

# Wisconsin Institute for Sleep and Consciousness

## *2017 Annual Report*

### **Mission Statement**

The overall mission of the Wisconsin Institute for Sleep and Consciousness is to remain both a national and international preeminent academic Sleep Center. Specific missions include the following:

- Facilitate and enhance basic and clinical sleep research within the UW campus.
- Develop new technology for the study of sleep and sleep disorders through the translation of new neurophysiological recording techniques, such as high-resolution EEG, transcranial magnetic stimulation and/or brain imaging, and noninvasive cardiovascular and respiratory monitoring.
- Coordinate educational efforts in basic sleep science and sleep medicine, including outreach to healthcare providers throughout the region.
- Address areas of public policy relevant to sleep and sleep disorders, such as prevention of sleep deprivation.
- Provide community education and outreach related to sleep and health.
- Provide outstanding clinical care to patients with sleep disorders including outpatient services and diagnostic laboratory testing.

### **Center Activity and Vision**

- **Expanding scientific-clinical scope.** Explicit broadening of the scope of the center to include both sleep and consciousness, in both cases combining basic and clinical research.
- **Greater integration across departments.** Currently WISC is providing high-density EEG equipment to both the Anesthesiology (Sanders) and Neurology (Boly) departments. In addition to offering a data collection and an analysis support framework for use of this equipment, we have also provided extensive consultation to both departments as they write grants to support their own potential equipment purchases if necessary to supplement existing resources. We also encourage the active involvement of several UW departments including: Psychiatry (schizophrenia, mood disorders, PTSD); Neurology (epilepsy, disorders of consciousness such as coma/vegetative state, stroke, Parkinson, Alzheimer); Neurosurgery (intracranial recordings and their relation to hdEEG and preoperative mapping); Anesthesiology (intraoperative evaluation of patients' level of consciousness); and Pediatrics and Surgery (psychiatric and sleep disorders in children).
- **Fostering young clinician scientists.** We have had remarkable success in attracting to Madison young clinician scientists with international standing who are interested in sleep and consciousness. They include Robert Sanders (Anesthesiology), Melanie Boly (Neurology), Aaron Boes (Neurology), Ryan Herringa (Child Psychiatry), Wendell Lake (Neurosurgery). The facilities/know-how at WISC provide a major recruiting tool.
- **Promoting national and international collaborations.** Our research on sleep and consciousness has led to a number of collaborations with several groups both in America and abroad, many of which including PIs who were trained here. These include Stanford, UCLA, Chapel Hill, MGH-Harvard, NYU, Allen Institute (Seattle), Melbourne, Brisbane, Tokyo, U Tennessee, Milan, Pisa, Zurich, Lausanne, Barcelona, Oslo.
- **Full integration with basic science in sleep and consciousness.** More than 30 scientists are working on these themes at the UW Department of Psychiatry, using tools ranging from molecular biology and electron microscopy to computer simulations and mathematics, providing an exceptional pool of diverse expertise from all over the world. A stronger integration would provide the center with a unique opportunity for translational research that has already proven fruitful. This includes research on the function of sleep, the role of sleep and stress during development for neuropsychiatric disorders, on the neural substrate of consciousness and on measures of consciousness.
- **Becoming a software and data hub.** Our pioneering work on hdEEG and TMS-EEG has resulted in a unique set of tools for the characterization and analysis of brain activity (e.g. software for measuring

PCI Index and traveling waves) that are being used and extended all over the world. The center already includes one of (if not) the largest centralized repository of hdEEG sleep data that is utilized to provide Center collaborators (see above) with pilot data along with algorithms and the expertise to support their grant submissions. Our efforts continue to make these resources as easily accessible and comprehensive as possible. For instance, the source code for PyPhi (a software suite for calculating integrated information – a proxy for consciousness, VPhi, the online visual interface to PyPhi (available at <http://integratedinformationtheory.org/calculate.html>), has been used 1,312 times by 986 unique visitors in the last quarter and an online animat visualization (available at <http://integratedinformationtheory.org/animats.html>) are all available on the center website.

- **Capitalizing on major collaborations with industry.** The center is at the forefront of the ongoing expansion of home health assessments to include accurate and ecologically valid sleep and consciousness monitoring, and be the hub for the analysis of the unprecedented data gathered from these efforts. As a result of collaboration between **Philips** and the Center Director (Tononi) along with Assistant Director (Riedner), a closed-loop device for sleep monitoring and enhancement (called **SmartSleep**) was launched at the 2018 Consumer Electronics Show in Las Vegas in January 2018. The device received considerable press coverage (over 40 article mentions) including Time Magazine listing in their top 10 coolest items at CES. Several other articles included Men’s Health “Four Wearables We’re Super Stoked About at CES 2018 (<https://www.menshealth.com/guy-wisdom/new-wearables-ces-2018/slide/4>), Tech Radar , “6 of the Best Wearables of CES 2018: the Greatest Tech You May Soon Be Wearing (<http://www.techradar.com/news/6-of-the-best-wearables-of-ces-2018-the-greatest-tech-you-may-soon-be-wearing>) and GQ “The 15 best new gadgets at CES this year (<http://www.gq-magazine.co.uk/article/ces-2018>). Perhaps more importantly, it was recently awarded by MedTech Breakthrough as the Best Sleep Monitoring Solution of 2018. Through our collaborations with Neurology (Boly) we continue to explore use of this platform to include not only monitoring of epileptic activity but potential opportunities for intervention. Development is also ongoing for development of an intraoperative monitoring system to measure patients’ level of consciousness, to provide a sorely needed tool to both anesthesiologists and neurologists in the operating room. Currently Philips Health is funding a high-level engineer and a research assistant in house in Psychiatry and plans further collaborations.
- **Clinical Excellence.** Wisconsin Sleep Clinic and Lab offer patients the opportunity to receive cutting edge, state of the art care.
  - WI Sleep Clinic hosts a multi-disciplinary team of care providers who are committed to providing high-quality, compassionate care. The clinic supports the primary and specialty clinical activities of the faculty physicians of the University of Wisconsin School of Medicine and Public Health. In 2017 our clinic staffed over 13,000 patient visits and managed to improve our clinic access from 9 weeks to 4-5 weeks. The addition of our satellite office has, strategically located on the East side of the city, has allowed WI Sleep to better accommodate patient’s need and has contributed to our improved access.
  - WI Sleep, Inc., is an independent diagnostic testing facility operated as a joint venture between UW Medical Foundation and UnityPoint Health. A range of testing is offered through 14 private sleep study suites. In 2017, over 6,000 in lab or home studies were completed.
  - **Clinical Research:** WI Sleep clinical staff work collaboratively with researchers on a variety of innovative and contemporary studies. Successful execution and completion of the center’s research requires a commitment from Wisconsin Sleep physicians as well as from registered sleep polysomnographers employed by Wisconsin Sleep.
  - - **Predicting Alzheimer’s from Metabolic Measures and Sleep (PAMMS)** Collaboration between Center for Alzheimer’s disease Research and Center for Sleep and Consciousness. Investigators include Barbara Bendlin, PhD, Department of Medicine (PI). WISC Investigators include, David Plante, M.D., Stephanie Jones, PhD, Brady Riedner, Phd, Mihaela Bazalakova, MD.

- **Wisconsin Center for the Neuroscience and Psychology of Meditation.** Collaboration between Center for Investigating Healthy Minds and Wisconsin Institute for Sleep and Consciousness. Investigators include, Richard Davidson, PhD, Psychology, (PI); Giulio Tononi, MD, PhD (PI), David, Plante, MD (Co-I), Brady Riedner (Co-I).
- **Evaluating novel measures of hypersomnolence in clinical patients.** American Sleep Medicine Foundation (ASMF) Strategic Research Award to David Plante, MD (PI)
- **Local Sleep Loss and Neurobehavioral Function in Pediatric Sleep-Disordered Breathing: A High-Density EEG Investigation.** Investigators include Stephanie Jones, PhD (PI), Camilla Matthews, MD, Department of Pediatrics (Co-I); Tony Kille, MD, Department of Surgery (Co-I)

## Challenges

- **Changes in insurance policies.** Sleep clinic “factories” are going out of business (even at institutions like Harvard), indicating that laboratories focused only on standard polysomnography for sleep apnea are not the model for the future. Thanks to its unique facilities, the scientific reputation, and forward thinking of leadership, Wisconsin Sleep has remained profitable and actually grown. The maintenance of our reputation as one of the world’s pre-eminent sleep research centers plays a central role in securing the future success of Wisconsin Sleep.
- **Competition.** The new approaches developed in Wisconsin have not gone unnoticed and other centers are being developed with substantial funding to promote integrated approaches to sleep and consciousness research based on hdEEG, TMS-EEG and fMRI. These include the Michigan-Ann Arbor, Stanford, NYU, Waterloo, Ontario (Canada), Tübingen (Germany), Paris (France), Sussex-London (UK), Zurich-Lausanne (Switzerland), Tsukuba (Japan – a government special project).

## Opportunities

- **Public health.** The impact of sleep problems upon public health and safety is large, affecting morbidity, mortality, productivity, health care economics, and quality of life. Yet the vast majority of Americans affected by sleep disorders remain unidentified and untreated. Sleep deprivation is also rampant, contributing to a number of health epidemics (hypertension, obesity, diabetes). At the same time, public interest in the role of sleep in optimal health and function is at an all-time high. This is an ideal opportunity for the Center to develop a program of public **outreach** and education to promote basic sleep science and public policy.
- **Home medicine.** Technologically, sleep medicine has been dominated for more than 40 years by a single medical procedure (polysomnography). However, a revolution in the diagnosis and treatment of sleep problems is around the corner. Through a collaboration between UW and **Philips** Health new devices will soon be launched (**SmartSleep**) that can put Wisconsin sleep at the very center of the new era of sleep medicine, an era that will feature high-tech sleep centers as hubs for home-based medicine.
- **Pediatric Sleep:** In addition to marked biological changes in sleep structure and duration across child development, unhealthy sleep behaviors (ie, poor “sleep hygiene”) in children including irregular sleep-wake patterns, electronic media use in the bedroom, and excessive caffeine use are common. The National Sleep Foundation Sleep in America Poll found that only 60% of sixth through eighth graders get the necessary 9 or more hours of sleep each night and only 20% of 12<sup>th</sup> graders sleep at least 8 hours. Insufficient sleep in youth was recognized as a serious health risk in 2010 by the American Medical Association and the American Academy of Sleep Medicine. Sleep Health, a new topic in Healthy People 2020, specifically includes reducing adolescent sleep loss. Insufficient sleep is at epidemic levels in this population, and is associated with significant adverse consequences ranging from reduced academic performance, increased risk of obesity and cardio-metabolic dysfunction, mood disturbance and increased risk taking behavior such as alcohol and substance use. **This is an ideal time for the center to expand its educational outreach to include youth and to develop a larger portfolio of research in the area of sleep and development.**

- **Consciousness.** There is also a growing public interest in the scientific study of consciousness, a field traditionally linked to sleep. The number of investigators and high-level publications are growing, and so for the first time is funding (16M to U of Ann Arbor, 5M to Sussex, 10M to Japanese consortium focused around IIT (integrated information theory, first meeting was in Madison in June 2016). A large 10-year initiative on consciousness is in the final stages of approval in Osaka (Japan) complementing the already established initiative on sleep in Tsukuba. An ambitious initiative for consciousness science (the **TBD foundation** – The Blue Dot – Elizabeth Koch) has received funding for the first 3 years (>3M), and a substantial expansion is planned for the following 10 yrs.

To meet these challenges and take advantage of the opportunities, the Center will focus efforts on enhancing multidisciplinary, translation efforts.

### **Proposed Changes**

- **Integration between clinical and research activities at WISC**

In June 2017 David Plante became the new WISC Medical Director. Dr. Plante, a psychiatrist who combines extensive clinical experience in sleep disorders with considerable research activities, shares the overall vision outlined above to continue and expand Wisconsin Sleep as a state-of-art, highly profitable clinical facility.

The mission and vision, as detailed above, are the guiding principles of the work conducted by the faculty and staff of the Wisconsin Institute for Sleep and Consciousness. As demonstrated through a variety of individual and collaborative efforts by our talented and committed team, the Wisconsin Institute for Sleep and Consciousness continues to be a world renowned leader in the field of Sleep and Consciousness. Below is a sampling of outreach efforts, center funded projects, published manuscripts, and grants awarded from the past year.

### **Outreach**

Baird: Forget Freud: Dream replay our everyday lives [Interview]. (2017, June 22). NPR.

**Wisconsin Institutes for Discovery, Wisconsin Science Festival:** Sleep and the Brain (11.2-11.5.2017)

Jones: **Brava Magazine Interview:** Sleep, precious sleep. (2.1.2017). <https://bravamagazine.com/sleep-precious-sleep/>

**Wisconsin Sleep Open House** (11.4.2017)

The event included tours of the sleep laboratory, clinic and research rooms and a chance to ask questions of sleep experts. The "open lab" is one of many taking place around Madison that weekend as part of the Wisconsin Science Festival.

Cirelli: **Woodland Academy Visit** (4.13.2018) (<https://www.woodlandacademy.org/learning/>)

Dr. Chiara Cirelli hosted a group of students from Woodland Academy, a non-traditional elementary school that is geared toward educating students whose mental health and/or discipline issues have prevented them from succeeding in a traditional learning environment. She gave them a tour of WISC and explained to them the different types of research undertaken at our facility. She also gave them a lesson about the nature and importance of sleep, and discussed with them her vocation (i.e., sleep researcher).

Lang and Grasso: **Socratic Society (UW-Madison Undergraduate Philosophical Society) Talk** (4.2018)  
Panpsychism and Integrated Information Theory

### **Center funded pilot Projects 2017-2018**

**Sleep and Emotion Processing in Pediatric post-traumatic stress disorder.** Jones, Stephanie, PhD (PI), Herringa, Ryan, M.D, PhD (Psychiatry) Co-I. The Center provided support for data collection of 20 youth with PTSD and typically developing matched control subjects. An R01 to follow-up on these data submitted in 2018.

**Development of an Analysis Tool for Assessment of Sudden Cardiac Death Risk during Polysomnography.** Korcarz, Claudi, PhD (PI, Cardiology); In the last 12 months, the Center provided recruitment and enrollment of 45 eligible patients Wisconsin Sleep patients with Obstructive Sleep Apnea with cardiac risk factors. Dr. Korcarz has completed data collection and will be submitting an R01 to follow-up on these data.

**The intrinsically photosensitive retinal ganglion cell (ipRGC)- mediated pupil light reflex, a potential biomarker for sleep.** Yanjun (Judy) Chen, MD, PhD, Department of Ophthalmology (PI). The center provided actigraphy and home sleep apnea (ApneaLink®) testing equipment for compiling pilot data on 20 middle-age and elderly participants with complaints of disrupted sleep. as well as assistance with sleep and activity data analyses. Results from this pilot study will inform larger clinical trials to focus interventions on the application of light therapy to promote sleep.

**Detecting consciousness in unresponsive subjects using high-density EEG: a within-state validation approach in epileptic seizures and during sleep.** Juan, PhD (PI). Swiss National Science Foundation Fellow (SNSF). Center has provided human and fiscal resources to support preliminary data collection.

**Spontaneous and evoked markers of consciousness in unresponsive subjects: a high-density EEG study in sleep and epileptic seizures.** Elsa Juan. PhD (PI) Swiss National Science Foundation Fellow (SNSF).

**High-density EEG exploration of somnambulism and loss of consciousness during sleepwalking episodes.** Amandine Valomon, PhD (PI) Swiss National Science Foundation Fellow. The Center has provided financial support for preliminary data collection.

#### **Published manuscripts (2017-2018)**

Bellesi M, Haswell JD, de Vivo L, **Marshall W**, Roseboom PH, **Tononi G**, **Cirelli C** (2018) Myelin modifications after chronic sleep loss in adolescent mice. Sleep, 41(5). doi: 10.1093/sleep/zsy034

D'Agostino A, **Castelnovo A**, Cavallotti S, Casetta C, Marcatili M, Gambini O, Canevini M, **Tononi G**, **Riedner B**, Ferrarelli F, **Sarasso S** (2018) Sleep endophenotypes of schizophrenia: slow waves and sleep spindles in unaffected first-degree relatives. NPJ schizophrenia, 4(1):2. doi: 10.1038/s41537-018-0045-9

**Marshall W**, Kim H, Walker SI, **Tononi G**, **Albantakis L** (2017) How causal analysis can reveal autonomy in models of biological systems. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 375(2109). doi: 10.1098/rsta.2016.0358

Lee M, **Sanders RD**, Yeom SK, Won DO, Seo KS, Kim HJ, **Tononi G** & Lee S-W (2017) Network Properties in Transitions of Consciousness during Propofol-induced Sedation. Scientific Reports, 7(1):16791. doi: 10.1038/s41598-017-15082-5

**Boly M**, Massimini M, Tsuchiya N, Postle BR, Koch C, **Tononi G** (2017) Are the Neural Correlates of Consciousness in the Front or in the Back of the Cerebral Cortex? Clinical and Neuroimaging Evidence. The Journal of Neuroscience, 37(40): 9603-13. doi: 10.1523/jneurosci.3218-16.2017

Nir Y, Andrillon T, Marmelshtein A, Suthana N, **Cirelli C**, **Tononi G**, Fried I (2017) Selective neuronal lapses precede human cognitive lapses following sleep deprivation. Nature Medicine, 23: 1474-1480. doi: 10.1038/nm.4433

Funk CM, Peelman K, Bellesi M, **Marshall W**, **Cirelli C**, **Tononi G** (2017) Role of somatostatin-positive cortical interneurons in the generation of sleep slow waves. J Neurosci, 37 (38): 9132-48. doi: 10.1523/JNEUROSCI.1303-17.2017

**Cirelli C, Tononi G** (2017) The Sleeping Brain. Cerebrum, June issue. PMID: 28698776.

Bellesi M, de Vivo L, Chini M, Gilli F, **Tononi G, Cirelli C** (2017) Sleep loss promotes astrocytic phagocytosis and microglial activation in mouse cerebral cortex. J Neurosci, 37(21): 5263-5273. doi: 10.1523/JNEUROSCI.3981-16.2017.

Siclari F, **Baird B**, Perogamvros L, Bernardi G, LaRoque J, **Riedner B**, Boly M, Postle BR, **Tononi G**. (2017) The neural correlates of dreaming. Nature Neuroscience, 20:872-878. doi: 10.1038/nn.4545

Siclari F, **Tononi G** (2017) Local aspects of sleep and wakefulness. Current Opinion in Neurobiol., 44: 222-227. doi: <https://doi.org/10.1016/j.conb.2017.05.008>

Boly M, Jones B, Findlay G, Plumley E, Mensen A, Hermann B, **Tononi G**, Maganti R. (2017) Altered sleep homeostasis correlates with cognitive impairment in patients with focal epilepsy. Brain: a journal of neurology, 140(4): 1026-40. doi: 10.1093/brain/awx017

Bodart O, Gosseries O, Wannez S, Thibaut A, Annen J, Boly M, Rosanova M, Casali A, Casarotto S, **Tononi G**, Massimini M, Laureys S. (2017) Measures of metabolism and complexity in the brain of patients with disorders of consciousness. NeuroImage: Clinical, 14: 354-62. doi: 10.1016/j.ncil.2017.02.002

de Vivo L, Bellesi M, **Marshall W**, Bushong EA, Ellisman MH, **Tononi G, Cirelli, C.** (2017) Ultrastructural evidence for synaptic scaling across the wake/sleep cycle. Science, 355(6324): 507-10. doi: 10.1126/science.aah5982

Nagai H, de Vivo L, Chilardi MF, **Tononi G, Cirelli C** (2017) Sleep Consolidates Motor Learning of Complex Motor Sequences in Mice. Sleep, 40 (2). doi: 10.1093/sleep/zsw059.

**Cirelli C** (2017) Sleep, synaptic homeostasis, and neuronal firing rates. Curr Opin Neurobiol., 44: 72-79.

Allada R, **Cirelli C**, Sehgal A (2017) Molecular mechanisms of sleep homeostasis in flies and mammals. CSH Perspectives, Apr 21. pii: a027730. doi: 10.1101/cshperspect.a027730.

Kurth S, **Riedner BA**, Dean DC, O'Muircheartaigh J, Huber R, Jenni OG, Deoni SCL, LeBourgeois MK. Traveling slow oscillations during sleep: A marker of brain connectivity in childhood. Sleep. 2017 Sep 1;40(9).

Cook JD, Prairie ML, **Plante DT**. Ability of the Multisensory Jawbone UP3 to Quantify and Classify Sleep in Patients with Suspected Central Disorders of Hypersomnolence: A comparison against polysomnography and actigraphy. J Clin Sleep Med, 2018 14(5):841-8.

**Plante DT**, Birn RM, Walsh EC, Hoks RM, Cornejo MD, Abercrombie HC. Reduced resting-state thalamostriatal functional connectivity is associated with excessive daytime sleepiness in persons with and without depressive disorders. J Affect Disord, 2018; 227:517-20.

Abercrombie HC, Frost CP, Walsh EC, Hoks RM, Cornejo MD, Sampe MC, Geffey AE, **Plante DT**, Ladd CO, Birn RM. Neural signaling of cortisol, childhood emotional abuse, and depression-related memory bias. Biol Psychiatry Cogn Neurosci Neuroimaging, 2018; 3(3):274-84.

**Plante DT**. Nocturnal sleep architecture in idiopathic hypersomnia: a systematic review and meta-analysis. Sleep Med 2018; 45:17-24.

## **Presentations (2017-2018)**

- Tononi, G** Invited Speaker, 2018, May 6: “Consciousness: a journey from the mind to the brain”. The 4<sup>th</sup> Festival della Scienza Medica. University of Bologna, Bologna, Italy.
- Tononi, G** April 19: “The burden of wake and the reasons of sleep”. The Swammerdam Lecture. University of Amsterdam, Amsterdam, Netherlands.
- Tononi, G** Invited Speaker, 2018, January 20: “Consciousness: From Theory to Practice”. The 2018 Future Congress. Salón de Honor - National Congress, Santiago, Chile.
- Tononi, G** Invited Speaker (w/ Prof. Chiara Cirelli), 2017, October 30: “The costs of wake and the reasons of sleep”. Peter C. Farrell Prize Lecture. Harvard Medical School, Cambridge, MA.
- Tononi, G** Invited Faculty Speaker, 2017, July 10: “Sleep and Dreaming”. Neuroscience School of Advanced Studies Summer Course “Sleep and Cognition”. Bologna, Italy.
- Tononi, G** Keynote Speaker, 2017, May 19: “Consciousness: From Phenomenology to Physics”. IX Edition of the International Scientific Conference on Neuroethics. Padova University, Padova, Italy. Awarded with the SIne Medal (Italian Society for Neuroethics).
- Tononi, G** Invited speaker, 2017, April 8: “Consciousness everywhere”. 2017 Festival Puerto de Ideas. Antofagasta Municipal Theater, Antofagasta, Chile.
- Cirelli, C.** Invited speaker, 2017 April 9 “Why we sleep?” 2017 Festival Puerto de Ideas. Antofagasta Municipal Theater, Antofagasta, Chile.
- Cirelli, C.** Symposium Speaker, 2018 Feb 17: “The price of being awake and the function of sleep: synaptic homeostasis”. AAAS Annual meeting, Austin, TX.
- Cirelli, C.** Symposium Speaker, 2018 Feb 25-27: “Sleep and synaptic down selection”. The Sagol School International Symposium, Tel Aviv U, Tel Aviv, Israel.
- Riedner, B.** Novel Ways to Enhance Slow Wave Sleep. Industry Evening Expert Forum. European Respiratory Society International Congress 2017. Milan, Italy. September 2017.
- Riedner, B.** Novel Ways to Improve Sleep Quality. Industry Product Theater. *SLEEP 2017. Boston, MA. June 2017.*
- Baird, B.** 2018. Dreaming - a new look at an old topic: Recent findings and discoveries. Invited speaker at Sleep Research Society Trainee Symposia Series, *SLEEP*, Baltimore, MA.
- Baird, B.,** Tononi, G. 2018. Recent research on consciousness and reflective consciousness using sleep paradigms. Abstract accepted for presentation at *Association for the Scientific Study of Consciousness*, Krakow, Poland.
- Baird, B.** 2018. Neural correlates of lucid REM sleep measured with high-density electroencephalogram. Talk presented at *The Science of Consciousness*, Tucson, AZ.
- Marshall, W.,** 2018 *Consciousness: From Theory to Practice*, NSAS: Venice, Italy, Summer School Lecture.
- Marshall, W., Albantakis, L, Boly, M., Haun, A.,** 2018 *Integrated Information Theory of Consciousness: Introduction, Tutorial, and Extrapolations*, ASSC 22, Krakow, Poland 2018, Workshop.
- Shuntaro, S.** Kyoto University, Japan (March, 2017) “On the possibility of the ‘functional split-brain’”

**Plante DT**, Woolcock Institute of Medical Research, Sydney, Australia. (June 2018) “Hypersomnolence: Current Management and Future Research Directions”

**Plante DT**, AWAKE Symposium, Melbourne, Australia. (June 2018). “Hypersomnolence in Psychiatric Disorders”. Keynote Speaker.

**Plante DT**, W03: Defining Hypersomnolence: Moving Beyond the Multiple Sleep Latency Test, “Using Multimodal Assessments to Identify Hypersomnolence” (Chair Plante), APSS June 2018, Baltimore, MD.

**Plante DT**, Duke University, Department of Psychiatry--Grand Rounds, Durham, NC (April 2018), “Hypersomnolence in Psychiatric Disorders.”

**Plante DT**, Geisel School of Medicine at Dartmouth, Department of Psychiatry, Hanover, NH (April 2018), “Hypersomnolence in Psychiatric Disorders.”

### **Grants submitted**

R01 MH118600-01 Submitted 2.5.2018. Impact score: 30; Percentile Rank: 24<sup>th</sup>

Jones, Stephanie (PI), Riedner, B (Co-I), Herringa, Ryan (Co-I), Cisler, Josh, Co-I)

Title: Sleep and Emotion Processing in Pediatric Post-Traumatic Stress Disorder

The goal of this proposal is to conduct the first comprehensive analysis of the role of sleep in emotion processing in pediatric posttraumatic stress disorder (PTSD). **Pilot data collection for this study was paid for with Center funds.**

Resubmission planned November 2018

PI, Tononi, Co-I, Riedner, B

December 2018 – November 2020

OASIS: Optimizing Auditory Stimulation to Improve cognitive performance using SmartSleep

NASA – Translational Research Institute for Space Health

Invited for Biomedical Research Advances for Space Health Step 2 proposal to investigate the cognitive benefits of using our closed loop auditory stimulation system for sleep enhancement.

Submitted June 2018

### **Grants awarded (since Center formation)**

2017/08/11 – 2019/07/31

R21HD092986, NICHD

**Jones, Stephanie (PI)**; Co-Investigators: Riedner, B (Sleep), Kille, Tony (Surgery), Matthews, Camilla (Pediatrics)

Local Sleep Loss and Neurobehavioral Function in Pediatric Sleep-Disordered

Breathing: a High Density EEG Investigation

The study will increase our understanding of the impact of local sleep disruption on daytime behavioral and neural function in pediatric sleep-disordered breathing.

**Preliminary data collection for this award was supported by a pilot grant from the Institute for Sleep and Consciousness.**

2017/12/28-2020/12/27,

Templeton World Charity Foundation, **Tononi, Giulio (PI)**

Beyond the Turing test: a principled approach for assessing consciousness and intelligence in the natural and artificial world.

This project will develop practical measures that are needed to assess the value of integrated information  $\Phi$  in large systems, based on their functional and anatomical connectivity. It will use these new measures to test the prediction that the functional connectivity of brain networks that support human consciousness have high  $\Phi$ ,



and that those brain areas that do not support consciousness have low  $\Phi$ . Once validated, these new measures will be applied to artificial systems in order to estimate their level of consciousness.

2016/01/01-2018/12/31

Tiny Blue Dot Foundation, **Tononi, Giulio (PI)**

Measuring Consciousness: From Theory to Practice

This project will apply  $\Phi$ -inspired indices in human subjects during dreaming sleep and dreamless sleep using fMRI, hd-EEG, and TMS-EEG and establish their validity.  $\Phi$ -inspired indices will also be applied in human subjects exposed to natural audio-visual environments (movies) and to audio-visual noise to assess which brain regions show a maximum of neurophysiological differentiation (fMRI, hd-EEG). Additionally, using mice models of loss/recovery of consciousness (LOC/ROC) this project will investigate the neural substrate of consciousness using optogenetic/pharmacogenetic/pharmacological approaches. Role: PI

2016/04/01-2020/03/31,

R01GM116916-01, NIH/NIGMS **Tononi, Giulio & Banks, Matthew (MPI)**

Cortico-thalamic mechanisms of anesthetic unconsciousness

This project will test in mice the hypothesis that general anesthetics, irrespective of their precise mechanism of action, induce loss of consciousness when they bring about the breakdown of information integration in specific neuronal populations within the cortico-thalamic system. Role: MPI

2016/09/15-2018/08/31

R03NS096379 NIH, Boly (PI)

Characterizing epileptic spikes as travelling waves using high-density EEG

This project will apply traveling waves analyses previously validated for discrete EEG events such as sleep slow waves and spindles to characterize the origins and propagation pathways of epileptic spikes in patients with drug-refractory epilepsy. This approach could provide useful information to guide selective epilepsy resection surgery, by guiding in which direction to orient resection approaches and potentially improve the efficiency of surgery without need for more invasive strategies.

Core-002

2016/01/01 – 2018/12/01

Philips Healthcare, Riedner (PI)

Assessing the level of consciousness: from theory to practice

*This project uses the integrated information theory of consciousness to guide development of an index of consciousness based on the differentiation of sensory stimuli applied during waking, sleep and anesthesia. The long-term aim will be to develop a practical device that could be used in the operating room to measure depth of anesthesia.*

2016/02/25-2019/02/24

ASMF Strategic Research Award Category II, Plante (PI)

A Multidimensional Assessment to Improve the Evaluation and Treatment of Hypersomnolence

Examine ancillary measures of excessive daytime sleepiness and duration in patients referred for multiple sleep latency testing

09/2017

Amicitia Excellence Prize, Juan, E.

Rewarding an outstanding PhD graduate from the Lemanic Neuroscience Doctoral School continuing a scientific career at an international academic institution.

2016/09-2018/02

Swiss National Science Foundation Early Post-Doctoral Mobility Grant, Juan, E.

Spontaneous and evoked markers of consciousness in unresponsive subjects: a high-density EEG study in sleep and epileptic seizures

2018-2018  
Swiss National Science Foundation, Valomon, A.  
High-Density EEG and Somnambulism.