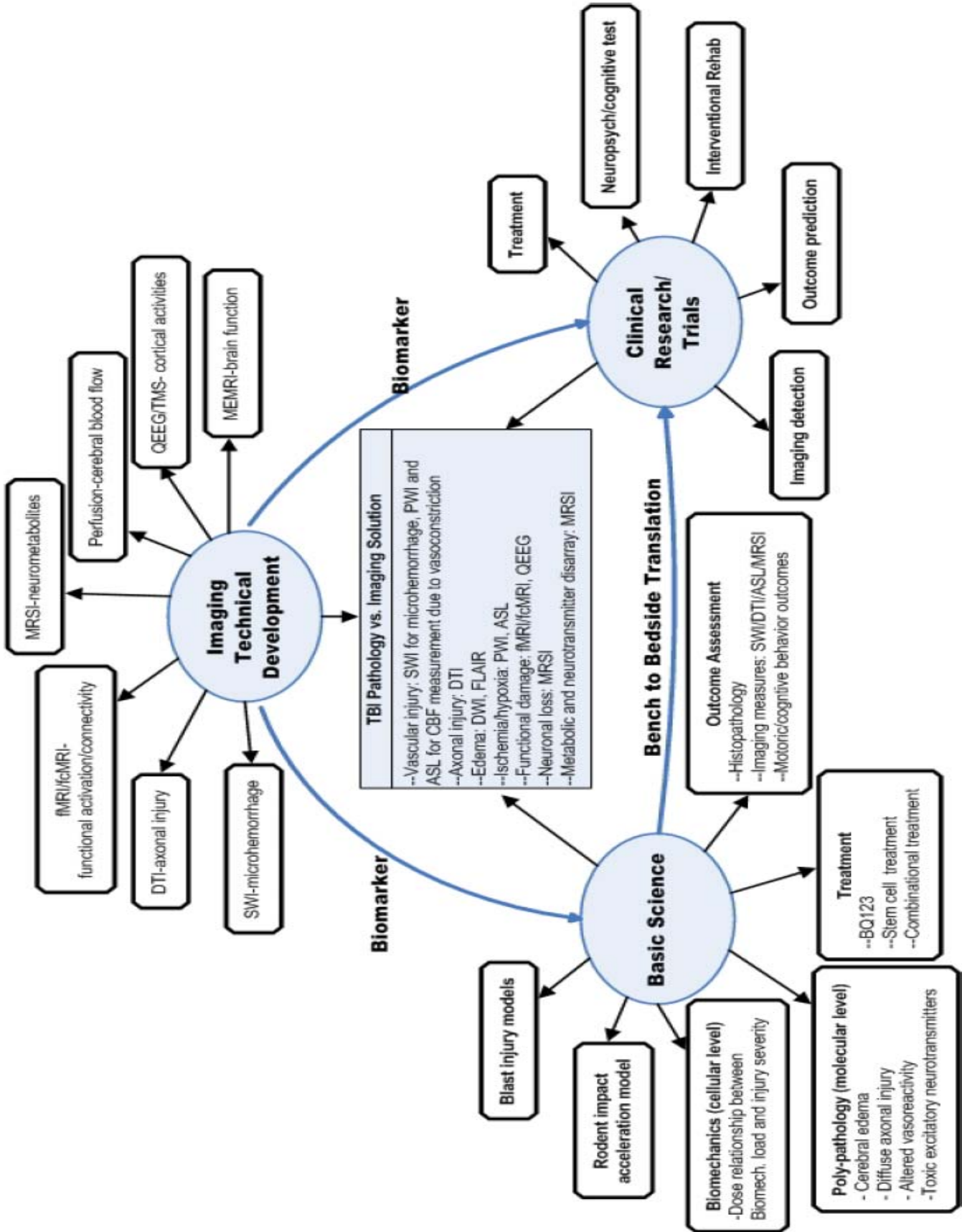
Our overarching hypothesis is that the heterogeneous and complex nature of TBI requires a comprehensive effort to better understand the disease and to manage the patients. Our central scheme is to use imaging tools to integrate the investigation of the poly-pathology of TBI in both animal models and human patients with the treatment of TBI. We strongly believe that this synergistic effort will deliver a much greater impact than a simple addition of individual groups or projects and provide fodder for major funding. These projects are organized according to three arms: imaging, fundamental mechanisms and treatment.

Ongoing Activities

Seminar Series: The WSU program for Traumatic Brain Injury organizes and holds monthly seminar series hosting pioneers in TBI research. Every month, both an internal speaker (WSU faculty) and an external faculty (from other universities in the US) are invited to visit WSU and talk about their current research and recent findings. The main goal of this seminar series is to a) keep WSU community up-to-date with the recent advances in TBI research, b) open the door to possible collaborations and multidisciplinary research, c) spread the word across the USA about the work done at WSU, as a means to attract new students who are interested in becoming neuroscientists.

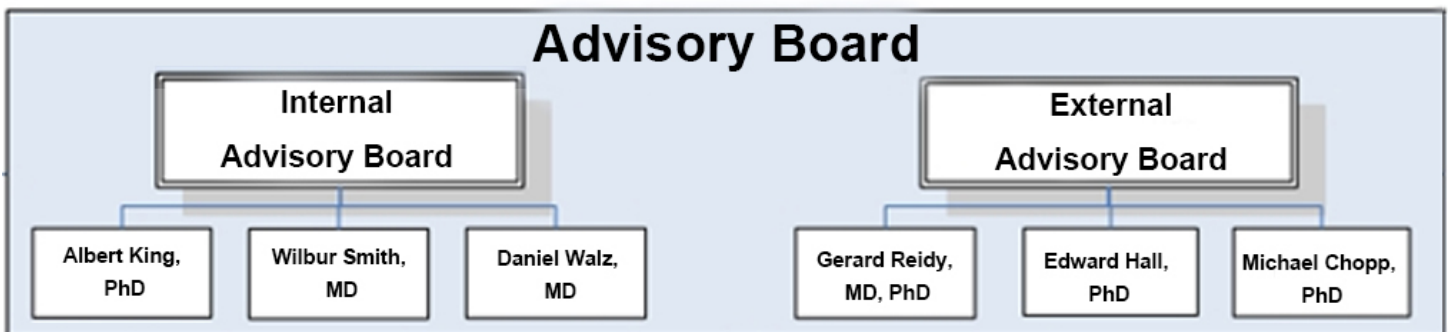
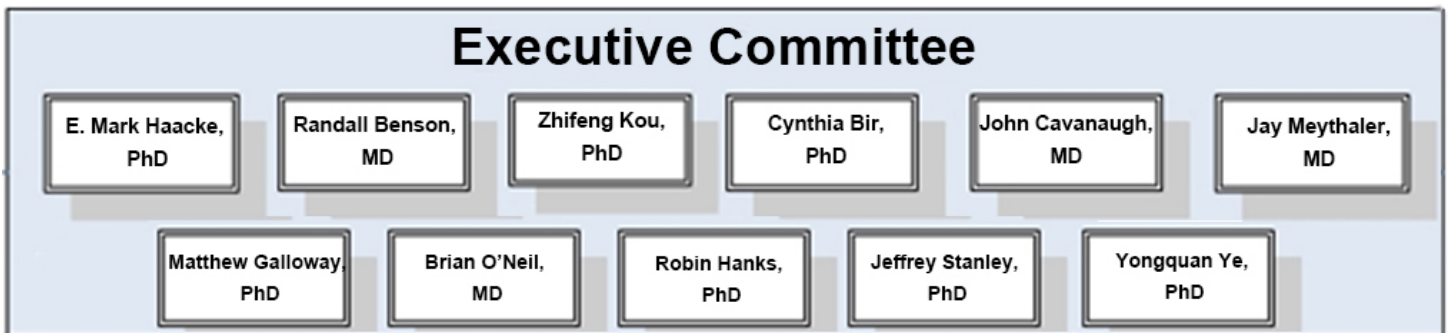
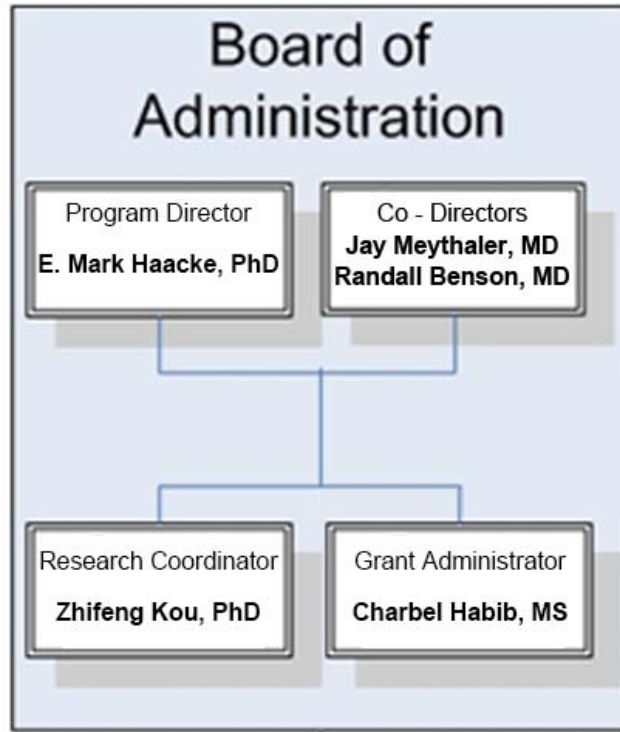
Annual Workshops: The annual TBI workshop provides the entire WSU_community the opportunity to meet for a day and share their findings and research results from the last year. This opens the door for potential multidisciplinary projects through collaborative efforts.

For more information, visit: www.tbi.wayne.edu





WSU PROGRAM FOR TBI RESEARCH BOARDS & COMMITTEES





SUMMER SCHOOL – NEUROSCIENCE AND IMAGING OF TBI

The strength of the summer school lies behind the fact that it can fit the needs for students pursuing studies in different fields related to TBI, such as Biomedical Engineering, Psychiatry, Psychology, to name few, in addition to all the medical school community, from medical school students to residents, fellows and attending.

The program has been designed to get the students and the medical school community up to speed on the current research achievements in TBI (lecture series and CME credits) as well as hand on to get lab experience through the laboratory rotations described below.

Program Options

Lecture series and reading assignments

The lecture series will be presented for three consecutive weeks by 20-25 faculty dedicated to TBI, neuroscience and imaging in addition to six external guest speakers who will be presenting their work at a rate of two speakers per week. This will provide a wealth of information to the attendees, covering a wide spectrum for neuroscience, imaging and TBI research. These sessions will be 3 hours and will be divided into 1 hour lectures, 20 minutes discussion and 20 minutes coffee break and the same repeated after the coffee break. As reference, reading material will be made available for attendees ahead of time to review. No textbooks will be needed for this course. Friday of each week will have a special clinical focus so that medical students and residents can obtain CME credits for attending these days.

The fourth week of the school is reserved for students' presentations. Students who have been enrolled in a lab rotation will present their work. Students registered for lecture series will discuss a special topic with the committee to present during the last week. These presentations are open for registered students only.



CME Credits

CME credits will be offered on Friday of every week of the summer school to the medical community. To better fit their schedule, two sessions, morning and afternoon, will host TBI researchers from the medical community, which might cover results from imaging, clinical trials, and other clinical related research. A total of 6 CME credits will be available per week. Tuition will be charged for outside students, post-docs and physicians to attend.

Internships/lab rotations

The lab rotation can take place before, during and/or after the lecture series depending on the trainee's and trainer's preferences. Following the same concept on the amount of credits, at 3 hours per day, for 5 days for four weeks, will total 60 hours, which will be equivalent to 2 credits. The student can extend his internship to 8 weeks or 4 credits, based on being involved in a specific project. Consents from the advising faculty should be provided to get an extension to include a project. At the end of the project, a presentation and report are required to earn the certificate of attendance and/or the credits. We expect the students to also present reports in the mornings of the last week of the course.

Scholarships availability

Four scholarships (amount: TBD) will be awarded to graduate students to attend this course. The scholarships can cover the in-state tuition fees (2 credits) as well as students' accommodation.

Eligibility:

Students enrolled in any biomedical related graduate program at WSU as well in any accredited university in Michigan, Ohio, Indiana and Illinois can apply to this scholarship. The students should be in good academic standing (GPA 3.0 or better). Students who will be applying from other universities should check with their graduate program on the eligibility of credit transfer. Students are required to submit a copy their transcripts, a personnel statement as well as 2 recommendation letters. The deadline for scholarships applications is January 2013. Please check www.tbi.wayne.edu for further information on how to apply.



REQUIREMENTS AND ADMISSION PROCESS

The Summer school is offered for graduate students who are currently admitted to graduate programs including but not limited to anatomy, biomedical engineering, chemistry, electrical and computer engineering, neurology, neurosurgery, pediatric radiology, physics, psychiatry and radiology, and with a research focus on imaging, TBI and neuroscience. Students can be enrolled at WSU or any accredited university across the USA.

Lecture series

- Students who choose one credit will be required to attend at least two weeks of lectures.
- Students who choose the two credits option will be required to attend all four weeks of lectures and give a presentation during the fourth week as described above.
- *Admission requirements:* Acceptance by the program director. Interested students should contact the program director to discuss their eligibility to join the summer school.

Lab Rotations

- Laboratory rotation (hands on), which will be counted as 2 credit internship for a one month rotation of at least 3 hours a day or 4 credits for 6 to 8 hours a day.
- The students can enroll in the lab rotation in parallel with the lectures and can choose to enroll in one of the two.
- The lab rotation availability is limited, therefore a more complex admission process will be required including permission from the relevant lab director.
- *Admission requirements:* In addition to the requirements to register in the lecture series, the students who are applying to join the lab rotation should submit the following additional documents:
 - A statement of his/her interest in neuroscience and imaging of TBI and any previous related experience
 - Curriculum Vitae
 - A recommendation letter (preferably from previous lab project's advisor)
 - The student should rank their preferences on what lab he/she would like to join based on the listing found on page 15.

Finally, in addition to the experience, the student can register for 1-8 credits toward his graduate program. Whether these credits will be transferable to another University will have to be investigated by the individual student. Documents of attendance may be provided if requested.



TBI AND NEUROSCIENCE LABORATORIES AND ROTATIONS

Research Facilities:

College of Engineering

- [Advanced Human Modeling Laboratory](#)
- [Ballistic Impact and Forensic Biomechanics Laboratory](#)
- [Impact Testing Laboratory](#)
- [Cell Injury and Repair Strategies Laboratory](#)
- [Spine Research Laboratory](#)
- [Sports Injury Biomechanics Laboratory](#)

School of Medicine

- [WSU MR Research Facility \(MRRF\)](#)
- [Clinical Electrophysiology Laboratory](#)
- [Manganese-Enhanced MRI Laboratory](#)
- [Positron Emission Tomography \(PET\) Center](#)
- [Centers & Institutes affiliated with the Dept. of Physiology](#)

College of Liberal Arts and Sciences

- [Aphasia and Neurocognitive Disorders Laboratory](#)
- [Children's Productive Language Laboratory](#)
- [Infant & Adult Speech Acoustics Laboratory](#)
- [Speech-Language NeuroScience Laboratory](#)
- [Psycholinguistics Laboratory](#)
- [Laboratory of Auditory Protheses Research](#)
- [Stuttering Research Laboratory](#)

DISTINGUISHED GUEST SPEAKERS

External Speakers: Week 1



External Speakers: Week 2



External Speakers: Week 3





PROGRAM DETAILS

Week 1: Basic Science and TBI – Chair: John Michael Cavanaugh, MD	
Monday 06/03	
1:00pm – 2:20pm	Title: Biomechanics of Brain Injury (John Michael Cavanaugh – MD)
2:20pm – 2:40pm	Coffee Break
2:40pm – 4:00pm	Title: Proton magnetic resonance spectroscopy: Neurochemical and physiological basis of the MR-visible compounds (Matthew Galloway – PhD)
Tuesday 06/04	
1:00pm – 2:20pm	Title: Systems Modeling of Oxidative and Nitrosative Stress (Mahendra Kavdia – PhD)
2:20pm – 2:40pm	Coffee Break
2:40pm – 4:00pm	Title: Angiogenesis (Weiping Ren – MD, PhD)
Wednesday 06/05	
1:00pm – 2:20pm	Title: Neuroprotection & Mechanism of Ethanol Therapy: New Prospects for an Ancient Drug (Yuchuan Ding, MD, PhD)
2:20pm – 2:40pm	Coffee Break
2:40pm – 4:00pm	Title: Similarities between Stroke and Traumatic Brain Injury (Quan Jiang – PhD)
Thursday 06/06	
1:00pm – 2:20pm	Title: Remodeling the Brain after Stroke and Neural Injury (Micheal Chopp, MD)
2:20pm – 2:40pm	Coffee Break
2:40pm – 4:00pm	Title: Role of caffeine in Traumatic Brain Injury (Srin Kallakuri – PhD)
Friday 06/07	
9:00am – 10:20am	Title: to be determined (External Guest Speaker)
10:20am – 10:40am	Coffee Break
10:40am – 12:00pm	Title: Acute Injury Phase trials at WSU and elsewhere (Robert Welch, MD)
1:00pm – 2:20pm	Title: to be determined (External Guest Speaker)
2:20pm – 2:40pm	Coffee Break
2:40pm – 4:00pm	Title: Can quantitative brain electrical activity aid in the initial screening of mild traumatic brain injured patients (Brian O'Neil, MD)



PROGRAM DETAILS

Week 2: Imaging – Chair: Ewart Mark Haacke, PhD

Monday 06/10	
1:00pm – 2:20pm	Title: to be determined (Jaladhar Neelavalli – PhD)
2:20pm – 2:40pm	Coffee Break
2:40pm – 4:00pm	Title: mild Traumatic Brain Injury (Zhifeng Kou – PhD)
Tuesday 06/11	
1:00pm – 2:20pm	Title: Magnetic Resonance Spectroscopy (Jeffrey Stanley – PhD)
2:20pm – 2:40pm	Coffee Break
2:40pm – 4:00pm	Title: Functional Magnetic Resonance Imaging (Diwadkar Vaibhav – PhD)
Wednesday 06/12	
1:00pm – 2:20pm	Title: Aging (Naftali Raz – PhD)
2:20pm – 2:40pm	Coffee Break
2:40pm – 4:00pm	Title: Dementia (John Woodard – PhD)
Thursday 06/13	
1:00pm – 2:20pm	Title: Positron Emission Tomography (Muzik Otto, PhD)
2:20pm – 2:40pm	Coffee Break
2:40pm – 4:00pm	Title: Inside neuron stadium: MEMRI of calcium channel pathophysiology in degenerative disorders (Bruce Berkowitz – PhD)
Friday 06/14	
9:00am – 10:20am	Title: to be determined (External Guest Speaker)
10:20am – 10:40am	Coffee Break
10:40am – 12:00pm	Title: to be determined (E. Mark Haacke, PhD)
1:00pm – 2:20pm	Title: to be determined (External Guest Speaker)
2:20pm – 2:40pm	Coffee Break
2:40pm – 4:00pm	Title: Update on the use of DTI in mild TBI (Randall Benson – MD)



PROGRAM DETAILS

Week 3: Special Topics in TBI – Chair: Matthew Galloway, PhD

Monday 06/17	
1:00pm – 2:20pm	Title: Neurobiochemical and psychometric correlates of noise-induced tinnitus following rTMS over the left temporal lobe in humans (Anthony Cacace – PhD)
2:20pm – 2:40pm	Coffee Break
2:40pm – 4:00pm	Title: Blast-Induced Tinnitus and Its Related TBI (Jinsheng Zhang – PhD)
Tuesday 06/18	
1:00pm – 2:20pm	Title: Stems Cells research in cancer (Jianjun Wang – MD)
2:20pm – 2:40pm	Coffee Break
2:40pm – 4:00pm	Title: Stems Cells research in TBI (Jean Peduzzi – PhD)
Wednesday 06/19	
1:00pm – 2:20pm	Title: Sports Related TBI Research (Cynthia Bir – PhD)
2:20pm – 2:40pm	Coffee Break
2:40pm – 4:00pm	Title: FE Modeling of Traumatic Brain Injury (Liyang Zhang – PhD)
Thursday 06/20	
1:00pm – 2:20pm	Title: Ethanol Sensitivity Following Experimental Traumatic Brain Injury (Alana Conti, PhD)
2:20pm – 2:40pm	Coffee Break
2:40pm – 4:00pm	Title: TBI and Driving: Neuroimaging Investigation of Cognitive Distraction and Real- World Applications (Li Hsieh, PhD)
Friday 06/21	
9:00am – 10:20am	Title: to be determined (External Guest Speaker)
10:20am – 10:40am	Coffee Break
10:40am – 12:00pm	Title: Results from the minocycline trial and the beginnings of Youth sports TBI impact study (Jay Meythaler, MD)
1:00pm – 2:20pm	Title: to be determined (External Guest Speaker)
2:20pm – 2:40pm	Coffee Break
2:40pm – 4:00pm	Title: Findings from Southeastern Michigan Traumatic Brain Injury System (Robin Hanks, PhD)



ACCOMMODATION

For Students:

More and more Wayne State students are discovering how living on campus is helping them achieve personal and academic success. With less than a five-minute walk to classes, libraries, a 24-hour computer lab, the Student Center and the Mort Harris Recreation and Fitness Center, living on campus offers a convenience that you can't find anywhere else. Be a part of this growing campus community where residents are establishing new friendships, exploring the community and building new traditions.

Housing Options:

- Residence Halls
- Furnished Apartments
- Unfurnished Apartments

More information can be found at: <http://housing.wayne.edu/options.php>

For Professionals and Physicians who will be attending the lectures for CME credits:

Hotels rates: TBD



ACKNOWLEDGMENT

The Wayne State University Program from Traumatic Brain Injury would like to thank the Office of Vice President for Research for supporting this summer program.

<http://research.wayne.edu/about/index.php>

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Program Director:

E. Mark Haacke, PhD

Organizing Committee:

John Michael Cavanaugh, MD

Mathew Galloway, PhD

Robert Welch, MD

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