



**POLITECNICO
DI TORINO**



Research Institute for Quantitative and Quantum Dynamics of Living Organisms

Center for Medicine, Mathematics & Philosophy Studies

Summer School on Brain and Gut Neuroscience: From Molecules to Mood

Turin, August 26-31, 2018.

50 hours of 45 minute lectures leading to 50 ECM credits for the participants

Lecturers: internationally-renowned experts

Massimo Cocchi, Gustav Bernroider, Lucio Tonello, Fabio Gabrielli, Jack Tuszynski, Natale Giuseppe Frega, Giovanni Lercker, Giuseppe Vitiello, Marco A. Deriu, Marco Pettini, Ted Dinan, Paavo Pylkkanen, Francesco Cappello, Travis Craddock, Ursula Werneke, Alessandro Vercelli, Mark Rasenick, Brian Fertig, Marco Cavaglia and Giovanna Traina

The Organizing Committee: Massimo Cocchi, Jack Tuszynski, Marco A. Deriu, Marco Pettini and Lucio Tonello.

Sponsors: Bromatech, Politecnico di Torino, Società Italiana di Biologia Sperimentale

All attendees will be provided with a certificate of attendance, and those who are physicians will receive 50 ECM credits. We are exploring a possible award of university-level course credits for graduate students from Italy.

Schedule:

Sunday August 26: arrival,

Monday August 27 to Friday August 31: 9:00-17:30 – regular lectures

Wednesday August 29: 20:00-22:30 - social dinner (Ristorante Tre Galline)

Friday August 31: 18:00 closing of the school, award of diplomas

Maximum Number of Participants: 100

Registration Fee: 300 euros for practicing physicians, 100 euros for students

Contact for detailed information:

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Location of the School:

Polito at Lingotto, Aula 201, Via Nizza 230, 10138 Torino, Italy.

(see page 17 of the attached brochure in pdf format)

Rationale and Description of the Course Material Covered by the School:

The objective behind this school is to present an **integrated view of the human brain** in terms of both its hierarchical structural organization and functional complexity. We will build this overview of **modern neuroscience** in a multi-scale approach starting with **molecular aspects** and ending with **psychological, psychiatric and pharmacological aspects**. The assumptions of cognitive neuroscience employ abstractions from the theoretical constructs of 19th century physics. Specifically, neural network models of “emergent conscious experience” rely on analogies to relations among molecules in crystals, fluids, and gases and employ chemical hypotheses regarding the emergence of thoughts, moods, and perceptions from chemical modulation of synaptic interactions among neurons. However, 20th and 21st century science offers probabilistic perspectives from which to view the mind-brain nexus. Quantum mechanics and quantum field theory have given physicists extra “degrees of freedom”, radically multiplied beyond thermodynamics. A relatively new offshoot of quantum physics is quantum information theory, quantum cryptography and actual quantum computation. Quantum logic formally upgrades the classical concept of a “bit” into the notion of a “qubit”. Quantum interference permits vast computational parallelism. Cognitive paradigms drawing upon wave-like quantum logic have recently spawned a new psychological literature. In 2013 Emmanuel Pothos and Jerome Busemeyer advanced an argument that quantum modeling captures many empirically known relations among human perceptions, including mutual interference, order-dependence, and non-localized links, more accurately and completely than does classical neural network theory. Gregory Engel's laboratory and other researchers after him in the last decade demonstrated experimentally that photosynthesis entails intrinsic quantum components giving rise to the field of “quantum biology.” Werner Loewenstein extended quantum biology to include cognitive neuroscience. Hence, it is high time to reconsider new quantum neuroscientific approaches developed over the past three decades as alternatives to traditionally dominant non-quantum paradigms. The way for this has been paved by the work of physicists like Hiroomi Umezawa, Kunio Yasue, Giuseppe Vitiello, Jack Tuszynski, and Travis Craddock, mathematicians like Roger Penrose, and biomedical investigators like Stuart Hameroff and Gustav Bernroider, some of whom will give lectures at this

school. These innovators, by plumbing the depths of the brain's "quantum underground" and its amplifications across diverse scales of the "connectome" have laid a foundation for a possible rapprochement between material substrates and human cognition. In the past few years, quantum-psychological and quantum-neurodynamical ideas have also provided alternative hypotheses concerning the genesis and nature of mental illness. Several efforts in this direction were undertaken by members of the QPP initiative, an effort led by Massimo Cocchi to develop viable quantum paradigms of psychopathology. Nancy Woolf suggested possible links between psychopathology and anomalous quantum computation in cytoskeletal proteins. Paavo Pylkkanen hypothesized a relationship between diffuse physical substrates of mental illness and quantum "pilot waves" gone awry. Massimo Cocchi and his collaborators identified via membrane biophysics possible quantitative correlations between phospholipid composition, serotonin and quantum properties of the cytoskeleton in depression and psychosis. Massimo Pregolato suggested wave-like quantum logic as a possible non-Boolean algebra underlying primary process in thought disorders. Ursula Werneke reinterpreted the content of "impaired" reality testing in the context of Hugh Everett's many-worlds ontology. Eliano Pessa proposed a mathematical structure for psychiatric disease nosology based on symmetry breaking. These ideas may guide future explorations of quantum paradigms of psychopathology. First, shifts from coherent to incoherent quantum brain states may, when aberrant, flag neural correlates of psychotic perception. Second, persistently mismatched phase relations among "parallel channels" of quantum information processing may shed light on clinical thought disorders. Third, bulk properties of brain states emerging from scaled-up quantum-statistical aspects of neural matter may include subjective experience, including normal and abnormal variation of moods. Fourth, resonances across the connectome, readjusted to account for quantum uncertainty effects, may inform us about effects of psychotherapeutic interventions, including electromagnetic brain stimulation. An important emerging topic of the gut-brain axis via microbiota will be extensively covered. The 2018 Summer School in Turin is oriented toward two groups of attendees: physicians without any technical background in physics beyond premedical course work, and graduate students in a range of fields including bioengineering, biophysics and medical research. In this advanced course on neuroscience we will explore the strengths and weaknesses of quantum-cognitive and quantum-neurodynamical perspectives on normal and pathological mentation in comparison to mainstream non-quantum paradigms through lectures, exercises and discussion. Emphasis will be on the evolution and content of novel paradigms and their empirical correlates while technical details will be kept to a minimum. Participants will be introduced to historical, theoretical, and empirically oriented material and then encouraged to synthesize their own sets of conclusions regarding the possible practical relevance of quantum psychology and quantum brain models to neuroscience and psychiatry.

List and Schedule of Topics of the Lectures:

Registration

Opening: Prof. Stefano Paolo Corgnati (Vice Rector for Research)

Molecular Structural Level:

Monday, August 27, 9:00-12:30 Cocchi, Bernroider, Deriu, Craddock

- *Massimo Cocchi: Fatty Acids, Platelets, Brain and Psychopathology (Part I)*
- *Gustav Bernroider: Neurosignaling and Ion channel dynamics (neuro-segnalazione e dinamica dei canali ionici) (Part I)*
- *Marco Deriu: The Methodology of Multiscale modeling*
- *Travis Craddock: The Physical Basis for Nano-neuroscience*

Coherence Level:

Monday, August 27, 14:00-17:00 Lecturers: Pettini, Vitiello, Deriu, Craddock

- *Marco Pettini: Long-distance electrodynamical interactions among biomolecules*
- *Giuseppe Vitiello: Matter, mind and consciousness: from information to meaning (Part I)*
- *Marco Deriu: Application of multi-scale modeling to neurodegenerative diseases*
- *Travis Craddock: Light based quantum processes in the brain*

Tuesday, August 28, 9:00-12:30 Lecturers: Tuszynski, Pettini, Vitiello, Bernroider

- *Jack Tuszynski: From Quantum Physics to Quantum Biology*
- *Marco Pettini: Measuring the complexity of networks, including biological networks*
- *Giuseppe Vitiello: Matter, mind and consciousness: from information to meaning (Part II)*
- *Gustav Bernroider: Neurosignaling and Ion channel dynamics (neuro-segnalazione e dinamica dei canali ionici) (Part II)*

Communication Level I:

Tuesday, August 28, 14:00-17:00 Lecturers: Craddock, Vercelli, Tuszynski, Rasenick

- *Travis Craddock: Complex Neuronal-Glial Interaction, Altered Homeostatic Regulation, and the Perpetuation of Chronic Neuroinflammation*
- *Alessandro Vercelli: Neuronal diversity and circuitry in cerebral cortex (Part I)*
- *Jack Tuszynski: From Quantum Biology to Quantum Medicine*
- *Mark Rasenick (via skype): Lipid raft, Gs alpha protein and psychopathology (Part I)*

Communication Level II

Wednesday, August 29, 9:00-12:30 Lecturers: *Werneke, Dinan, Pylkkanen*

- *Ursula Werneke: Detecting and managing rare side effects of psychotropic drugs: the example of serotonin syndrome*
- *Ted Dinan: Brain-gut-microbiota axis communication: implications for brain diseases (Part I)*
- *Ted Dinan: Brain-gut-microbiota axis communication: implications for brain diseases (Part II)*
- *Paavo Pylkkanen: Quantum theory, active information and the mind-matter relationship*

Behavioral Level (10 hours)

Wednesday, August 29, 14:00-17:00 Lecturers: *Garlaschelli, Cavaglia, Gabrielli, Rasenick*

- *Enrico Garlaschelli: Contesti antropologici della depressione (Part I)*
- *Marco Cavaglia': Anesthesia and Consciousness: an Oxymoron?*
- *Fabio Gabrielli: Le forme della depressione contemporanea. Della biochimica l'antropologia (Part I)*
- *Mark Rasenick (via skype): Lipid raft, Gs alpha protein and psychopathology (Part II)*

Environmental Level

Thursday, August 30, 9:00-12:30 Lecturers: *Traina, Lercker, Tonello*

- *Giovanna Traina: Elementary models of learning*
- *Giovanni Lercker: Tecnologie alimentari, colesterolo, acidi grassi e membrane cellulari.*
- *Giovanna Traina: Mast cells in gut and brain*
- *Lucio Tonello: Networks and psychopathologies*

Thursday, August 30, 14:00-17:00 Lecturers: Cappello, Garlaschelli, Fertig, Vercelli

- *Francesco Cappello: Cervello Viscerale e Cervello Trino: da Papez a MacLean, e dintorni.*
- *Enrico Garlaschelli: Contesti antropologici della depressione (Part II)*
- *Brian Fertig: Implications of Metabolism for the Science and Practice of Medicine (Part I)*
- *Alessandro Vercelli: Neuronal diversity and circuitry in cerebral cortex (Part II)*

Disease Level

Friday, August 31, 9:00-12:30 Lecturers: Gabrielli, Fertig, Lercker, Frega

- *Fabio Gabrielli: Le forme della depressione contemporanea. Della biochimica l'antropologia (Part II)*
- *Brian Fertig: Implications of Metabolism for the Science and Practice of Medicine (Part II)*
- *Giovanni Lercker: Colesterolo e ossidazione*
- *Natale Giuseppe Frega: Fatty acids in animal and vegetal food*

Friday, August 31, 14:00-17:00 Lecturers: Cappello, Cocchi

- *Francesco Cappello: Circuiti vascolo-umorali nevrassiali e perinevrassiali: scoperte, inganni e riscoperte.*
- *Massimo Cocchi: Fatty Acids, Platelets, Brain and Psychopathology (Part II)*

Test

Closing and Diploma Awards