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## Demian Battaglia's CV

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### PERSONAL INFORMATION

BATTAGLIA, Demian

ORCID: 0000-0003-2021-7920 – Researcher ID: C-1281-2017

Date of birth: 11/6/1978 – Italian, married, two sons



ORCID

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Trained in Theoretical Physics, I carry out an *interdisciplinary research* at the crossroad between Physics of Complexity, Computation and Information Science and Neuroscience. I am expert in the theoretical and computational analysis of the dynamics of multi-scale brain circuits, with emphasis on its role in flexible information routing. In the last years, I have broadened my research to encompass the *investigation of whole-brain-scale networks, combining sophisticated modelling and data analysis*. I am currently exploring the Functional Connectivity Dynamics of the human brain's resting state, aiming to achieve its quantitative characterization —also for biomarking, e.g. in aging and development— and to reverse engineer its organizing principles.

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### EDUCATION

- 2005            PhD in Statistical Physics, at the interface with Computer Science and Information theory at SISSA, Trieste, Italy. PhD Supervisor: Riccardo Zecchina (then at ICTP, Trieste, Italy)
- 2002            Master in Theoretical Physics (University of Turin, Turin, Italy)

### CURRENT POSITION

- 2023 – ...     CNRS Faculty scientist at the Laboratory for Cognitive and Adaptive Neuroscience (LNCA, FunSy team), University of Strasbourg, Strasbourg, France.

### PREVIOUS POSITIONS

- 2015 – ...     CNRS Faculty scientist at the Institute for Systems Neuroscience (INS), Aix-Marseille University, Marseille, France.
- 2014 – 2016   Associate scientist at Max Planck Institute for Dynamics and Self-organization (MPIDS), Nonlinear Dynamics Department, Göttingen, Germany
- 2009 – 2014   Staff scientist at the MPIDS, Göttingen, Germany. Project leader within the local BCCN – Bernstein Center for Computational Neuroscience.
- 2006 – 2008   Postdoc at the Lab for Neurophysics and Physiology, University Paris Descartes, France

### FELLOWSHIPS AND PRIZES

- 2021 – 2022   USIAS visiting fellow at Strasbourg University, France

2013 – 2015 Marie Skłodowska-Curie fellow at Aix-Marseille University, France  
2012 – 2013 Bernstein fellow at the BCCN Göttingen, Germany

### **FIVE SELECTED PUBLICATIONS (see later for complete lists)**

1. Spaeth L, Bahuguna J, Gagneux T, Dorgans K, Sugihara I, Poulain B, Battaglia D\*, Isope P\* (2021). Cerebellar connectivity maps embody individual adaptive behavior. *Nature Communications*, 13:580 [*\*shared last authorship*]
2. Clawson W, Vicente AF, Ferraris M, Bernard C, Battaglia D\*, Quilichini P\* (2019) Computing hubs in the hippocampus and cortex. *Science Advances* 5:eaa4843. [*\*shared last authorship*]
3. Palmigiano A, Geisel T, Wolf F, Battaglia D (2017) Flexible information routing by transient synchrony. *Nature Neuroscience* 20(7):1014–1022.
4. Helmer M, Schottdorf M, Neef A, Battaglia D (2017) Gender bias in scholarly peer review. *Elife* 6:103.
5. Kirst C, Timme M, Battaglia D (2016) Dynamic information routing in complex networks. *Nature Communications* 7:11061.

Overall author of 29 original research articles and 11 additional peer-reviewed articles (reviews, methods or proceedings papers), 3 book chapters and editor of 1 monograph. H-index: **18**, Number of citations: **2538**

### **SUPERVISION OF POSTDOCS AND STUDENTS (graduate and master)**

#### *Postdocs:*

- 2019 – 2021 **Jyotika Bahuguna** (*Indian; with Nicole Malfait, Marseille*).  
2019 – 2021 **Nicole Voges** (*German; with Andrea Brovelli, Marseille*).  
2021 – ... **Samy Castro** (*Chilean; with Romain Goutagny, Strasbourg*).

#### *PhD students (official co-direction):*

- 2009 – 2012 **Olav Stetter** (*German; with Theo Geisel, Göttingen*).  
2012 – 2015 **Markus Helmer** (*German; with Theo Geisel, Göttingen*).  
2013 – 2016 **Agostina Palmigiano** (*Argentinian; with Theo Geisel, Göttingen*).  
2017 – 2021 **Lucas M Arbabyazd** (*Iranian; with Viktor Jirsa, Marseille*).  
2017 – 2021 **Diego Lombardo** (*Uruguayan; with Mira Didic, Marseille*).  
2018 – 2021 **Nicola Pedreschi** (*Italian; with Alain Barrat, Marseille*).  
2018 – ... **Shrutiben Naik** (*Indian; with Ghislaine Dehaene, Saclay & Marseille*).  
2019 – ... **Sophie Benitez-Stulz** (*German; with Agnes Trebuchon, Marseille*).  
2020 – ... **Vinicius Lima Cordeiro** (*Brazilian; with Andrea Brovelli, Marseille*).  
2021 – ... **Laura Lopez-Galdo** (*Spanish, with Bjorg Kilavik, Marseille*).  
2021 – ... **Matthieu Aguilera** (*French; with Romain Goutagny, Strasbourg*).

#### *Supervision of other PhD student projects (without official co-supervision):*

- 2012 – 2013 **Javier Orlandi** (*Spanish, with Jordi Soriano, Barcelona*).

- 2012 – 2014 **Christoph Kirst** (*German; with Marc Timme, Göttingen*).
- 2013 – 2015 **Enrique Hansen** (*Argentinian; with Viktor Jirsa, Marseille*).
- 2018 – 2021 **Wesley Clawson** (*USA; with Christophe Bernard, Marseille*).
- 2018 – 2020 **Samy Castro** (*Chilean; with Patricio Orio, Valparaiso*).
- 2019 – 2021 **Lia Papadopoulos** (*USA; with Danielle Bassett, Philadelphia*).
- 2020 – 2021 **Christopher Borçuk** (*USA; with Chantal Mathis, Strasbourg*).

*Direction of master students:* **Xiu-Jie Chen** and **Simone d’Amario** (2013, Göttingen); **Thomas Boudou**, **Julie Falque** and **Marin Dauguet** (resp. 2016, 2017 and 2019, Marseille). *Co-direction of master student:* **Vinicius Lima Cordeiro** (2019, with Antonio Roque, Sao Paulo).

### **TEACHING ACTIVITIES (selected)**

- 2021 – ... Teaching on “Why computational modelling is needed in neuroscience: don’t forget complexity!” (Master in Medicine, University of Strasbourg)
- 2021 Invited lecturer at the IBRO – KIBROS 3<sup>rd</sup> School in Neuroscience, topic: computational data analyses (Khourigba, Morocco, 9-12 November 2021)
- 2015 – ... Intensive teaching of computational neuroscience for the master and PhD program of Integrative and Clinical Neuroscience (“NeuroSchool”, Aix-Marseille University, France)
- 2016 – 2020 Invited lecturer at the 6<sup>th</sup>, 7<sup>th</sup> and 8<sup>th</sup> LASCON (São Paulo, Brazil) and 5<sup>th</sup> LACONEU (Valparaiso, Chile) schools in computational neuroscience
- 2015 – 2016 Invited lecturer at the Camillo Golgi (Erice, Italy) and CNM (AUB, Beirut, Lebanon) schools in Computational Neuroscience
- 2010 – 2015 Invited graduate teaching of Advanced Methods in Neural Data Analysis for the PhD program in Cognitive Neuroscience at SISSA (Trieste, Italy)
- 2009 – 2013 Undergraduate teaching (master in Physics, Computer Science or Biology) about Introduction to Theoretical Neuroscience (Göttingen University, Germany)

### **ORGANIZATION OF SCIENTIFIC CONFERENCES / SCHOOLS (selected)**

- 2021 Organizer of the international “iConn DATATHON” event: learning network science via interdisciplinary data exchange. Hands-on training for the EU ITN iConn network, on network applications in neuroscience, geology, ecology, socioeconomics, astronomy... (27-20 September 2021)
- 2021-22 Co-organizer of the 1<sup>st</sup> Neurex Summer School on Advanced tools for data analysis in neuroscience” (August 2021 and 2022)
- 2020-22 Co-organizer of the “Brain Criticality Conference”, on Zoom, braincriticality.org (virtual in October 2020 and hybrid in November

- 2022 @NIH, Bethesda, MD)
- 2019-21 Main coordinator of the “Theoretical Neuroscience symposia” initiative at the International NeuroFrance congress, (three symposia in 2019, Marseille; five symposia in 2021, Strasbourg)
- 2018 Co-organizer of the HBP EITN Workshop “The many flavors of Effective Connectivity: from cultures to fMRI”, Paris, France
- 2017 Co-organizer of the international AM\*IDEX Computational Neuroscience days, Marseille, France
- 2015 Local organizer and scientific board member for the 15<sup>th</sup> Brain Connectivity Workshop (Marseille, France).
- 2014 Co-organizer of the Kaggle crowdsourcing challenge “Neural Connectomics: from imaging to connectivity”, sponsored by IEEE WCCI-IJCNN (Beijing) and ECML (Nancy, France)

### **OTHER MANAGEMENT DUTIES (selected)**

- Member in six PhD jurys (Italy, Netherlands, Czech Republic, France, Australia)
- 2022–2025 Secretary of the CoNRS Interdisciplinary Commission CID51 “Mathematical, physical and computational modelling for the Life Sciences”
- 2022–2023 Vice-president of the selection board for ANR CES45 “Mathématiques et sciences du numérique pour la biologie et la santé »
- 2021 Member of the selection advisory board for junior researcher group leaders at the NeuroPsi institute (Saclay, Paris)
- 2016 –... Board member of the PhD program in Integrative and Clinical Neuroscience and of the Institute for Language, Brain and Communication (Aix-Marseille University)
- 2013 –... Associate editor for Neurocomputing (2013-2015), Editorial Board Member for Nature Scientific Reports (2017-).
- 2013 –... Expert reviewer for funding bodies (EU-H2020 FET, Dutch NOW, Israeli ISF programs) and Review panel member for EU HBP open calls to EOI and French ANR.
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### **OBTAINED GRANTS (selected)** *(with indication of personally administered budget)*

- 2010-2016 **BMBF** (German Federal funding) – “BCCN Göttingen” – ~150k € *(PI of Axis C1)*
- 2013-2015 **Marie-Curie IEF** “DynViB” (EU FP7) – ~270k € *(individual grant)*
- 2017-2018 **CNRS Mission for Interdisciplinarity INFINITI** “BrainTime” (Fr) – starter fund for research cooperation – ~9k € *(co-PI in interdisciplinary project)*
- 2018-2021 **Doc2AMU** (co-funding EU H2020 and Region PACA) – ~220k € *(co-PI in interdisciplinary project)*
- 2019-2022 **ANR** “ERMUNDY” PRC (Fr) – ~150k € *(INS PI, out of 3 PIs)*

- 2019-2022      **ANR “SENCE” PRC (Fr)** – ~110k € (*INS PI, out of 3 PIs*)  
 2020-2023      **MSCA-ITN “iCONN” (EU H2020)** – ~220k € (*PI in training network*)
- 2021-2022      **USIAS grant “Taming oscillatory complexity** (Univ. Strasbourg) –  
 visiting researcher support — ~120k € (*individual grant*)
- 2022-2025      **ANR “HippoComp” PRC (Fr)** – ~150k € (*INS PI, out of 2 PIs*)

## **OUTREACH ACTIVITIES**

- 2019-2020      Invited speaker at the EHESS Narratology seminar (Paris, February 2020)  
 and at the “ISSN - Narrative 2019” international narratology conference  
 (Pamplona, Spain) to give lectures on “Complexity and Emergence” from  
 an interdisciplinary science perspective
- 2018              Participation to the Pint of Science festival (Shadok pub, Strasbourg,  
 France) and to a broad public lecture (Cercle Ozanam, Paris, France) on  
 the topic “Brain simulation and transhumanism”
- 2018-2022      Regularly invited to interventions in “Ecoles Primaires” and “Collèges”  
 for scientific animations during the “Semaine des Mathématiques”,  
 “Semaine des Neurosciences”...
- 2021              Intervention in the LETHICA Autumn School on “Ethics and Literature”  
 (October 2021, Strasbourg) on the topic of “Moral machines” (ethical  
 implications of Artificial Intelligence and Computational Neuroscience)

## **LANGUAGES**

Italian (mother tongue), French and English (proficiency level), German (advanced).  
 Wishing to learn Spanish.

## COMPLETE LISTS OF SCIENTIFIC PUBLICATIONS

### Original research publications

1. Pedreschi, N., Battaglia, D., Barrat, A. (2022) The temporal rich club phenomenon. *Nature Physics*, doi:10.1038/s41567-022-01634-8.
2. Spaeth, L., Bahuguna, J., Gagneux, T., Dorgans, K., Sugihara, I., Poulain, B., Battaglia, D.\*, Isope, P.\* (2022). Cerebellar connectivity maps embody individual adaptive behavior. *Nature Communications* 13, 580 [*\*shared last authorship*].
3. Durieux, L., Herbeaux, K., Borcuk, C., [...] Battaglia, D., Majchrzak, M., Lecourtier, L. (2022). Functional brain-wide network mapping during acute stress exposure in rats: Interaction between the lateral habenula and cortical, amygdalar, hypothalamic and monoaminergic regions. *Eur J Neurosci* 56(8):5154-5176. doi: 10.1111/ejn.15803. Epub 2022 Sep 22. PMID: 35993349.
4. Borcuk, C., Héraud, C., Herbeaux, K., [...] Goutagny, R., Battaglia, D., Mathis, C. (2022). Early memory deficits and extensive brain network disorganization in the AppNL-F/MAPT double knock-in mouse model of familial Alzheimer's disease. *Aging Brain* 2: 100042. doi:10.1016/j.nbas.2022.100042
5. Schiepek, G., Viol, K., Aas, B., Kastinger, A., Kronbichler, M., Schöller, H., Reiter, E.-M., Said-Yürekli, S., Kronbichler, L., Kravanja-Spannberger, B., Stöger-Schmidiger, B., Aichhorn, W., Battaglia, D.\*, Jirsa, V.\* (2021) Pathologically reduced neural flexibility recovers during psychotherapy of OCD patients. *Neuroimage Clin* 32, 102844. [*\* Shared last authorship*].
6. Arbabyazd, D.M., Shen, K., Wang, Z., Hofman-Apitius, M., Mcintosh, A.R., Battaglia, D.\*, Jirsa, V.\* (2021). Completion and augmentation of connectomic datasets in dementia and Alzheimer's Disease using Virtual Patient Cohorts. *eNeuro*, 0475, 1-33 [*\* Shared last authorship*].
7. Battaglia, D., Boudou, T., Hansen, E.C.A., Lombardo, D., Chettouf, S., Daffertshofer, A., Mcintosh, A.R., Zimmermann, J., Ritter, P., Jirsa, V., 2020. Dynamic Functional Connectivity between order and randomness and its evolution across the human adult lifespan. *NeuroImage* 222, 117156.
8. Lombardo, D., Cassé-Perrot, C., Ranjeva, J.-P., Le Troter, A., Guye, M., Wirsich, J., Payoux, P., Bartrés-Faz, D., Bordet, R., Richardson, J.C., Félician, O., Jirsa, V., Blin, O., Didic, M.\* Battaglia, D.\* (2020). Modular slowing of resting-state dynamic Functional Connectivity as a marker of cognitive dysfunction induced by sleep deprivation. *NeuroImage* 222, 117155. [*\* Shared last authorship*].
9. L. Papadopoulos, C.W. Lynn, D. Battaglia\*, D.S. Bassett\* (2020). Relations between large-scale brain connectivity and effects of regional stimulation depend on collective dynamical state. *PLoS Comput Biol* 16, e1008144. [*\* Shared last authorship*].
10. S. Castro, W. El-Dereby, D. Battaglia\*, P. Orio\* (2020). Cortical ignition dynamics is tightly linked to the core organisation of the human connectome. *PLoS Comput Bio* 16, e1007686 [*\* Shared last authorship*].
11. N. Pedreschi, C. Bernard, W. Clawson, P. Quilichini, A. Barrat\*, D. Battaglia\* (2020). Dynamic core periphery structure of information sharing networks in entorhinal cortex and hippocampus. *Network Neurosci* 4, 946–975. [*\* Shared last authorship*].

12. N. Deschle, A. Daffertshofer, D. Battaglia & E. A. Martens (2019) Directed flow of information in chimera states. *Frontiers in Applied Mathematics and Statistics* 5, 28.
13. W. Clawson, A.F. Vicente, M. Ferraris, C. Bernard, D. Battaglia\* & P. Quilichini\* (2019) Computing hubs in the hippocampus and cortex. *Science Advances* 5, eaa4843. [\* Shared last authorship].
14. A. Palmigiano, T. Geisel, F. Wolf & D. Battaglia (2017) Flexible information routing by transient synchrony, *Nature Neuroscience* 20, 1014–1022.
15. M. Helmer, M. Schottdorf, A. Neef, D. & D. Battaglia. Gender bias in scholarly peer review. *eLife* 6, e21718 (2017).
16. M. Helmer, V. Kozyrev, V. Stephan, S. Treue, T. Geisel & D. Battaglia. Model-Free Estimation of Tuning Curves and Their Attentional Modulation, Based on Sparse and Noisy Data. *PLoS ONE* 11, e0146500 (2016).
17. C. Kirst, M. Timme & D. Battaglia. Dynamic information routing in complex networks. *Nat Comms* 7, 11061 (2016).
18. P. Wadewitz, K. Hammerschmidt, D. Battaglia, A. Witt, F. Wolf & J. Fischer. Characterizing Vocal Repertoires-Hard vs. Soft Classification Approaches. *PLoS ONE* 10, e0125785 (2015).
19. E.C.A. Hansen<sup>x</sup>, D. Battaglia<sup>x</sup>, A. Spiegler, G. Deco & V.K. Jirsa. Functional connectivity dynamics: modeling the switching behavior of the resting state. *NeuroImage* 105, 525–535 (2015). [<sup>x</sup> These authors contributed equally to this work].
20. J. Orlandi, O. Stetter, J. Soriano, T. Geisel and D. Battaglia, *Transfer entropy reconstruction and labeling of neuronal connections from simulated calcium imaging*, *PLoS ONE* 9:e98842 (2014).
21. A. Witt, A. Palmigiano, A. Neef, A. El Hady, F. Wolf and D. Battaglia, *Controlling the oscillation phase through precisely timed closed-loop optogenetic stimulation: a computational study*, *Frontiers in Neural Circuits* 7:49 (2013).
22. D. Battaglia, A. Karagiannis, T. Gallopin, H.W. Gutch and B. Cauli, *Beyond the frontiers of neuronal types*, *Frontiers in Neural Circuits* 7:13 (2013).
23. O. Stetter, D. Battaglia, J. Soriano and T. Geisel, *Model-free reconstruction of excitatory neuronal connectivity from calcium imaging signals*, *PLoS Computational Biology* 8(8):e1002653 (2012).
24. D. Battaglia, A. Witt, F. Wolf and T. Geisel, *Dynamic effective connectivity of inter-areal brain circuits*, *PLoS Computational Biology* 8(3):e1002438 (2012).
25. D. Battaglia and D. Hansel, *Synchronous chaos and broad band gamma rhythm in a minimal multi-layer model of striate cortex*, *PLoS Computational Biology* 7(10):e1002176 (2011).
26. A. Karagiannis<sup>x</sup>, T. Gallopin<sup>x</sup>, C. David<sup>x</sup>, D. Battaglia<sup>x</sup>, H. Geoffroy, J. Rossier, E. Hillman, J. Staiger and B. Cauli, *Classification of NPY-expressing cortical interneurons*, *Journal of Neuroscience* 29(11):3642 (2009). [<sup>x</sup> These authors contributed equally to this work].
27. D. Battaglia, N. Brunel and D. Hansel, *Temporal decorrelation of collective oscillations in neural networks with local inhibition and long-range excitation*, *Physical Review Letters* 99(23), 238106 (2007).

28. D. Battaglia, A. Braunstein, J. Chavas and R. Zecchina, *Source coding by efficient selection of ground state clusters*, Physical Review E 72, 015103 (2005).
29. D. Battaglia, G. Santoro and E. Tosatti, *Optimization by quantum annealing: lessons from hard satisfiability problems*, Physical Review E 71, 066707 (2005).
30. D. Battaglia, M. Kolár and R. Zecchina, *Minimizing energy below the glass thresholds*, Physical Review E 70, 036107 (2004).
31. D. Battaglia and M. Rasetti, *Quantum-like diffusion over discrete sets*, Physics Letters A 313, 8–15 (2003).

### Research monographs

1. D. Battaglia, I. Guyon, V. Lemaire, J. Orlandi, B. Ray & J. Soriano (eds.), *Neural Connectomics Challenge*. The Springer series in Challenges in Machine learning. Springer (2017). ISBN 978-3-319-53070-3.

### Invited book chapters

1. Battaglia D\* and Brovelli A\*,. *Functional connectivity and neuronal dynamics: insights from computational methods*, chapter in the book “*The Cognitive Neurosciences*” (6<sup>th</sup> edition), edited by D. Poeppel, G.R. Mangun, M.S. Gazzaniga, MIT Press, chapter 62, p. 739 (2020) [*\* equal contributions*].
2. D. Battaglia, *Information follows dynamics*, chapter in the book “*Directed Information Measures in Neuroscience*”, edited by R. Vicente, M. Wibral and J. Lizier, pp. 111-136, Springer-Verlag (2014).
3. D. Battaglia, G. Santoro, L. Stella, E. Tosatti and O. Zagordi, *Deterministic and stochastic quantum annealing approaches*, chapter in the book “*Quantum Annealing and related optimization methods*”, edited by B. Chakrabarti and A. Das, pp. 171-206, Springer-Verlag (2005).

### Other peer-reviewed publications (review or methods articles, conference proceedings)

1. M. Aguilera, V. Douchamps, D. Battaglia, R. Goutagny (2022). How Many Gammas? Redefining Hippocampal Theta-Gamma Dynamic During Spatial Learning. *Frontiers in Behavioral Neuroscience* 16, doi: 10.3389/fnbeh.2022.811278.
2. V. Voutsas, D. Battaglia, L. J. Bracken, A. Brovelli, J. Costescu, M. D. Muñoz, B. D. Fath, A. Funk, M. Guirro, T. Hein, C. Kerschner, C. Kimmich, V. Lima, A. Messé, A. J. Parsons, J. Perez, R. Pöpl, C. Prell, S. Recinos, Y. Shi, S. Tiwari, L. Turnbull, J. Wainwright, H. Waxenecker, M.-T. Hütt (2021). Two classes of functional connectivity in dynamical processes in networks. *J R Soc Interface* 18(183), 20210486.
3. L.M. Arbabyazd, D. Lombardo, O. Blin, M. Didic, D. Battaglia\*, V. Jirsa\* (2020). Dynamic Functional Connectivity as a complex random walk: Definitions and the dFCwalk toolbox. *MethodsX* 7, 101168. [*\* Shared last authorship*].
4. J. Orlandi, B. Ray, D. Battaglia, I. Guyon, V. Lemaire, M. Saeed, A. Statnikov, O. Stetter & J. Soriano. First Connectomics Challenge: From Imaging to Connectivity. *The Journal of Machine Learning Research: W &CP* 46, 1–22 (2015). *Reissued in* Battaglia D. et al. (eds), *Neural Connectomics Challenge*. Springer (2017).



5. I. Guyon, D. Battaglia, A. Guyon, V. Lemaire, J. Orlandi, B. Ray, M. Saeed, J. Soriano, A. Statnikov, O. Stetter, *Design of the first neuronal connectomics challenge: From imaging to connectivity*, proceedings of the IEEE IJCNN conference (IEEE WCCI-IJCNN 2014, Beijing), pp. 2600–2607 (2014).
6. O. Stetter, J. Soriano, T. Geisel & D. Battaglia. From structure to function, via dynamics, proceedings of the 12th Granada Seminar on Computational and Statistical Physics (La Herradura, Spain) – “Physics, Computation and the Mind”, edited by P.L. Garrido, J. Marro, J. Torres et al. Book Series: AIP Conference Proceedings, vol. 1510, pp. 64-73 (2013).
7. D. Battaglia, *Neuron-less neural-like networks with exponential association capacity at tabula rasa*, proceedings of the workshop “Third International Work-Conference on the Interplay Between Natural and Artificial Computation” (IWINAC 2009, Santiago de Compostela), edited by J. Mira and J.R. Álvarez, Lecture Notes in Computer Science, Volume 5601/2009, pp. 184-194, Springer (2009).
8. D. Battaglia and L. Stella, *Optimisation through Quantum Annealing: Theory and some application*, Contemporary Physics, Vol. 47, No. 4. (8220), 195-208 (2006).
9. D. Battaglia, M. Kolár and R. Zecchina, *From Statistical Physics Methods to Algorithms*, International Journal of Modern Physics B, Vol. 20 (19), 2814-2823 (2006).
10. J. Chavas, D. Battaglia, A. Cicutin et R. Zecchina, *Construction and VHDL implementation of a fully local network with good reconstruction properties of the inputs*, proceedings of the workshop “First International Work-Conference on the Interplay Between Natural and Artificial Computation” (IWINAC 2005, Las Palmas), edited by J. Mira and J.R. Álvarez, Lecture Notes in Computer Science, vol. 3562, pp. 385-394, Springer (2005).
11. D. Battaglia, A. Braunstein, J. Chavas et R. Zecchina, *Exact probing of glassy states by Survey Propagation*, proceedings of the workshop “Statistical physics of disordered systems and its applications” (SPDSA, Hayama 2004), edited by K. Hukushima, K. Tanaka and H. Nishimori, Prog. Theor. Phys. Suppl. 157, 330-337 (2005).

### **Invited lectures in advanced schools and training events**

1. IBRO – KIBROS 3<sup>rd</sup> School in Neuroscience, topic: computational data analyses (Khourigba, Morocco, 9-12 November 2021). Two hours of lectures on the topic: *Neurocomputational modelling and data analysis*.
2. 1<sup>st</sup> Neurex School in “Advanced tools for data analysis in Neuroscience” (Strasbourg, France, August 2021. Cycle of three lectures and practical tutorials on the topics of *Introduction to whole-brain modelling*, *Machine learning and unsupervised methods for dummies*, *Network Science for dummies*.
3. LASCON 2020 – 7<sup>th</sup> Latin American School on Computational Neuroscience (São Paulo, Brazil, January 2020). Cycle of five lectures and practical tutorials: *From the connectome to the chronnectome, via neural dynamics* (invited by Antonio Roque).
4. LACONEU 2019 – 5<sup>th</sup> School on Computational Neuroscience (Valparaiso, Chile, January 2019). Cycle of three lectures: *From dynamics of neuronal circuits to dynamic functional connectivity* (invited by Patricio Orio).

5. International Neuroengineering school “Massimo Grattarola” (Genova, Italy, June 2018). Lecture: *Oscillations and neural information processing: from routing to computing modes* (invited by Paolo Massobrio).
6. LASCON 2016 – 6<sup>th</sup> Latin American School on Computational Neuroscience (São Paulo, Brazil, January 2016). Cycle of five lectures and practical tutorials: *From the connectome to the chronnectome, via neural dynamics* (invited by Antonio Roque).
7. CNM 2016 – 1<sup>st</sup> “Computational Neuroscience by the Mediterranean” winter school (American University in Beirut, Beirut, Lebanon, 18-22 January 2016). Two lectures and practical tutorial: *From Structural to Functional Connectivity Networks, via Emergent Dynamics* (invited by Wafic Sabra and Ahmed El Hady).
8. School of Brain Cells and Circuits “Camillo Golgi”: “Modeling the brain: from neurons to integrated systems” (Erice, Italy, 29 November – 3 December 2015). Two lectures: *From Structural to Functional Connectivity Networks, via Emergent Dynamics*; and practical software demonstration session: “*Meet the Virtual Brain!*” (invited by Egidio d’Angelo).
9. 5<sup>th</sup> INDIREA network Advanced Training Course: “Introduction to neurocomputational modeling” (Barcelona, 17-18 September 2015). One lecture: *Switching functional interactions across multiple brain scales* (invited by Gustavo Deco).

#### Talks in international conferences

1. Brain Criticality Conference (Bethesda/hybrid, 7-9 November 2022). *The Revenge of the Weak: Decoding Cognition and Behavior from Oscillatory Bursts* (invited by Dietmar Plenz).
2. CNS 2022 - Organization for Computational Neuroscience international meeting (Melbourne, 19 July 2022); workshop “Methods of Information Theory in Computational Neuroscience”: *Decomposing neural circuit function into information processing operations* (invited by Joe Lizier).
3. Workshop “The interplay of complex and coherent dynamics in brain function” (Cergy, 18-20 May 2022). *Local or global? What affects Functional Connectivity changes and their control* (invited by Alessandro Torcini).
4. French-German WE-Heraeus-Seminar “Outstanding challenges in nonlinear dynamics” (Les Houches, 22-25 March 2022). *Mapping the Algorithmic Effects of Brain Circuit Nonlinear Dynamics* (invited by Theo Geisel).
5. “WISER: women in science and engineering research” conference (Jeddah, 8-9 March 2022). *Beyond numerical parity between genders: Healing network misconstruction in scholarly peer review*
6. MAIN Meeting 2021 – Maths, AI and Neuroscience (Stockholm, 13-15 December 2021). *Seemingly random? information dynamics from complex neural dynamics* (invited by Arvind Kumar).
7. NETSCI – Networks Neuroscience Satellite Conference 2021 (virtual conference, 30 June -1<sup>st</sup> July 2021). *Virtual Connectomic datasets in Alzheimer’s Disease and Aging using Whole-Brain Computational Modelling* (invited by Daniele Marinazzo).
8. Organization for Human Brain Mapping (OHBM) international meeting – symposium “Communication in Brain Networks: Models, mechanisms, and

- applications” (virtual congress, 21-25 June 2021). *Dynamics, Connectivity Dynamics, Functional Dynamics* (invited by Olaf Sporns and Caio Seguin).
9. International research retreat “Cognitive maps in infants: Initial state and development” (Les Treilles, France; 8-13 March 2021). *Structured Neural Variability as a Computing Resource* (invited by Ghislaine Dehaene).
  10. Virtual Brain Criticality Conference (Bethesda/virtual conference, 6-8 October 2020). *Complex switching between information processing states in the hippocampus and entorhinal cortex* (invited by Dietmar Plenz).
  11. International Bernstein Conference on Computational Neuroscience (BCCN 2020, Göttingen/virtual conference, 29-30 September 2020); workshop “Crossing scales: understanding collective neural activity”: *Characterizing dynamics of functional states at different scales* (invited by Anna Levina).
  12. Human Brain Project 1<sup>st</sup> eBrains conference (virtual conference, 24-25 September 2020). *Virtual connectomic datasets in dementia and Alzheimer’s Disease using whole-brain network dynamics modelling* (invited by Viktor Jirsa).
  13. Paracelsus Medicine University Human Change conferences - Self-organization of the brain” Workshop (Salzburg/virtual conference, 24 July 2020). *The liquid chronnectome* (invited by Gunther Schiepek).
  14. The “Predictive Brain conference” (Marseille, 26-27 September 2019). *Dynamics of Functional Connectivity* (invited by Daniele Schon).
  15. French-German WE-Heraeus-Seminar “Novel physics in living systems” (Roscoff, 2-6 September 2019). *When neural systems tell us that we should respect their complexity* (invited by Hugues Chaté).
  16. CNS 2019 - Organization for Computational Neuroscience international meeting (Barcelona, 16-17 July 2019); workshop “Emergent Phenomena in Macroscopic Neural Networks”: *Oscillations: computing beyond routing?* (invited by Joana Cabral).
  17. ISSN 2019 – Narrating conference (Pamplona, 16-17 July 2019): *Emergent narrations: short and random stories on complex dynamics* (invited by John Pier and Anne Duprat).
  18. HBP EITN Workshop “The many flavors of effective connectivity” (Paris, 10-11 December 2018): *Short stories on connectivity and dynamics* (member of program committee with Paolo del Giudice, Alain Destexhe and Cristiano Capone)
  19. Research retreat “Summer Institute in Cognitive Neuroscience” (Lake Tahoe, CA, 6-7 July 2018): *Functional Connectivity and Neuronal Dynamics: Insights from Computational Methods* (invited by Danielle Bassett and David Poeppel).
  20. NetSci 2018 (Paris, 11-15 June 2018); workshop “Network Neuroscience”: *Dynamic information routing in networks of oscillating neuronal populations* (invited by Daniele Marinazzo)
  21. International Bernstein Conference on Computational Neuroscience (BCCN 2017, Göttingen, 12-15 September 2017); workshop “Information transmission and communication in brain circuits”: *Flexible information routing by transient synchrony* (invited by Claudio Mirasso).
  22. International Bernstein Conference on Computational Neuroscience (BCCN 2017, Göttingen, 12-15 September 2017); workshop “The neural code: Universal

- grammar or area-specific mechanisms?": *Do oscillations modulate information processing? From routing states to computing modes* (invited by Eleonora Russo).
23. ESIsync 2017: "Principles of structural and functional brain connectivity" (Frankfurt am Main, 24 July 2017): *Flexible Information Routing by Transient Synchrony* (invited by Pascal Fries and Wolf Singer).
  24. CNS 2017 - Organization for Computational Neuroscience international meeting (Antwerp, 20 July 2017); workshop "Methods of Information Theory in Computational Neuroscience": *Discrete information processing states in anaesthetized rat recordings* (invited by Joe Lizier).
  25. CNS 2017 - Organization for Computational Neuroscience international meeting (Antwerp, 19 July 2017); workshop "Fingerprints of brain dynamics": *Functional Connectivity Dynamics descriptors as fingerprints of cognitive aging* (invited by Mathieu Gilson).
  26. Critical Brain Dynamics 2016: "Fifth Annual International Workshop on Criticality and the Brain" (NIH, Bethesda, MD, 17-19 October 2016): *The Impact of Canonic Cortical Circuit Structure on Neural Oscillations and Information Routing: Is there any?* (invited by Dietmar Plenz).
  27. 10<sup>th</sup> FENS forum of Neuroscience 2016 – Technical Workshop "Full brain network dynamics: modeling, analysis, experiments" (Copenhagen, 2 June 2016): *Theoretical foundations of the Virtual Brain: from the connectome to the "chronnectome"* (invited by Petra Ritter).
  28. International workshop "Aging in the neuro-musculo-skeletal system" (Aix-Marseille University, 15-17 March 2016): *Resting state Functional Connectivity Dynamics through the human adult lifespan* (invited by Jean-Jacques Temprado).
  29. CCT 2015 – "Chaos, complexity and transport" (Aix-Marseille University, 1-5 June 2015): *Functional connectivity and meta-connectivity of the aging human brain* (invited by Xavier Leoncini).
  30. NEFF Workshop on "Neural Information Dynamics, Causality and Computational Optimality" (FIAS, Frankfurt, 12-13 December 2014): *"Liquid" functional interactions across multiple brain scales* (invited by Michael Wibral).
  31. Second Workshop on "The Brain: Criticality, Dynamics, Network and Function" (HLR Labs, Malibu, CA, 10-12 September 2014): *Functional Connectivity Dynamics* (invited by Srinivasa Narayan and Dante Chialvo).
  32. CNS 2014 - Organization for Computational Neuroscience international meeting (Ville de Quebec, 31 July 2014); workshop "Large-scale brain structure and dynamics": *Dynamics of large-scale functional connectivity* (invited by Xiao-Jing Wang).
  33. CNS 2014 - Organization for Computational Neuroscience international meeting (Ville de Quebec, 30 July 2014); workshop "Dynamics of disease states": *On the nature of seizure dynamics* (invited by Jonathan Rubin to replace Viktor Jirsa).
  34. IEEE WCCI-IJCNN 2014 (Beijing, 6-11 July 2014); special session on the official IEEE WCCI-IJCNN machine learning competitions: *Design of the first neuronal connectomics challenge: From imaging to connectivity* (invited by Ruck Thawonmas).
  35. Workshop "Connections and communication in the brain" (The Banbury Center, Cold Spring Harbor Laboratory, 6-9 April 2014): *Collective dynamics of multi-scale*

*brain circuits shapes information routing* (invited by Nicolas Brunel and Bijan Pesaran).

36. 6th Annual Workshop of Computational Neuroscience (Institut de Neurosciences de la Timone, Marseille, 27-28 March 2014): *The intricate dependency of function from structure: functional multiplicity and structural degeneracy* (invited by Andrea Brovelli).
37. International Conference “Complex Nonlinear Systems: From Basic Science To Applications” (1<sup>st</sup> Dynamics Days Central Asia meeting, Samarkand, Uzbekistan, 7-11 November 2013): *Oscillations in multi-scale neural-circuits: from collective chaos to information routing* (invited by Davron Matrasulov and Giulio Casati).
38. International Bernstein Conference on Computational Neuroscience (BCCN 2013, Tübingen, 24-27 September 2013); workshop “Contextual control of neural computation”: *Function follows dynamics: context-dependent information flow in neural circuits* (invited by Michael Wibral).
39. International meeting INCF 2013 - Neuroinformatics (Stockholm, 27-29 August 2013); workshop “Transfer Entropy - an information theoretic tool of choice for brain research”: *Function follows dynamics: state-dependency of information flow in neural circuits* (invited by Zbigniew Struzik and Erik de Schutter).
40. CNS 2013 - Organization for Computational Neuroscience international meeting (Paris, 13-18 July 2013); workshop “Network neuroscience: structure and dynamics”: *Function follows dynamics, rather than structure* (invited by Michele Giugliano).
41. 12th Granada Seminar – “Physics, Computation and Mind” (La Herradura, Spain, 17-21 September 2012): *Function follows dynamics* (invited by Jesus Cortes and Joaquin Marro).
42. First international workshop “Networks, processes and causality” (Cala Galdana, Menorca, 3-6 September 2012): *Dynamic information routing in neuronal networks of the brain* (invited by Bernhard Schölkopf).
43. 3rd Annual Workshop of Computational Neuroscience (Université de Provence Aix-Marseille I, Marseille, 9-10 June 2011): *Dynamic control of effective connectivity among interacting brain areas* (invited by Viktor Jirsa).
44. 4th UNINET international workshop – “New directions of network modeling” (University Paris Descartes, Paris, 9-12 June 2008). Invited Oral. Title: *Complex dynamics in interacting primary visual cortex hypercolumns*.
45. First world workshop on quantum annealing and related optimization methods - QAOM 2005 (Saha Institute, Kolkata, India, 2-5 March 2005): *Quantum annealing of hard combinatorial optimization problems* (invited by Bikas Chakrabarti and Arnab Das).

#### **Invited seminar talks**

1. Invited seminar by Giuseppe Ancona (14 October 2022, IRMA, Université de Strasbourg, France): *Neurosciences computationnelles : De la "bosse des maths" aux "maths dans les bosses"*
2. Invited seminar by Jee Choi (5 October 2022, KIST, Seoul, South Korea): *Transient oscillations: from neural activity dynamics to information dynamics*.

3. Invited seminar by Ingrid Bethus (19 September 2022, NeuroMod, Sophia Antipolis, France): *Hippocampal gamma oscillations form complex ensembles modulated by behavior and learning.*
4. Invited seminar by Maxime Baud (25 February 2022, University of Bern, Germany): *Not how the networks are, but how the networks flow: Structured dynamics of functional connectivity*
5. Invited webinar for the ICTP-SAIFR "Complex systems and statistical physics" Seminar Series (31 May 2021, via Zoom @ICTP Sao Paulo, Brazil): *Neural dynamics and dynamics of information.*
6. Invited seminar for the "Wellcome Trust Neural Dynamics graduate school programme" (26 March 2021, Bristol University, Bristol, UK): *Structured Neural Variability as a Computing Resource.*
7. Invited webinar by Ulrich Egert (21 January 2021, via Zoom @ BCCN Freiburg, Germany): *Neural dynamics and dynamics of information.*
8. Invited seminar by Laura Harsan and Jack Foucher (9 October 2020, iCube, University of Strasbourg, France). *Functional Connectivity Dynamics: theory and applications.*
9. Invited webinar by Claudio Mirasso (28 May 2020, via Zoom @ IFISC, Palma de Mallorca, Spain): *Is the complexity of oscillatory dynamics a resource for neuronal information processing?*
10. Invited seminar by John Pier and Philippe Roussin (4 February 2020, Centre de Recherche Arts et Littérature-CRAL, EHESS, Paris, France). *Hasard, Complexité, Information, Cognition.*
11. Invited seminar by Jeremy Mattout (13 January 2020, Centre de Neurosciences de Lyon, France): *Brain (oscillatory) dynamics as "ordered disorder"*
12. Invited seminar by Stefano Panzeri (13 December 2019, CIMEC, Rovereto, Italy): *Brain networks and information dynamics between order and randomness*
13. Invited seminar by Marieke Vugt (15 November 2019, Groningen University, The Netherlands): *Brain (oscillatory) dynamics as "ordered disorder"*
14. Invited seminar by Mathilde Cordero-Erausquin (30 Novembre 2018, Strasbourg University, Strasbourg, France): *Oscillations and information processing: from routing to computing.*
15. Invited seminar by Christine Assaiante (12 Novembre 2018, Aix-Marseille University, Marseille, France): *Not how the networks are but how the networks dance: functional connectivity dynamics.*
16. Invited seminar for the "Wellcome Trust Neural Dynamics graduate school programme" (5 October 2018, Bristol University, Bristol, UK): *Do oscillations modulate information processing? Beyond routing.*
17. Invited seminar by Thilo Womelsdorf (16 March 2018, Vanderbilt University, Nashville, TN): *"Do oscillations modulate information processing? From routing states to computing modes.*
18. Invited seminar by Paolo del Giudice (1 March 2018, Sapienza University, Rome, Italy): *Do oscillations modulate information processing? From routing states to computing modes.*

19. Invited seminar by Christoph Kirst (16 November 2017, Rockefeller University, New York, USA): *Do oscillations modulate information processing? From routing states to computing modes.*
20. Invited seminar by Caroline Chau-Moulin (18 November 2016, FRUMAM – Aix-Marseille University, France): *“Beyond graph theory” - Alterations of the human structural and functional connectomes through aging.*
21. Invited seminar by Régis Bordet (2 November 2016, University of Lille II, Lille, France): *Functional Connectivity Dynamics of the resting state: from Virtual Brains to aging brains.*
22. Invited seminar by Pascal Barone and Simon Thorpe (2 November 2016, CERCO, Toulouse, France): *Dynamics of functional interactions (or “a tale of three “Omes”)*
23. Invited seminar by Ana Solodkin (20 October 2016, UC Irvine, Irvine, CA): *A tale of three “Omes”, with an application to healthy aging (and not only?)*
24. Invited seminar by Anne Didier (3 May 2016, Centre de Neurosciences de Lyon, Bron, France): *From the connectome to the “chronnectome” via dynamics.*
25. Invited seminar by Sandro Vaienti (26 April 2016, University of Toulon, France): *Are brain functional networks performing an anomalous diffusion?*
26. Invited seminar by Francesco Vaccarino (28 May 2015, ISI Foundation, Turin, Italy): *Functional Connectivity Dynamics across brain scales.*
27. Invited seminar by Xiao-Jing Wang (6 January 2015, NYU, New York, NY): *Quantifying and modelling large-scale Functional Connectivity Dynamics.*
28. Invited seminar by Henry Kennedy (Conférence CORTEX, 30 October 2014, INSERM, Bron-Lyon): *Functional Connectivity Dynamics.*
29. Invited seminar by Charles Gray (8 September 2014, Montana State University, Bozeman, MT): *Functional Connectivity Dynamics.*
30. Invited seminar by Matthias Kaschube (21 January 2014, FIAS, Frankfurt, Germany): *Collective dynamics of multi-scale brain circuits shapes information routing.*
31. Invited seminar by Susanne Ditlevsen and Eric Martens (11 June 2013, University of Copenhagen, Denmark): *Function follows dynamics: brain state-dependency of inter-areal information flow.*
32. Invited seminar by Pascal Fries (9 April 2013, Ernst Strüggmann Institute, Frankfurt, Germany): *Function follows dynamics: brain state-dependency of inter-areal information flow.*
33. Invited seminar by Sophie Achard (31 January 2013, GIPSA-LAB, INPG-CNRS, Grenoble): *Dynamic information routing at the edge of oscillatory synchrony.*
34. Invited seminar by Udo Ernst (27 November 2012, University of Bremen, Germany): *Function follows dynamics.*
35. Invited seminar by Stanislas Dehaene (10 February 2012, INSERM-CEA, Neurospin, Saclay): *Self-organization of interacting brain rhythms and information routing.*
36. Invited seminar by Matthew Diamond (18 November 2011, SISSA, Trieste, Italy): *Routing of digital-like information by analog rate oscillations.*

37. Invited seminar by Andreas Kreiter (20 January 2011, University of Bremen, Germany): *Dynamic control of effective connectivity between brain areas.*
38. Invited seminar by Jozsef Fiser (9 March 2008, Brandeis University, Waltham, USA): *From combinatorial optimization to combinatorial neural-like pattern association.*
39. Invited seminar by John Rinzel (7 March 2008, New York University, New York, USA): *Stimulus-dependent temporal decorrelation of evoked activity in striate cortex.*
40. Invited seminar by André Longtin (27 February 2008, University of Ottawa, Canada): *Stimulus-dependent temporal decorrelation of evoked activity in striate cortex.*
41. Invited seminar by Eytan Domany (19 September 2005, Weizmann Institute of Science, Rehovot, Israël): *Using clusters of ground states as codewords: from combinatorial optimization to source coding.*