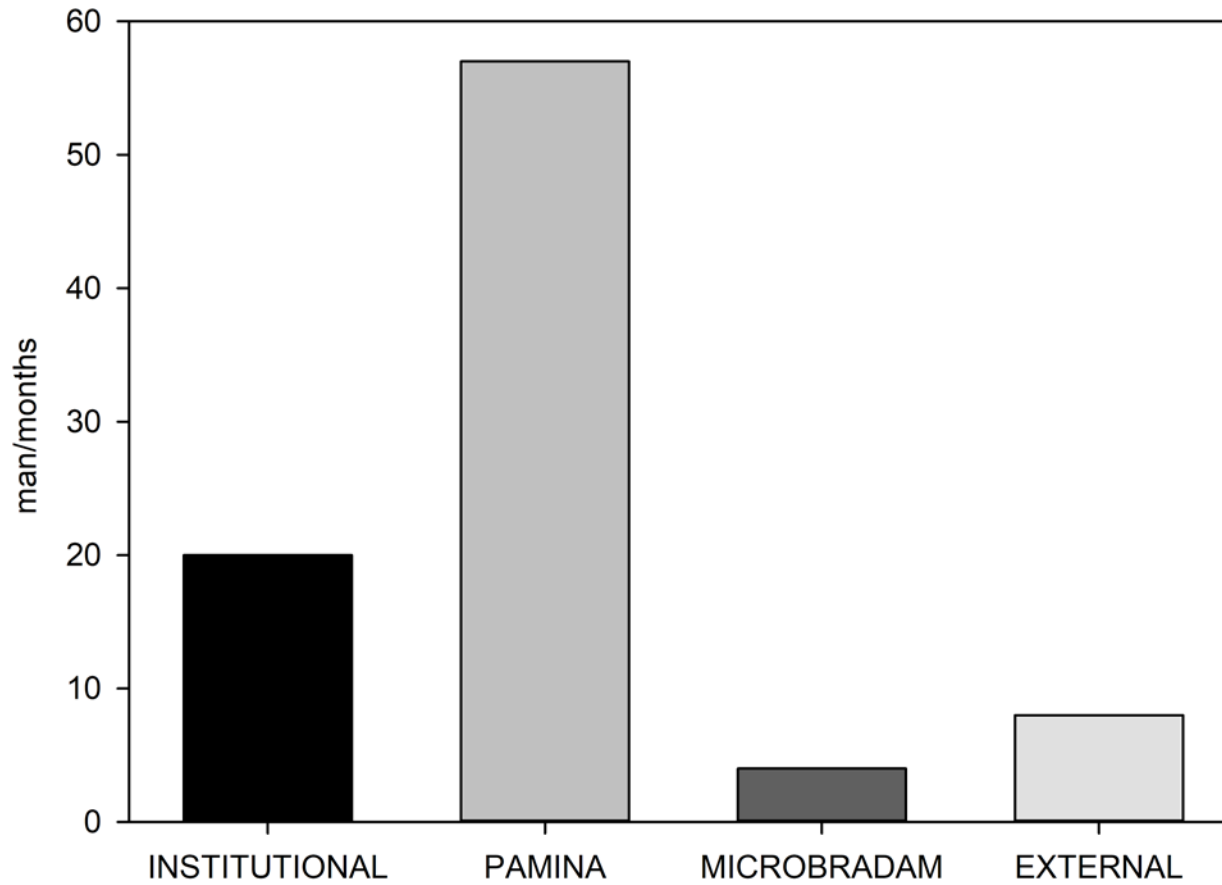


- **Coordinators:** Dr. Federico Giove, Prof. Bruno Maraviglia
- **Participants:**

Name	Position	Project	Funds	Until...
Federico Giove	Primo ricercatore TD (lead researcher, fixed term)	PAMINA, MICROBRADAM, TMENS	PAMINA	8/2018
Tommaso Gili	Ricercatore TD (researcher, fixed term)	PAMINA	PAMINA	Expired 2017
Fabrizio Piras	Ricercatore TD (researcher, fixed term)	PAMINA	PAMINA	Expired 2017
Daniele Mascali	Assegno di ricerca (postdoc fellowship)	TMENS; MICROBRADAM	TMENS; MICROBRADAM	1/2019
Fabio Mangini	Assegno di ricerca (postdoc fellowship)	PAMINA; TMENS	PAMINA	Expired 2017
Andrea Veroli	Assegno di ricerca (postdoc fellowship)	PAMINA	PAMINA	4/2018
Francesca Assogna	Assegno di ricerca (postdoc fellowship)	PAMINA	PAMINA	Expired 2017
Marta Moraschi	Assegno di ricerca (postdoc fellowship)	TMENS	TMENS	9/2018
Michela Fratini	Associate	TMENS	CNR; MOH through Fondazione Santa Lucia	
Laura Maugeri	Associate	TMENS	MOH through Fondazione Santa Lucia	
Bruno Maraviglia	Associate	TMENS		



Place of Work & Collaborations:

Centro Fermi MARBI Lab @ Santa Lucia Foundation

Company/Consortium/Public-service corporation/Research infrastructure

Charles River Oy, Kuopio, Finland

ENIGMA (Enhancing Neuro Imaging Genetics through Meta Analysis)

Fondazione Santa Lucia IRCCS, Roma

Policlinico S. Andrea, Roma

Policlinico Umberto I, Roma

Siemens Medical Solutions Italy

University/research institution

Cardiff University Brain Research Imaging Centre (CUBRIC), Cardiff, UK

Center for Magnetic Resonance Research (CMRR), University of Minnesota, Minneapolis, MN, USA

CNR, Istituto dei sistemi complessi, Roma

CNR, Istituto di Nanotecnologia, Roma

Department of Physics, University of Kuopio (Finland)

Dipartimento di Neuroscienze, Università Tor Vergata, Roma

Dipartimento di Scienze Biomediche, Università di Modena e Reggio Emilia

Dipartimento di Scienze Neurologiche, Università La Sapienza, Roma

Dept Computer Science, University College London

Dipartimento di Medicina Interna, dell'Invecchiamento e Malattie Nefrologiche, Università di Bologna

Dipartimento di Medicina Sperimentale, Università di Genova

Dipartimento di Neuroscienze, Università Tor Vergata, Roma

IMT Lucca

Lorentz Institute, University of Leiden

MICROBRADAM

New techniques for assessment of brain damage

TNEU

PAMINA

Platform for advanced applications to clinical research

Brain metabolism and energetics

(f)MRS, fMRI
(Physiology, epilepsy, cancer)

Computational approaches/simulation
Advanced MRS methods

Brain steady state networks

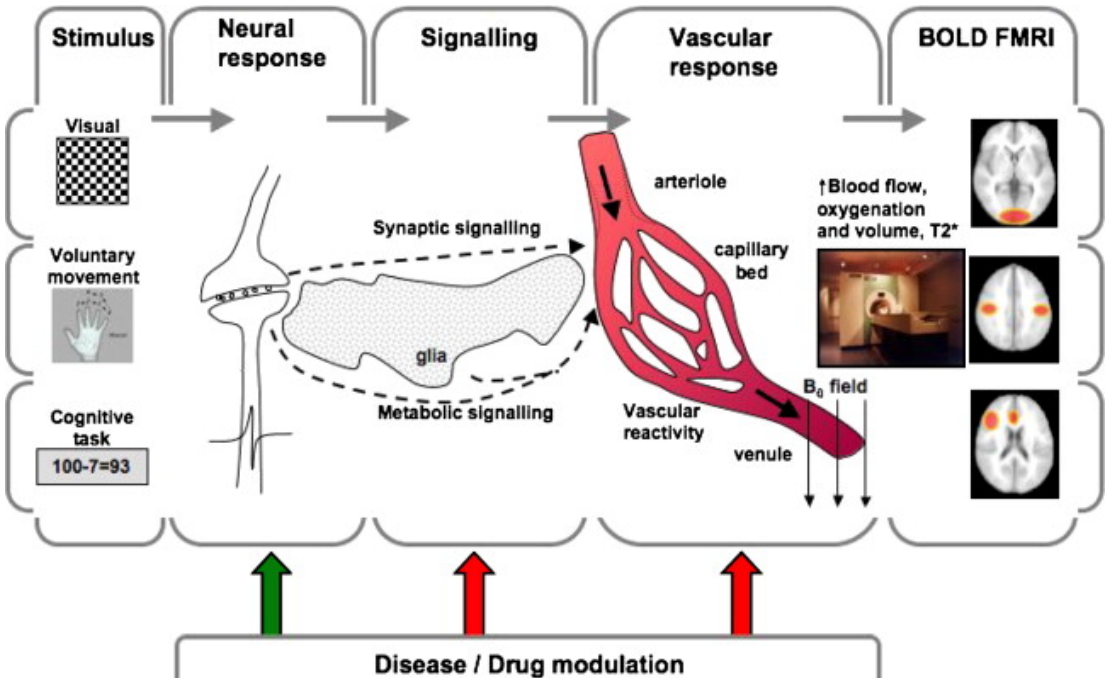
fMRI (physiology, neurodegeneration)
Methods

Spinal cord fMRI

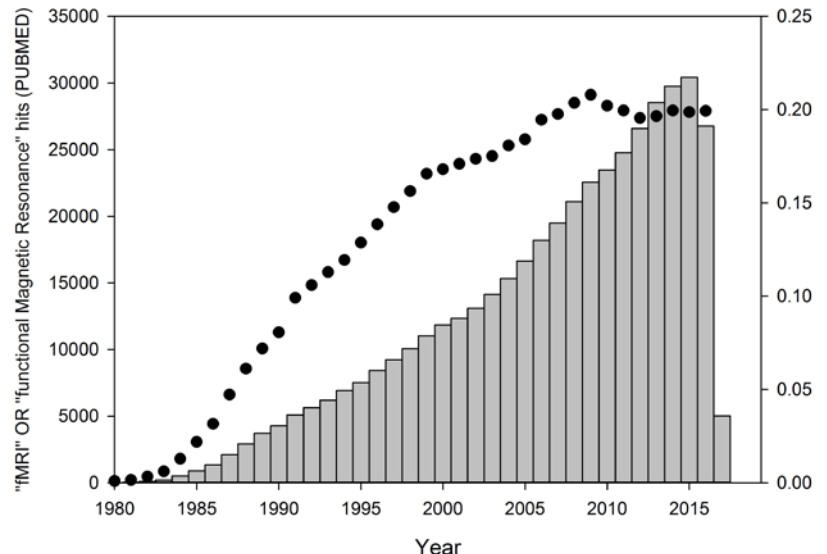
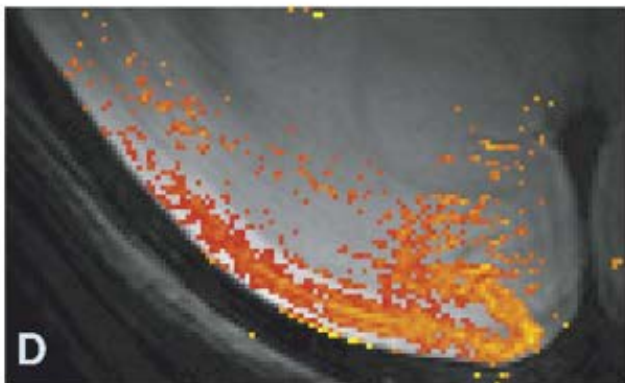
function, microstructure
Biophysics

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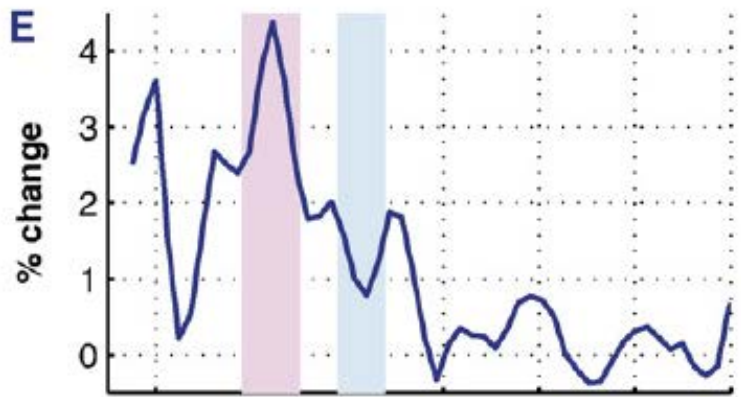
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 2. Silvia Tommasin et al. Non-linear and scale invariant rearrangement of resting state networks in the human brain under sustained stimulation. *Neuroimage* (2018). Under revision.
 3. Fabrizio Frezza, Fabio Mangini, E. Stoja, and Nicola Tedeschi. Electromagnetic Interaction by a Biological Cell during the Different Phases of Mitosis. *Mathematics and Mechanics of Complex System* (2017). Submitted.
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 6. Daniele Mascali, Giorgia Bussu, Mauro DiNuzzo, Silvia Mangia, Emiliano Macaluso, TBD, and Federico Giove. Whole brain reorganization of brain networks during visuospatial attention. *TBD* (2018). In preparation.
 7. Daniele Mascali, Silvia Tommasin, Silvia Mangia, TBD, and Federico Giove. Connectivity radius: a new metric for functional networks assessment. *TBD* (2018). In preparation.
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- Published on international journal: 25 research papers + 1 editorial
 - Ongoing: 9
 - Submitted + Under revision: 4
 - In preparation: 5
 - 1 edited special issue (*Frontiers in Physics, Frontiers in Neuroscience, Proceedings of ISMRBF, Erice, April-May 2016*)
 - 1 newspaper article (with other biomedical projects)
 - More than 15 communications to international congress (oral, invited, contributed)
 - 2 Workshops organized (*MICROBRADAM, Rome, May 2017 – ISMRBF, Erice, April 2018*)



Goense et al, MRI, 2006

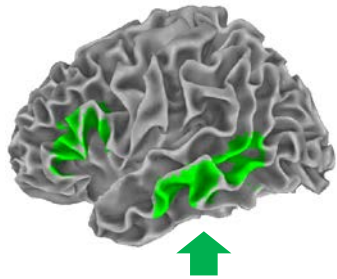


ch 2018 - PT,



Disruption of Semantic Network in Mild Alzheimer's Disease Revealed by Resting-State fMRI

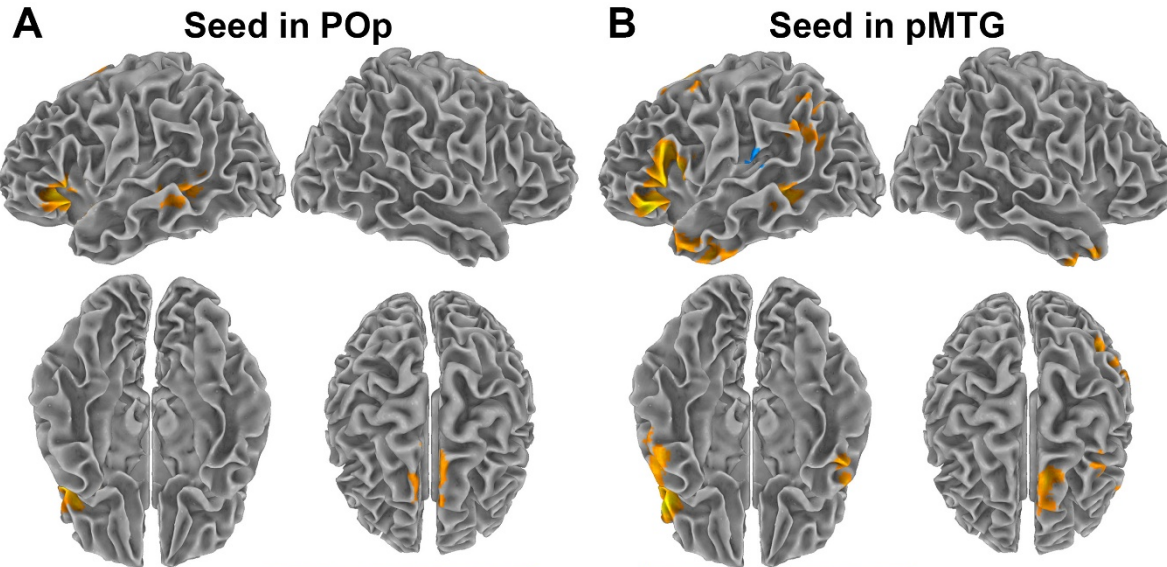
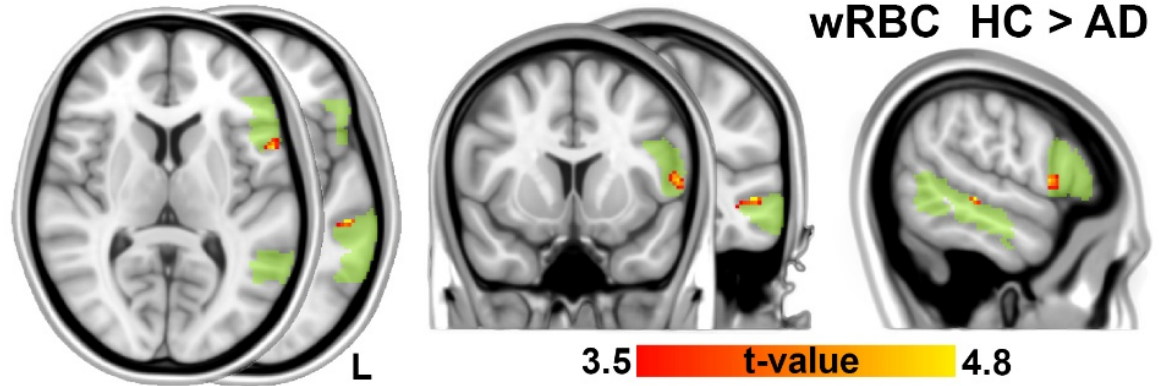
Mascali et al. Neuroscience 2018



semantic control network

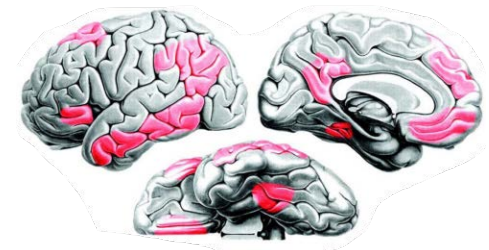
$$wRBC(i) = \frac{1}{N} \sum_{i \neq j} w(r(i, j)) \quad w(x) = \frac{1}{2} \ln\left(\frac{1+x}{1-x}\right)$$

$i, j \in \text{mask}$



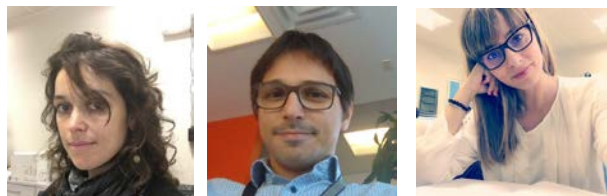
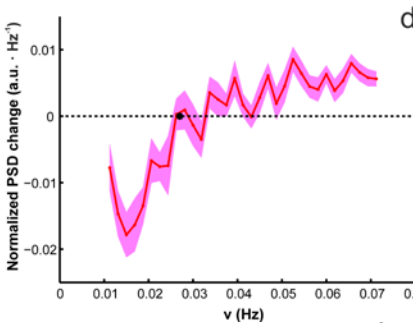
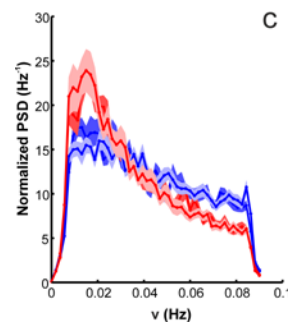
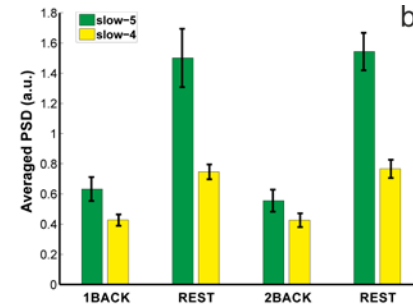
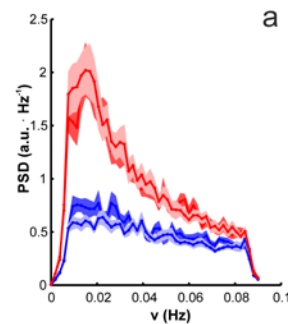
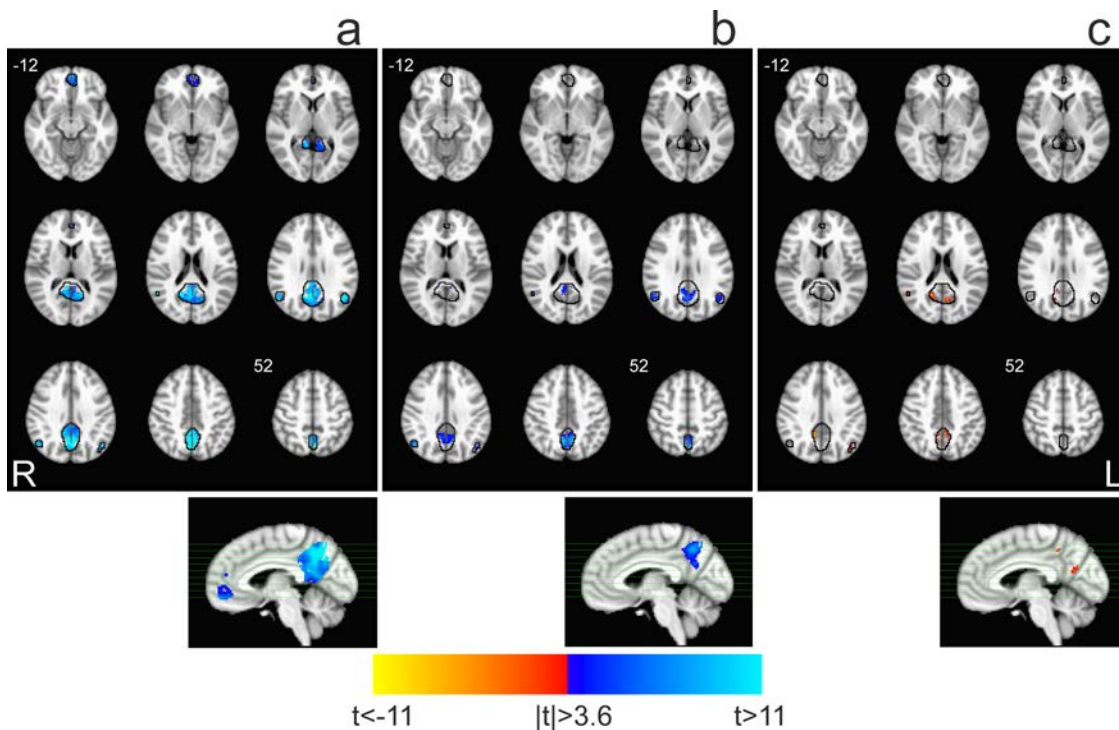
-7.5 HC < AD |t| > 3.5 HC > AD 7.5

In B) disconnected regions belong to the Verbal semantic processing network¹



¹ Binder 2009. Cereb Cortex

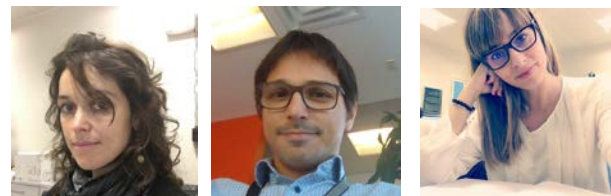
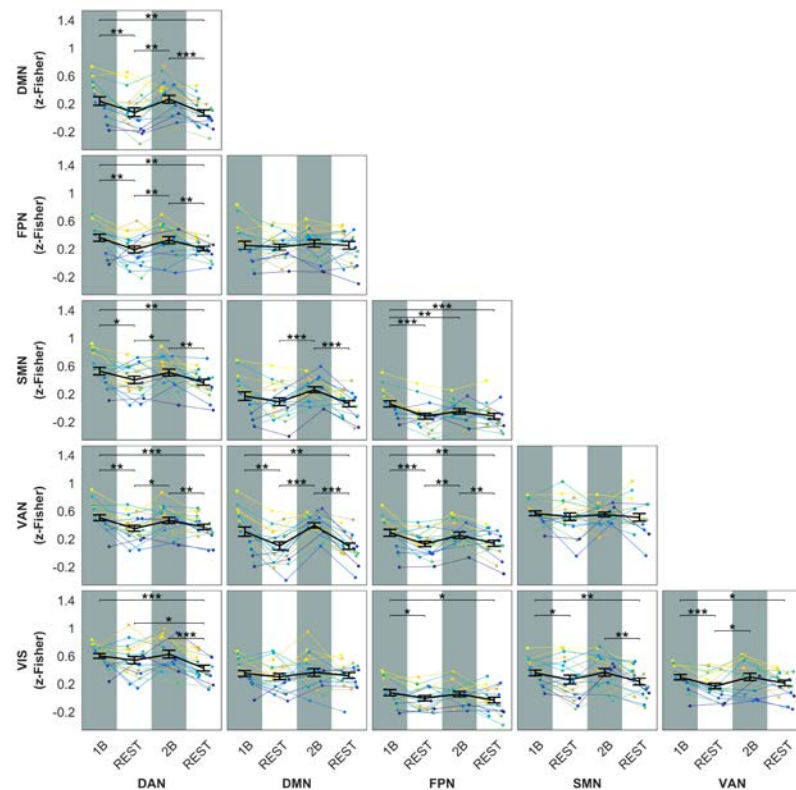
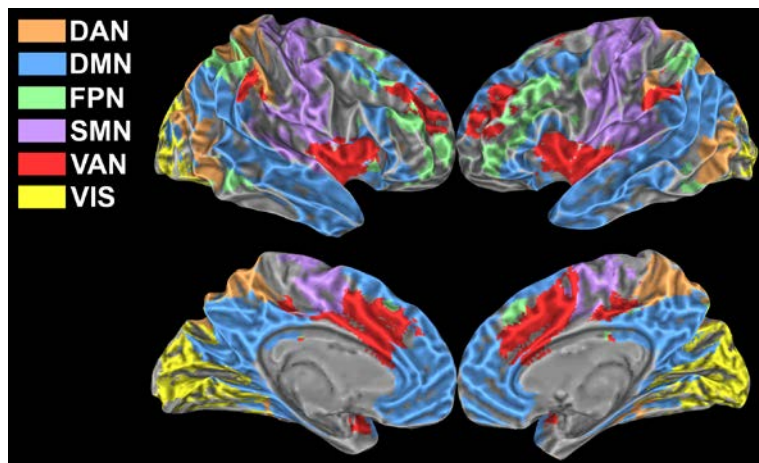
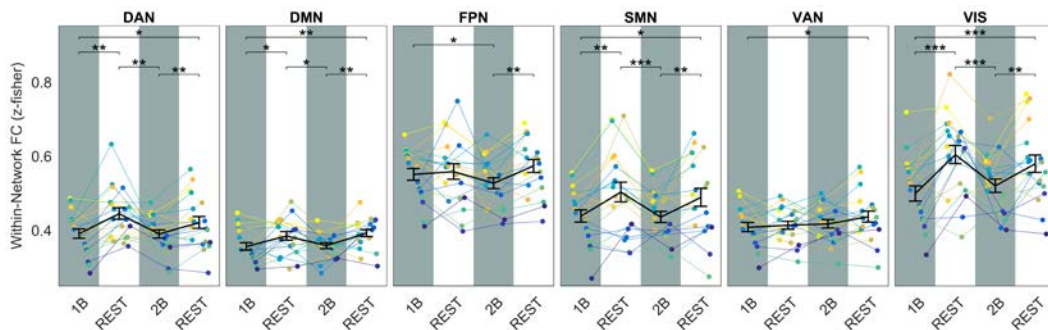
Tomassin et al., Front. Phys., 2017

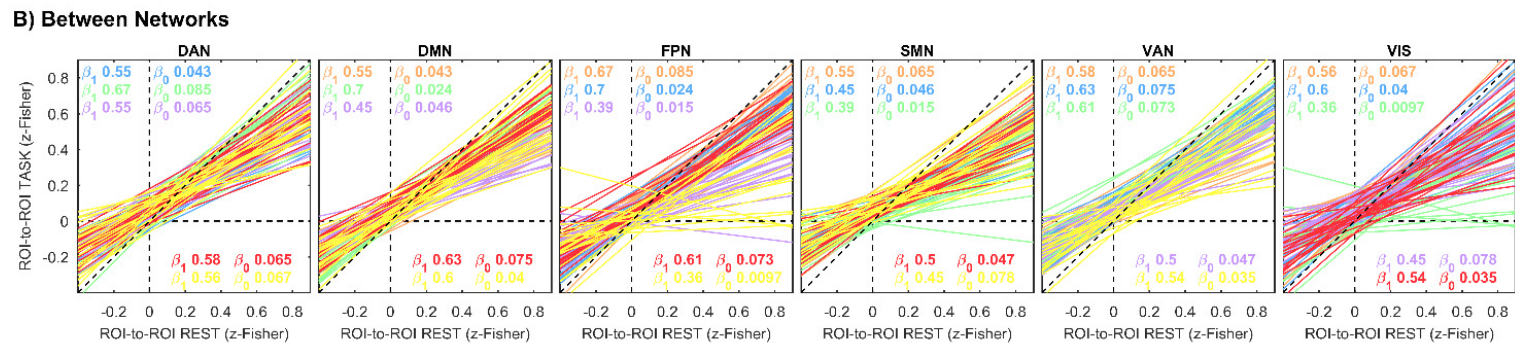
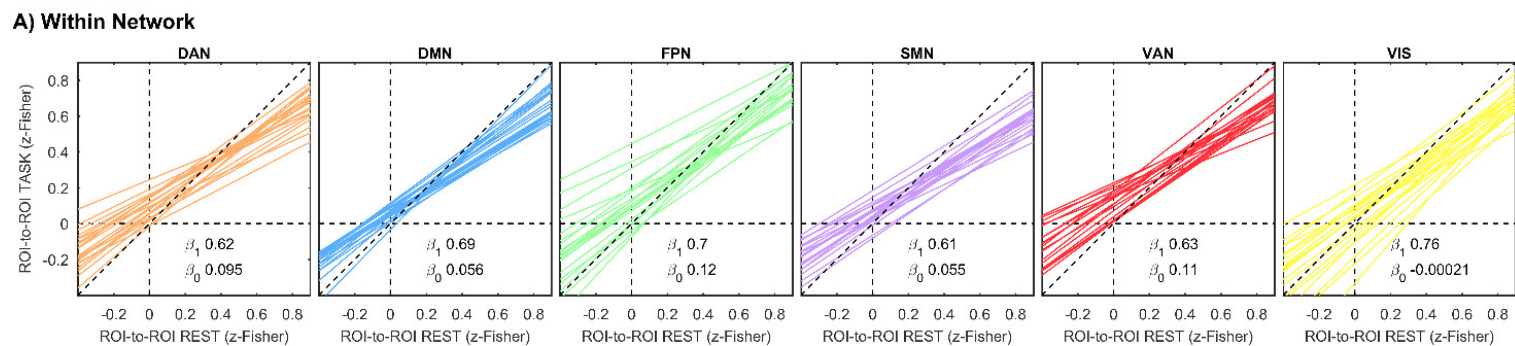
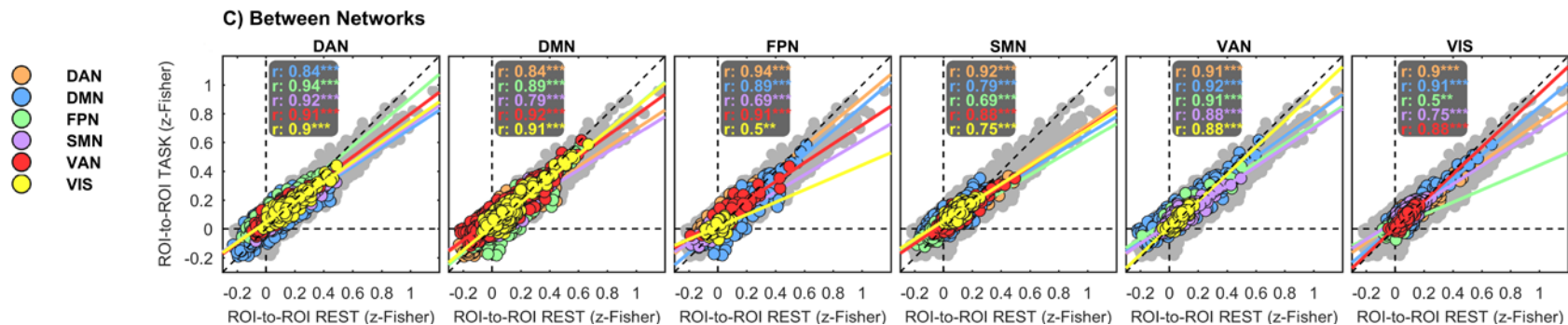
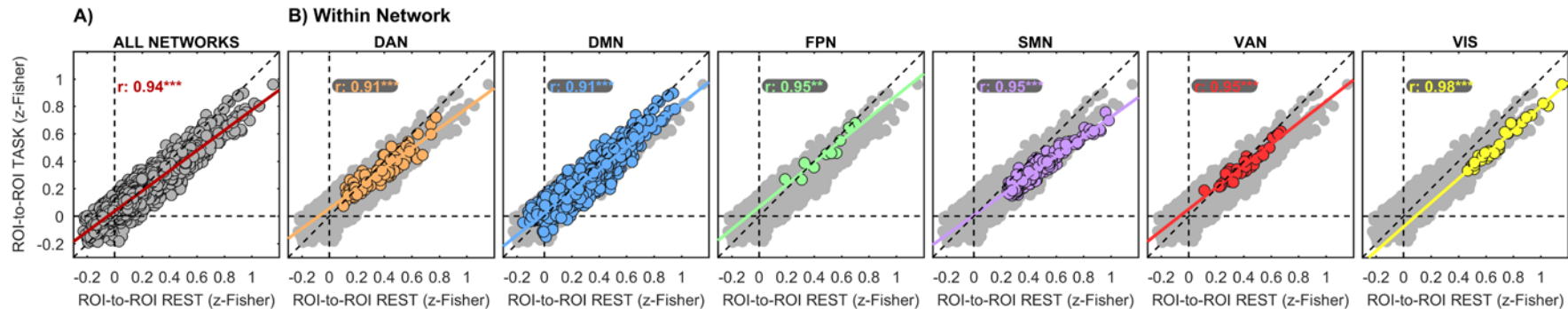


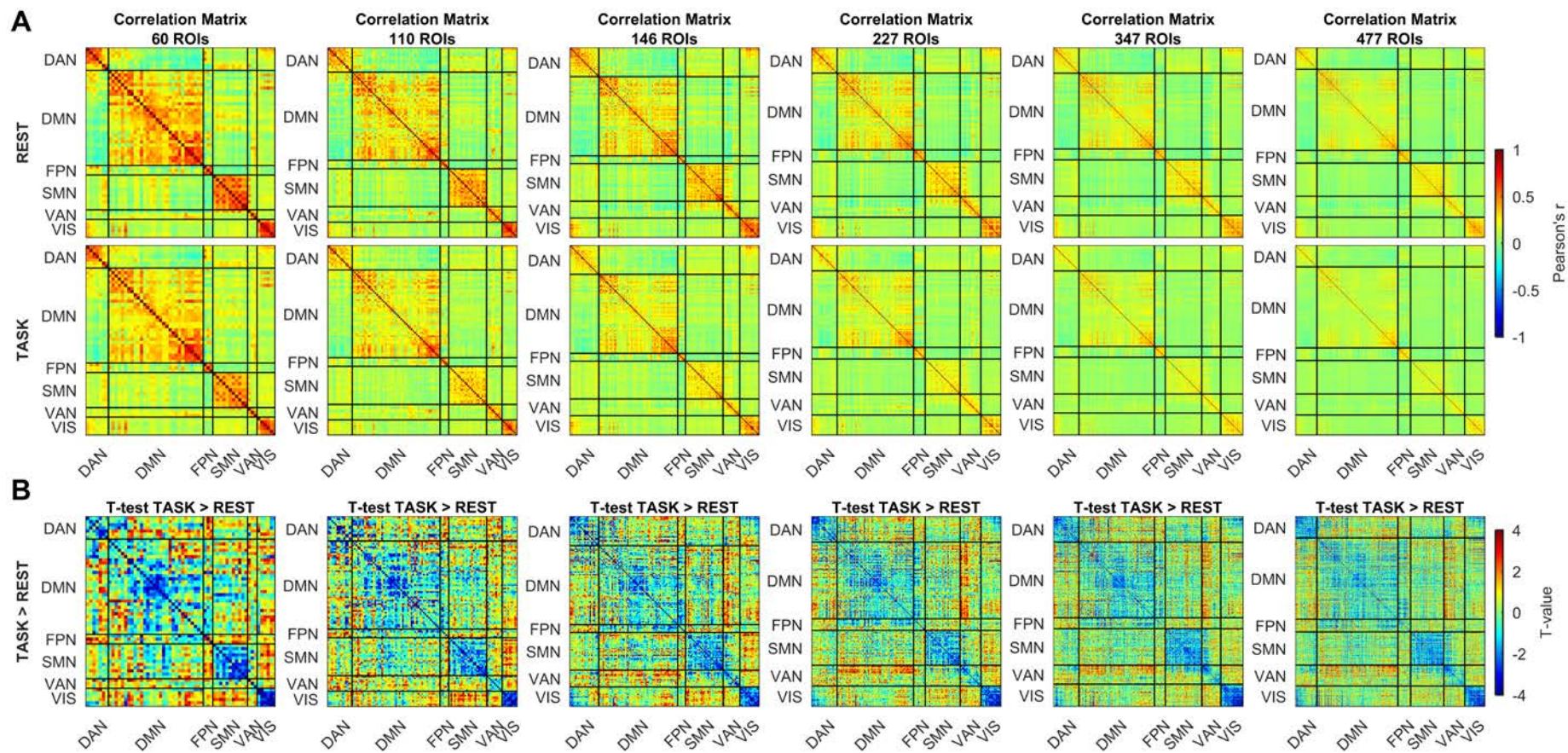
Roma, March 2018 - PTA

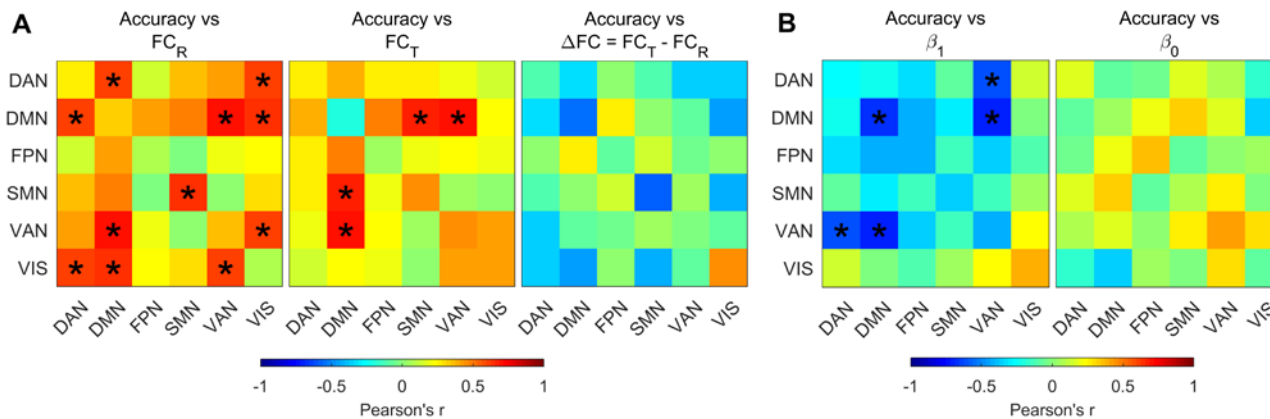
Non-linear and scale invariant rearrangement of RS networks under sustained stimulation.

Tommasin et al., under revision, Neuroimage

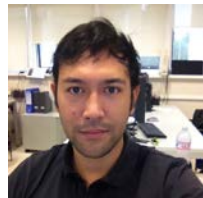
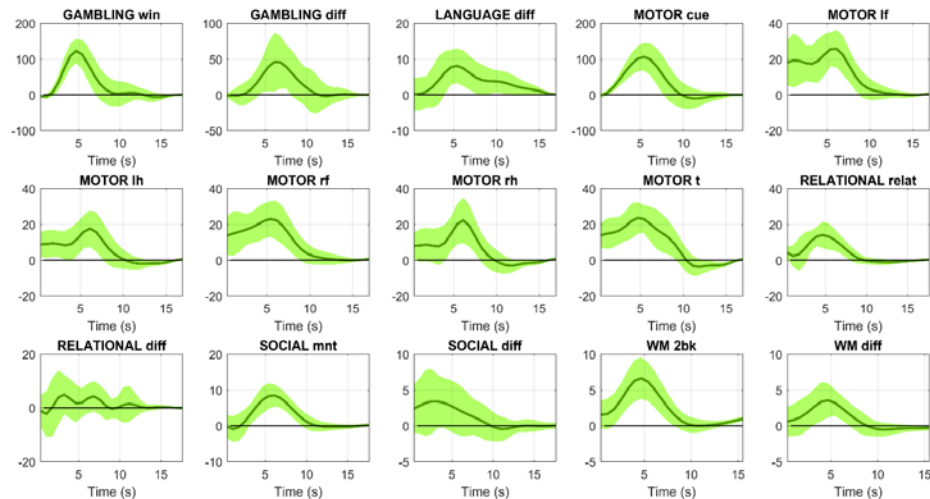
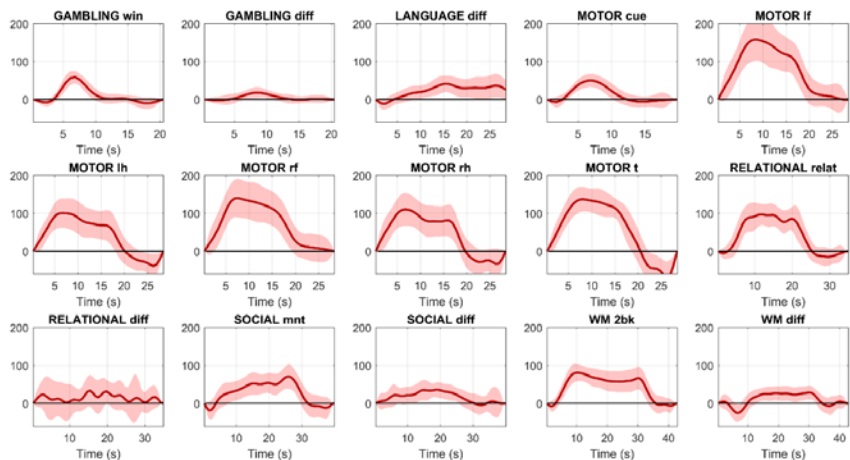




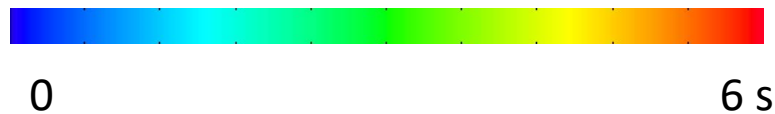
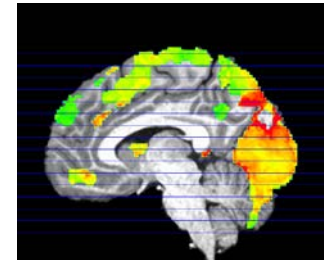
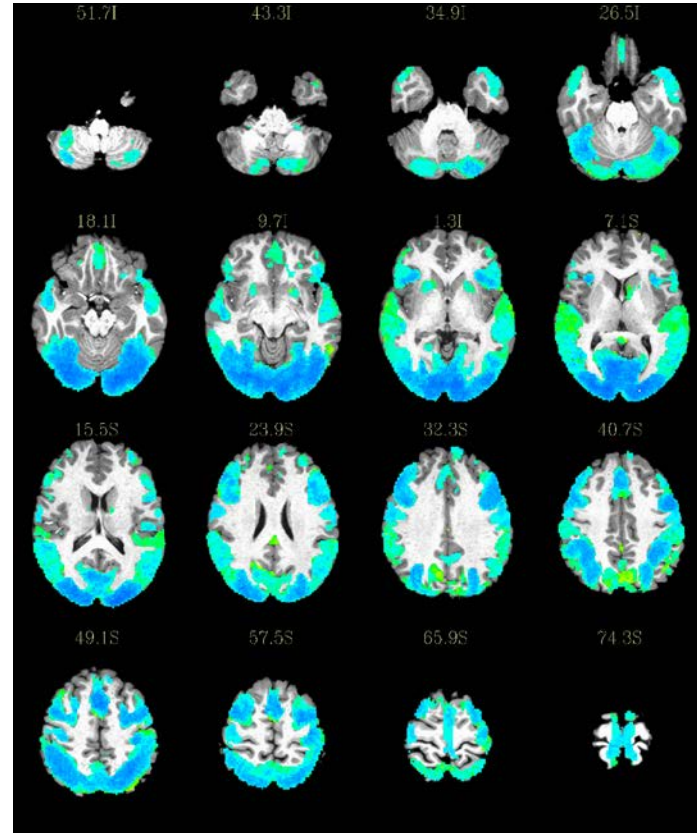
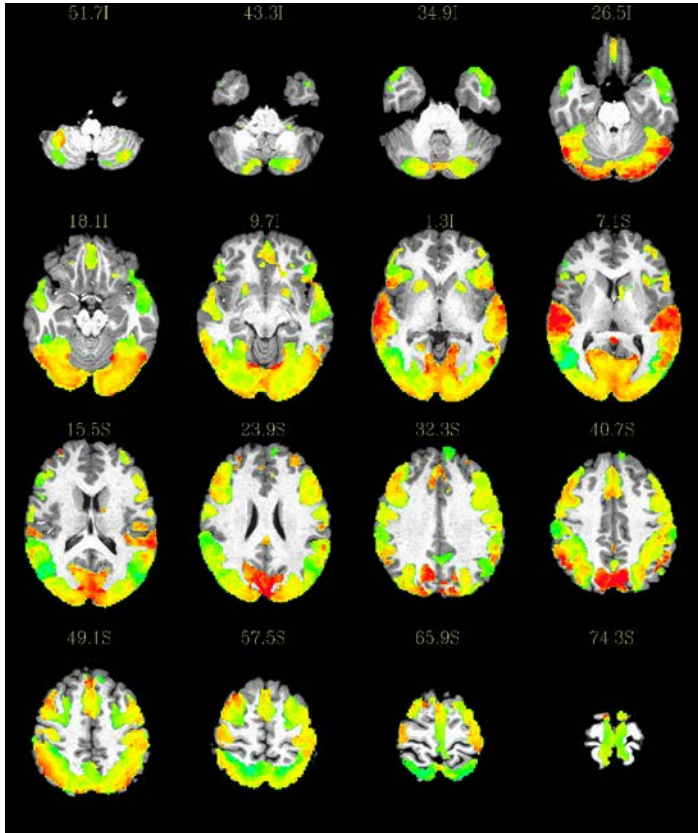




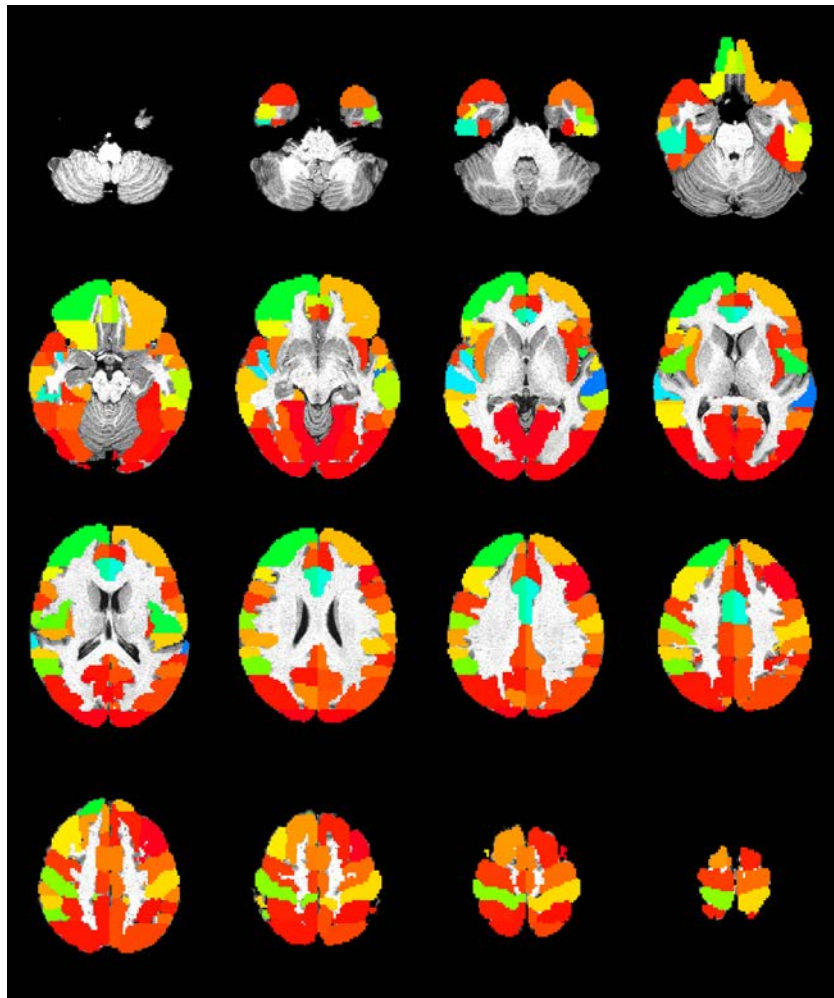
Towards whole Brain mapping of Haemodynamic Response Function



Time to Peak of HRF



Mangini et al. TBD 2018

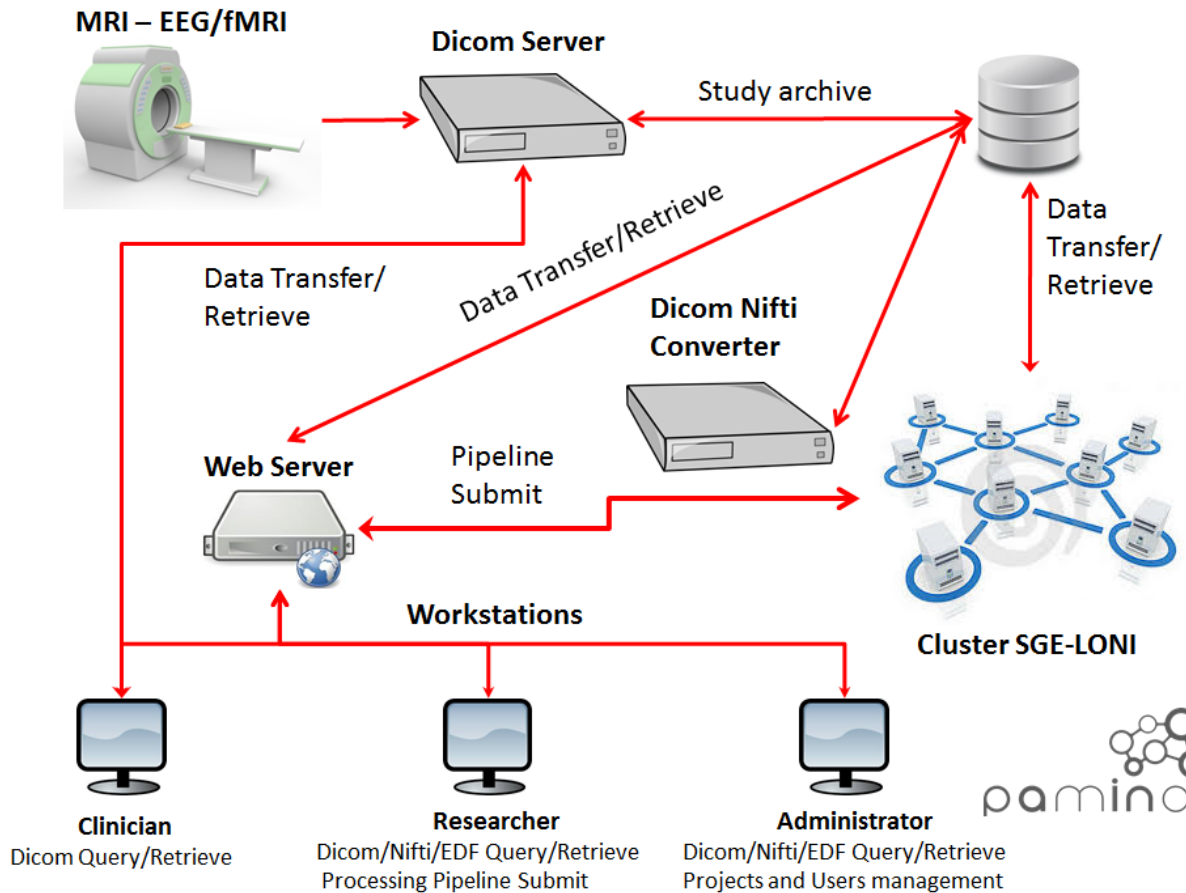


Maps of HRF similarity



0.6

1



Project

PROJECT_CER_LESS

Total subjects 1 M 0 F 1 Total Sessions 1

Subjects

5 (VA11402)

Sessions

20170314_110028.359000_VA11402

OBJECT DETAILS

Subject: 5 (VA11402)

RAWDATA (DICOM-NIFTI) METADATA PROCESSING

Pamina Subject ID 5 Sex [REDACTED]
 Name [REDACTED] Birthdate [REDACTED] Age [REDACTED]
 Dicom IDs (header tag: 0010,0020) VA11402

FILE TYPE	FILE SYSTEM PATH	Task
RAW	Multiple path	[Download]
Nifti	Multiple path	[Download] Add to my downloads

Filters

Opening date 02 / 08 / 0000 Status NO-SET

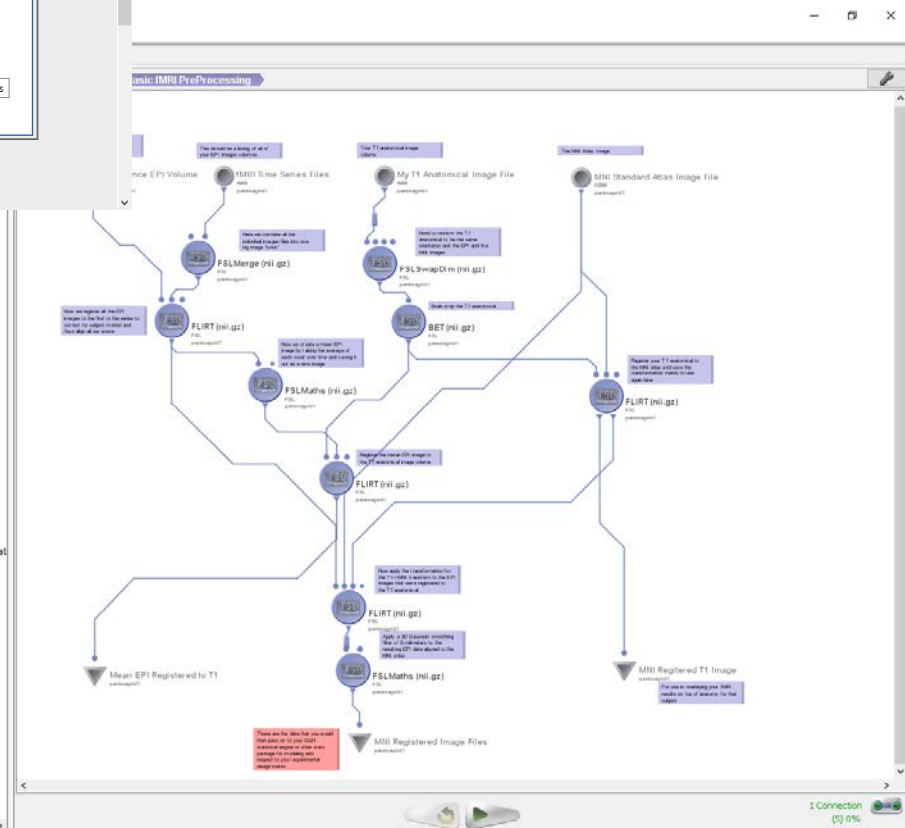
Short title

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Search results

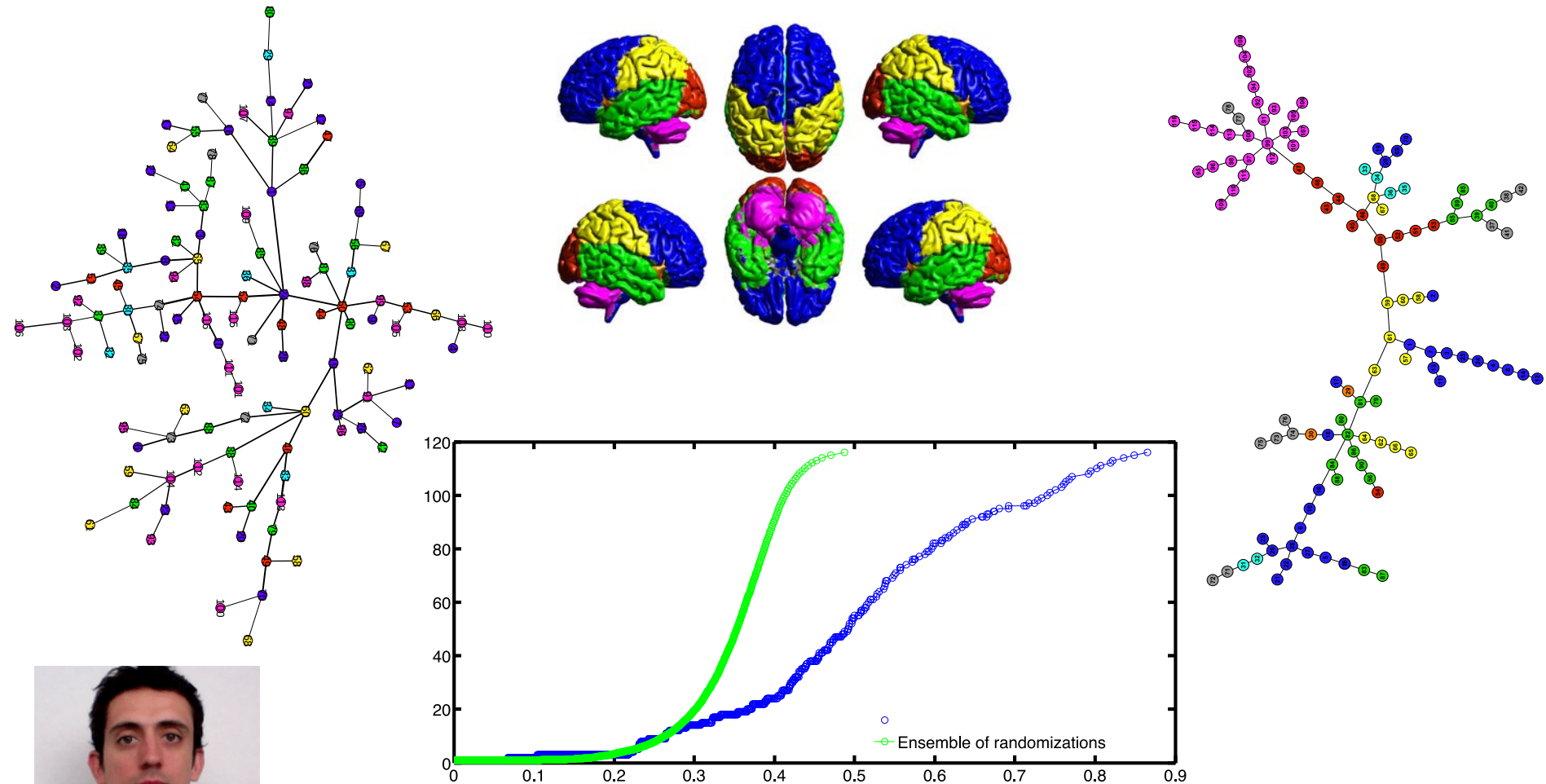
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Project	Presentation Date	Principal Investigator	Status	Task
PROJECT_CER_LESS	14/03/2017	Monica	ToBeAssigned	[Icons]
PROJECT_MTAM2	27/05/2015	Monica	ToBeAssigned	[Icons]
PROJECT_REDIIROMA	16/03/2017	Alessandro	ToBeAssigned	[Icons] Modify
PROJECT_TMS	11/10/2013	Raul	ToBeAssigned	[Icons]
PROJECT_TOPOIMAGE	16/03/2017	Giulia	ToBeAssigned	[Icons]
PROJECT_VALMUT	29/05/2015	Sauzer	ToBeAssigned	[Icons]



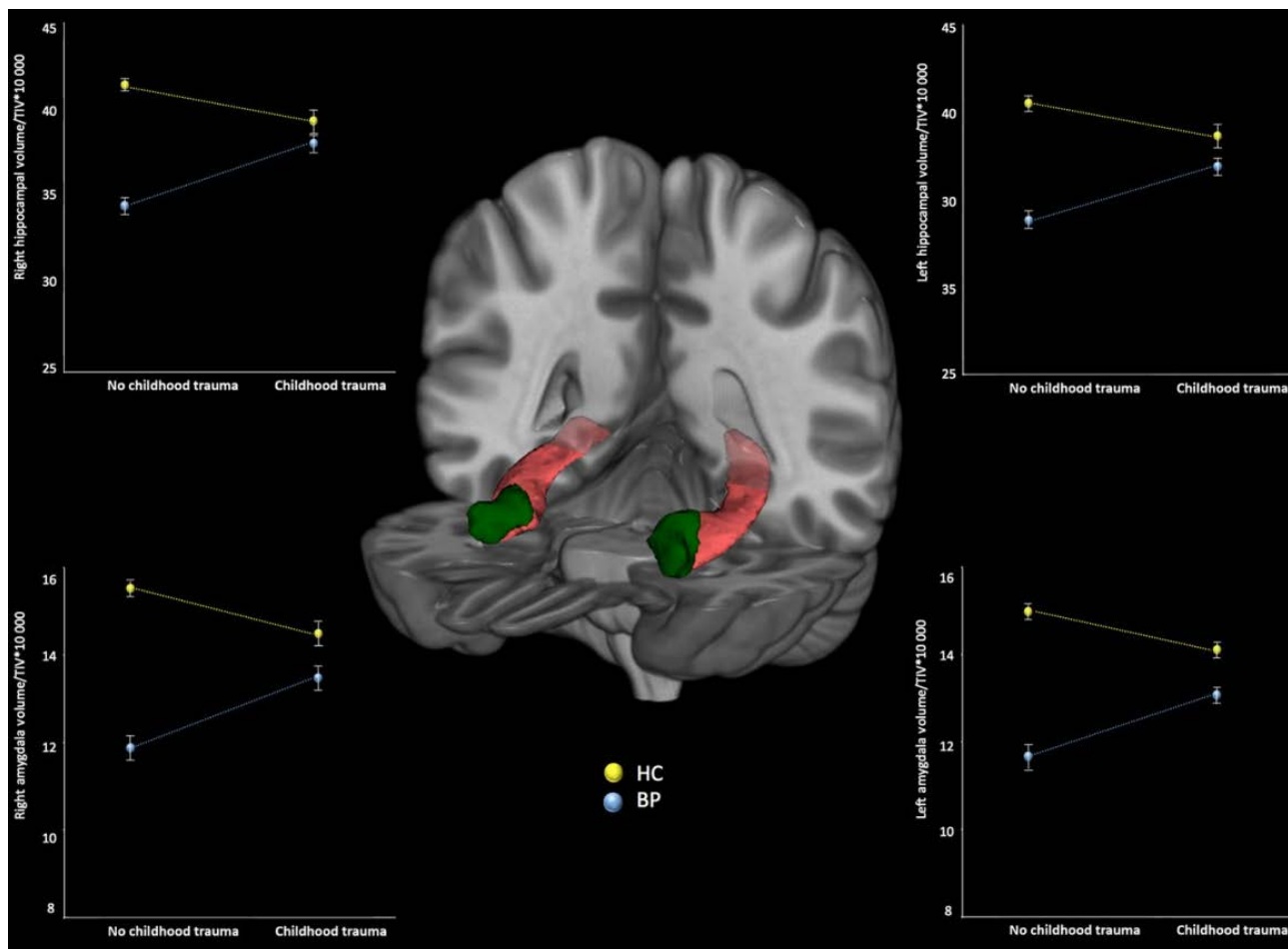
TOPOLOGICAL ORGANIZATION OF THE RESTING BRAIN

Mastrandrea R et al, Sci Rep, 2017



Amygdala and hippocampus volumes are differently affected by childhood trauma

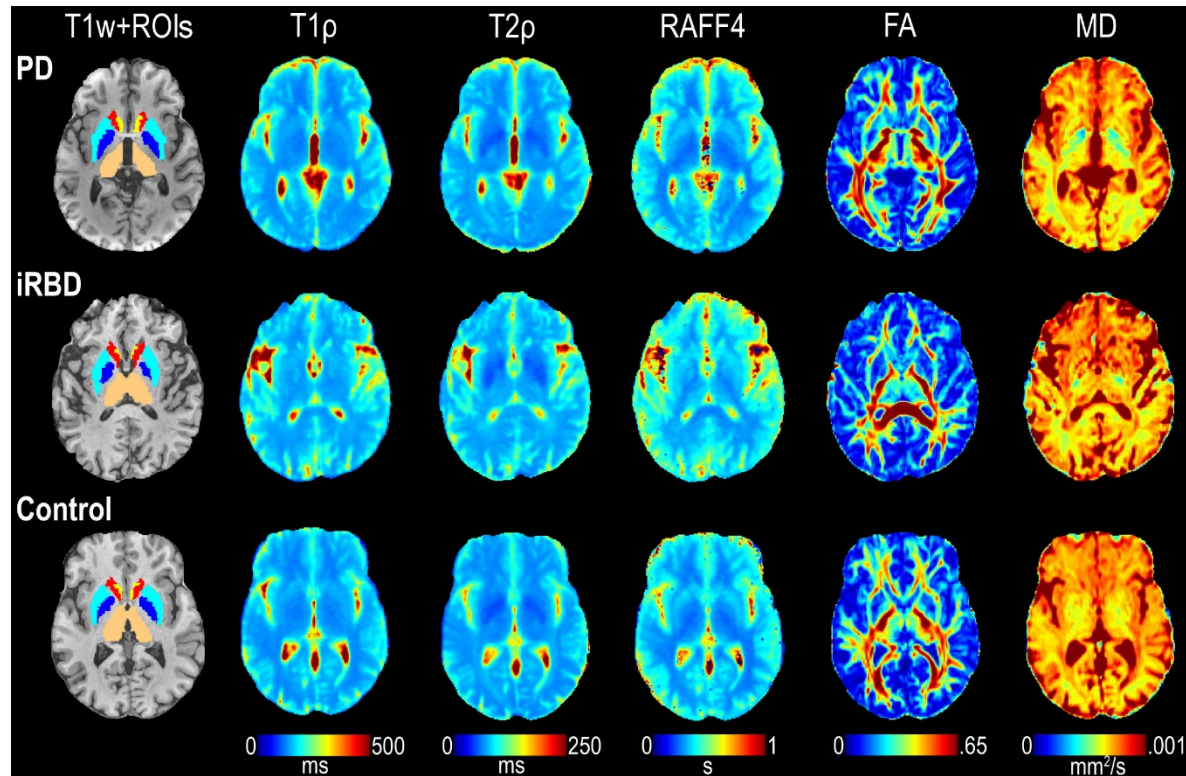
Janiri et al. Bipolar Disord, 2017

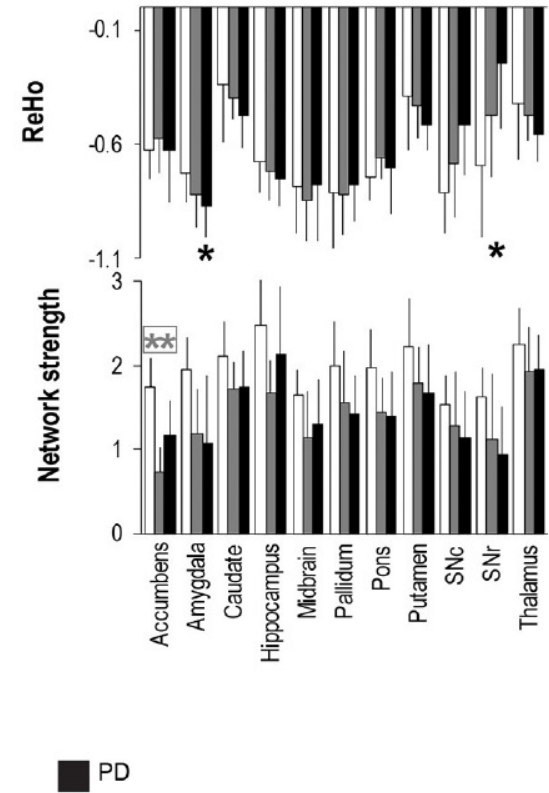
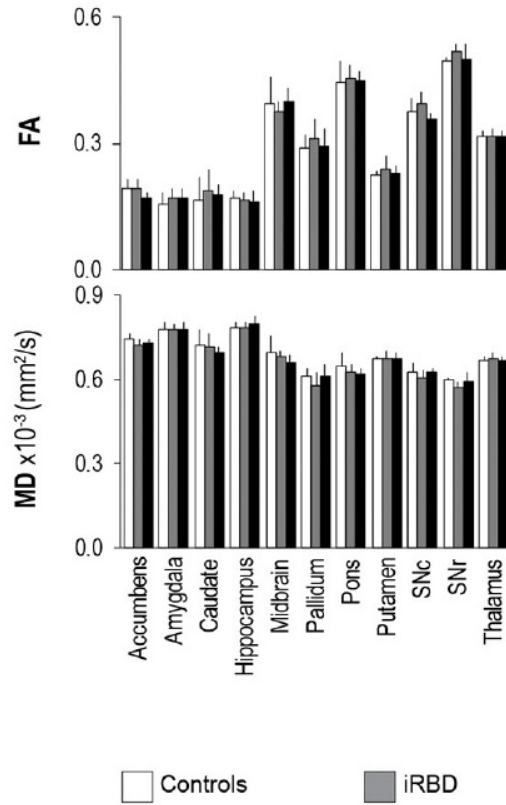
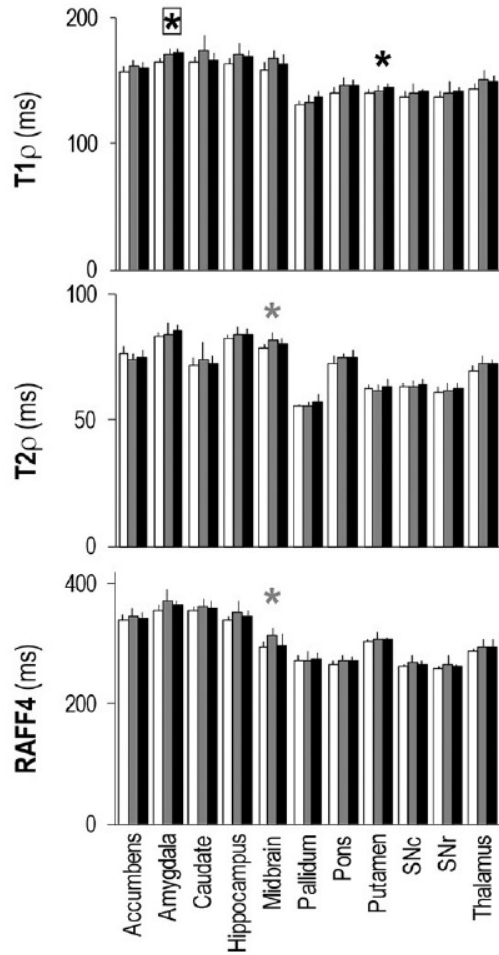


MICROBRADAM

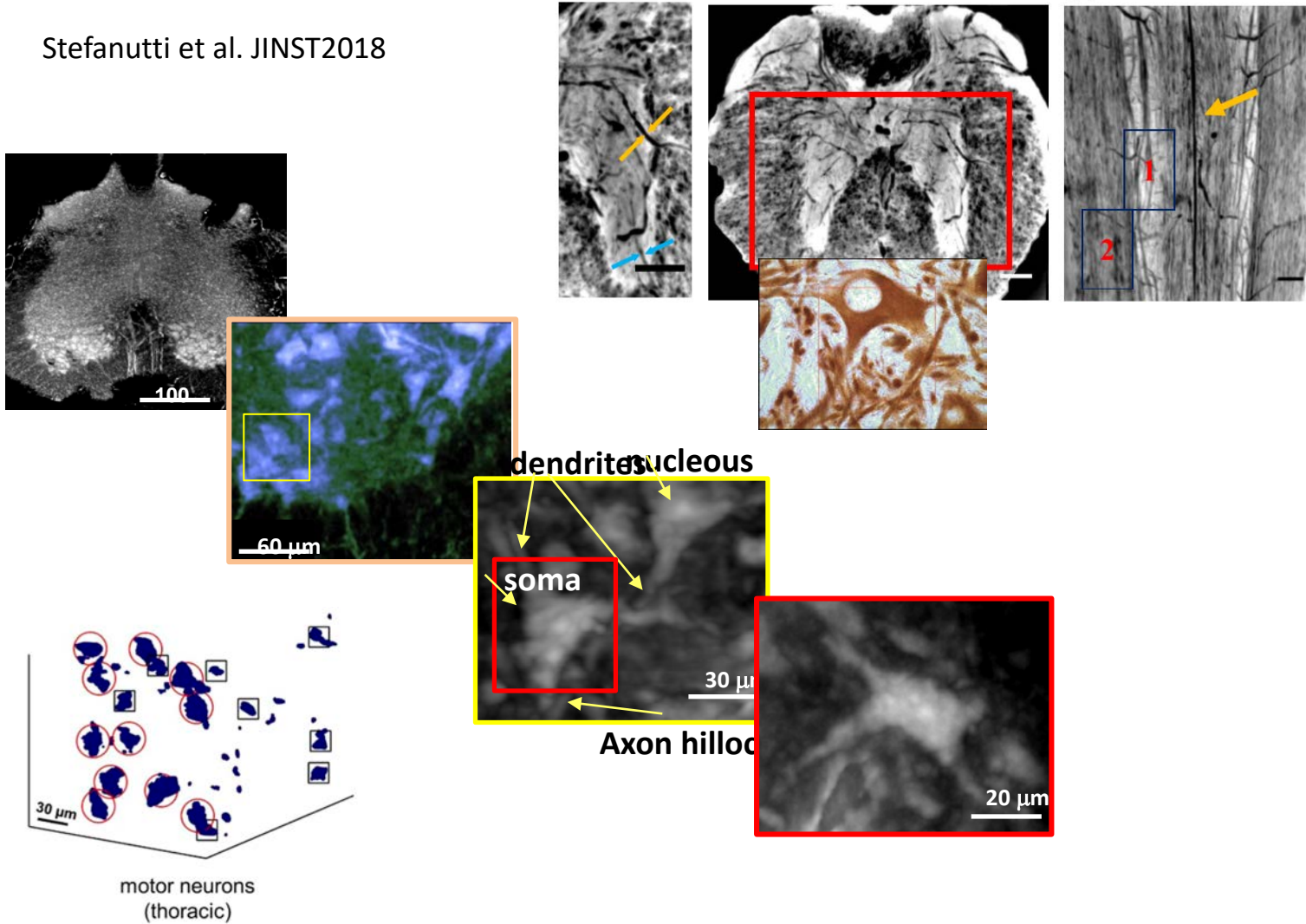
Multi-modal Brain MRI in Subjects with PD and iRBD

Mangia S. et al. Front. Neuroscience 2017





Stefanutti et al. JINST2018

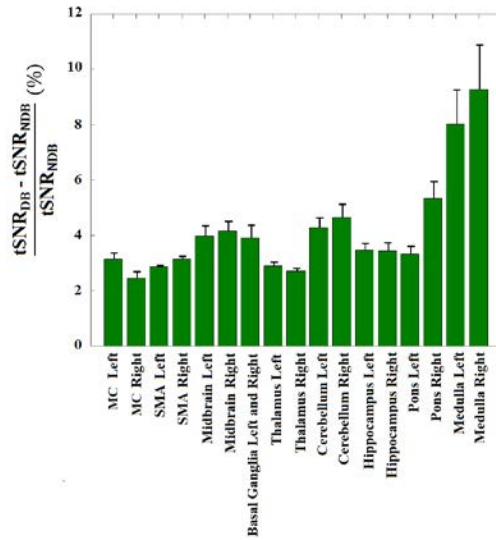
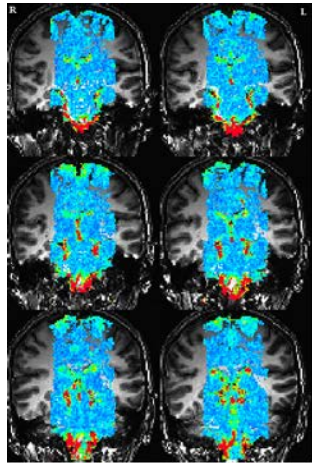


I. Buckreeva et al. Scientific Reports 2017 | DOI: 10.1038/srep4105

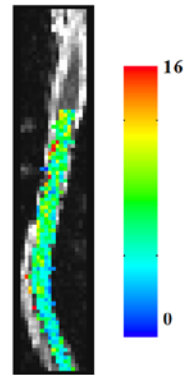
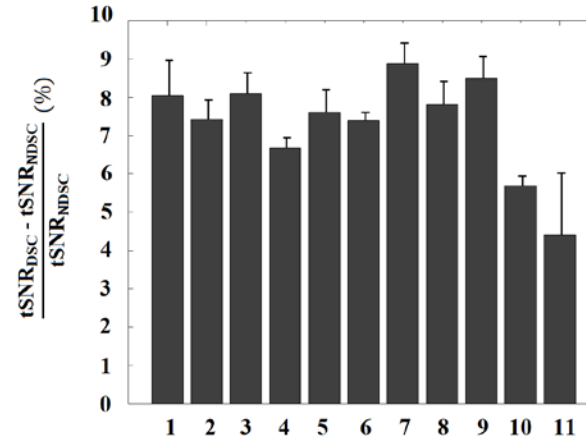
Roma, March 2018 - PTA

Assessing denoising strategies for fMRI in spinal cord and Brainstem

Maugeri et al., JINST, 2018



A



A

B



Roma, March 2018 - PTA

• **Milestones 2018**

– PAMINA:

- Release of the platform, project end

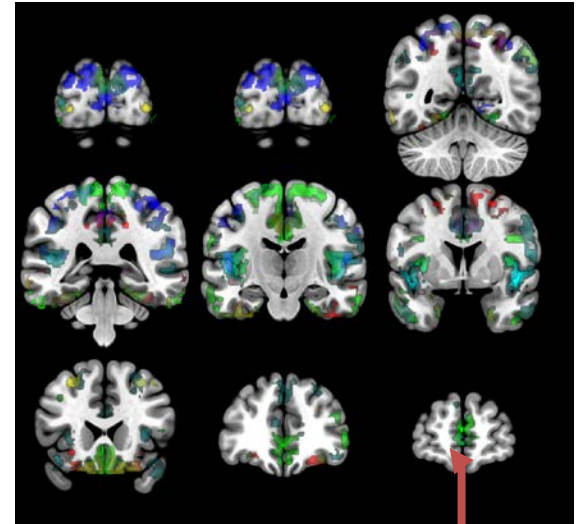
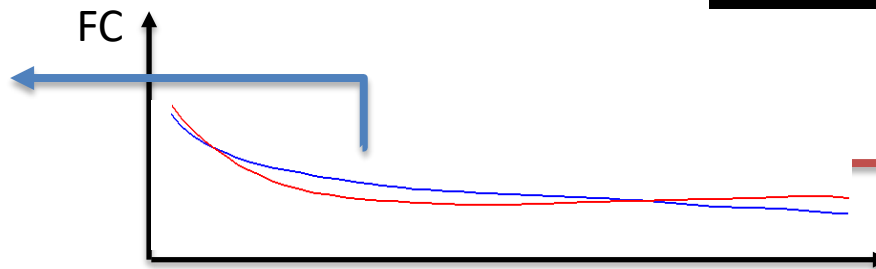
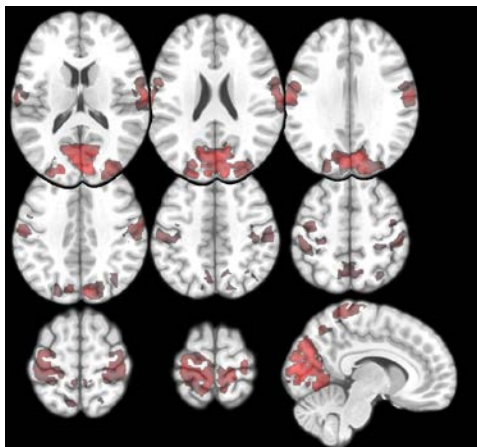
– MICROBRADAM/TMENS:

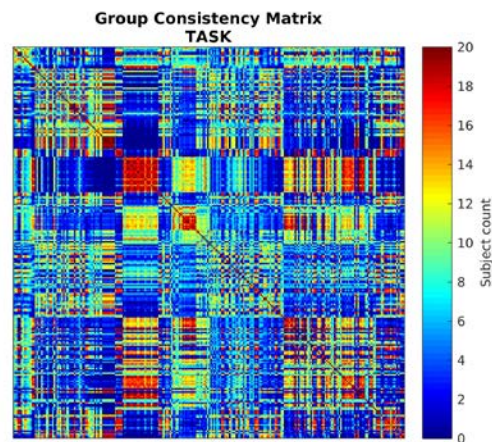
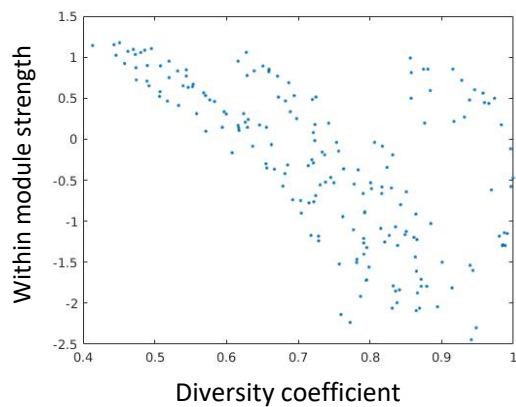
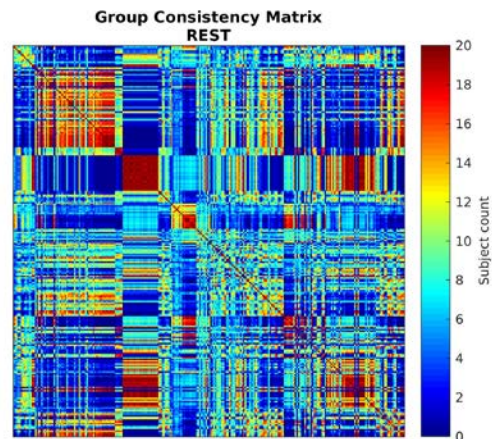
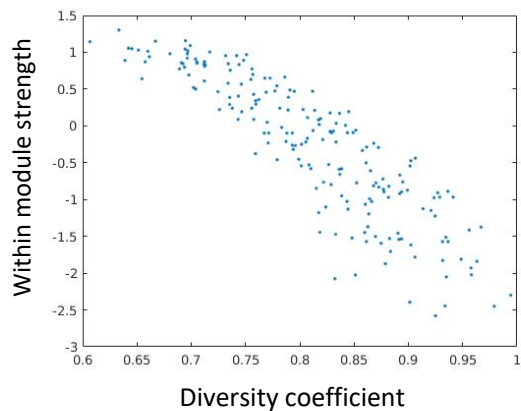
- End of the study on effect of physiological noise/motion on connectivity
- Release multimodal analysis on rodents brain
- Biophysical model of BOLD signal in the spinal cord, characterization of hrf in human spinal cord
- Characterization of advantages of multieco EPI
- Study on metabolic effects of dissociation between spiking and synaptic activity in the human brain

Plan of activities 2018 – 2020

- **Objective:** to develop functional MRI approaches for the study of human brain function:
 - Exploit higher spatial and temporal resolution ...to assess variance of hrf response
 - Increased fMRI sensitivity (single subjecty, pathology...)
 - ... to better understand the network properties of brain function
 - New diagnostic tool? Implications for pathology assessment, prediction power (evolution from MCI to AD)
 - ... to explore brain energetics in presence of neuromodulation
 - Assessing the neurometabolic coupling (future applications to epilepsy)
- **Objective:** to develop the functional imaging of the human spinal cord
 - Realistic biophysical modeling based on high resolution X ray phase contrast tomography
 - Application to patients
 - Assessment of functional damage, effect of therapy...
- **Objective:** to establish the ability of several innovative techniques (RAFFn, T1 ρ and T2 ρ , functional connectivity) to assess structural and functional changes related to myelin content
 - Continue exchange with CMRR, UEF

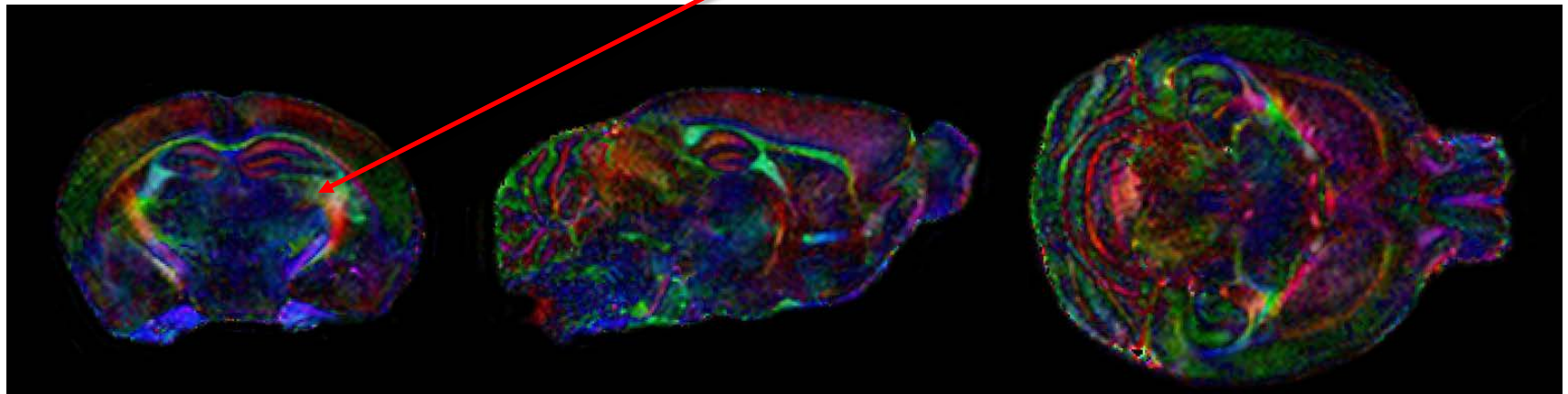
Metric of network connectivity based on Euclidean distance



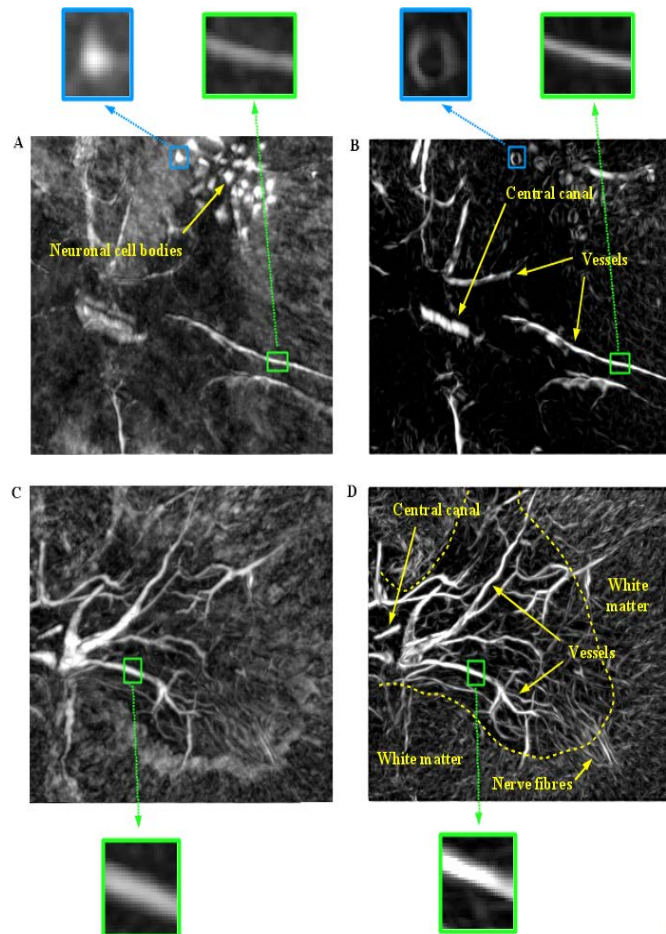


Dynamics of human brain networks: topological reorganization

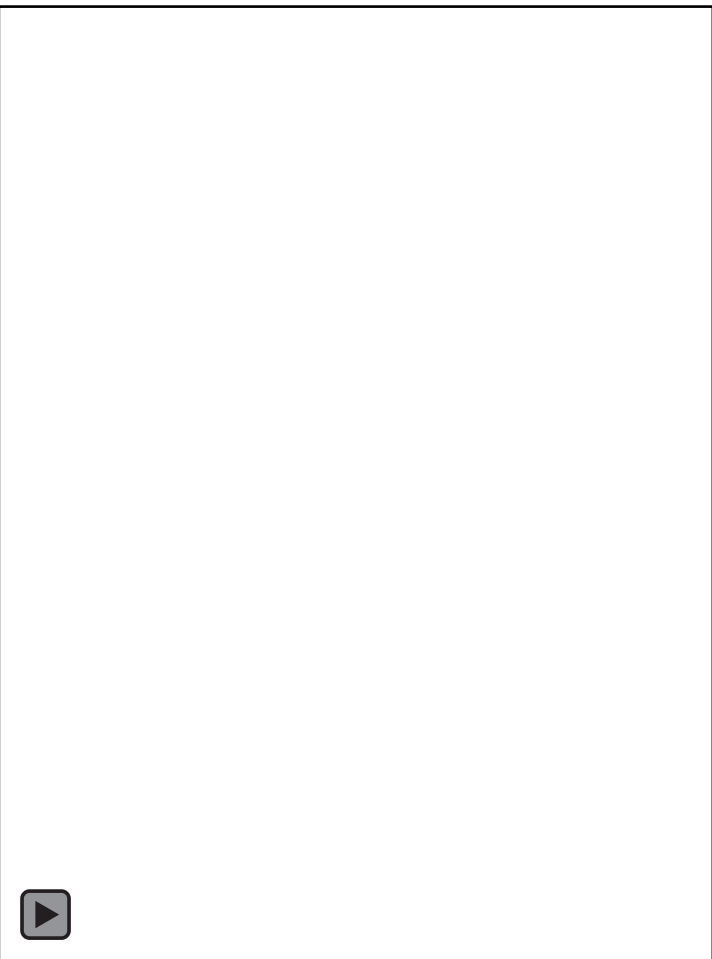
Courtesy O Grohn, M Fratini for the MICROBRADAM project, A Cedola I Bukreeva CNR Nanotech/Tomalab



Segmented spin-echo EPI, 125 μm isotropic resolution, TE=32 ms, TR=1 s, b-value=3000 s/mm^2 , 42 directions



Michela Fratini coll. CNR Nanotech/Tomalab: A. Cedola, I Bukreeva et al



- **Expected funding in the 3-year period:**
- **Request of funding by Centro Fermi**
 - *Grants : complement the external grants, in order to have always at least **3 researchers involved** (one senior, 2 postdocs)*
 - *Cofunding (about 50%) for 36-48 months MICROBRADAM postdoc to be sent to CMRR (USA, N=12 months) and UEF (Finland, 11 months).*
 - *Cofunding for other grants if awarded and if needed*
 - *Consumables/inventory per year: about 15 k€+ contribution (studentships for young scientists) for the biennial Erice Workshop (next date: 22-29 April 2018, <http://ismrbf.marbilab.eu>)*
- **External funding, current**
 - *PAMINA (PI Federico Giove), ends 2018. k€ 862*
 - *H2020 691110 MICROBRADAM (PI Federico Giove), ends 2019. k€ 175*
 - *MDS GR-2013-02358177 (PI Michela Fratini), ends 2019. k€ 382 (@Santa Lucia Foundation)*
 - *From industry (EMS), una tantum, k€ 4.5*
 - *From Fondazione Santa Lucia and CMRR, in kinds: k€/yr about 50*
- **Potential external funding**
 - *Regione Lazio Research groups grant (APPREND, applied for), 250 k€*
 - *ASI Biomedicine in Space 2017 (applied for) 25 k€*
 - *PRIN 2017 (In Preparation), 200 k€*
 - *Other h2020 (Health, MSCA)*



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