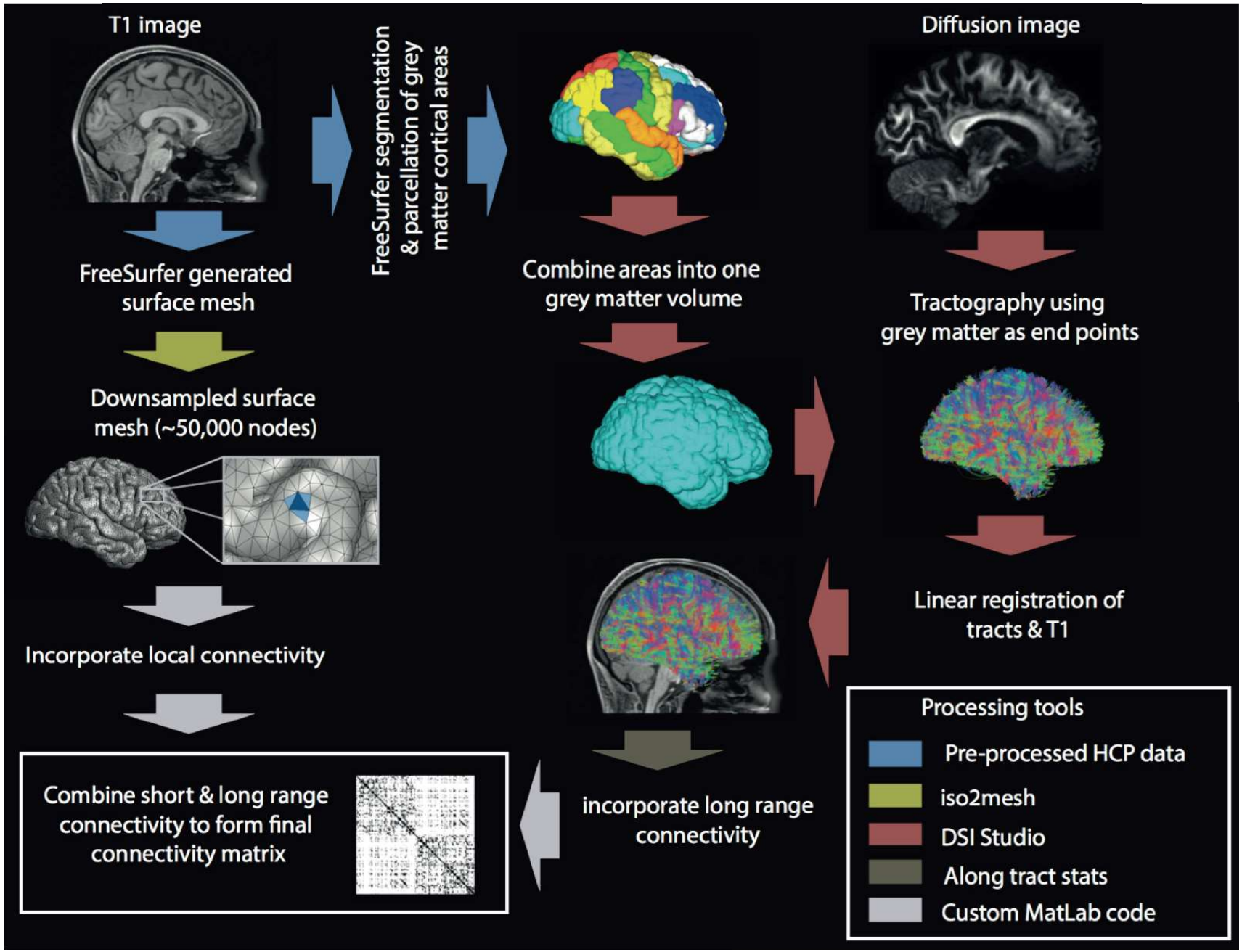
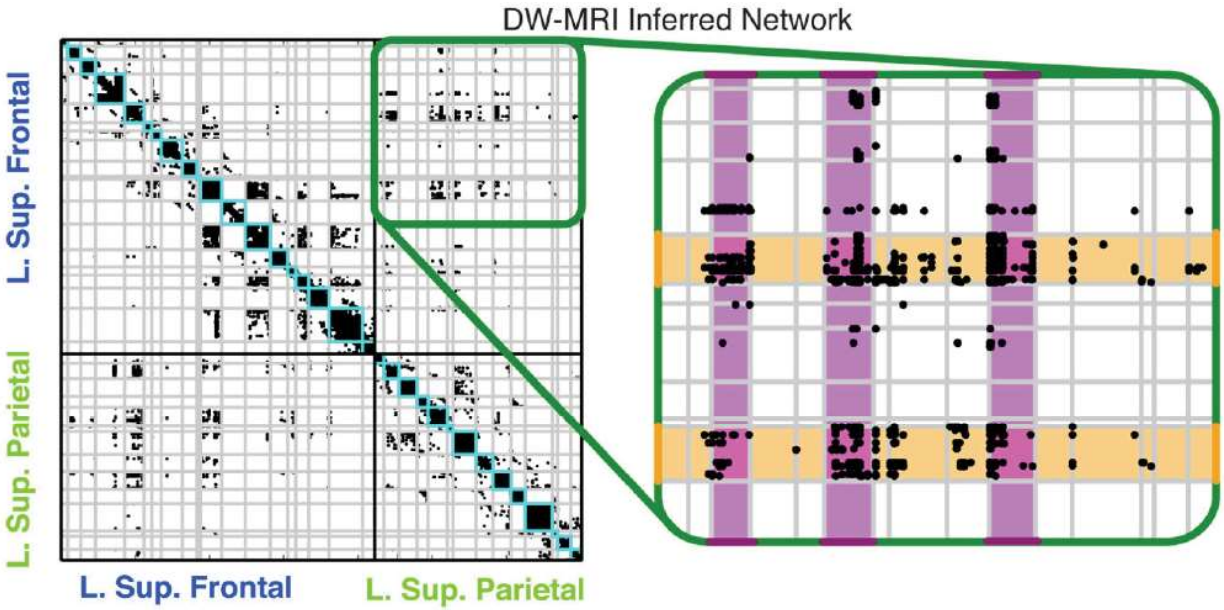
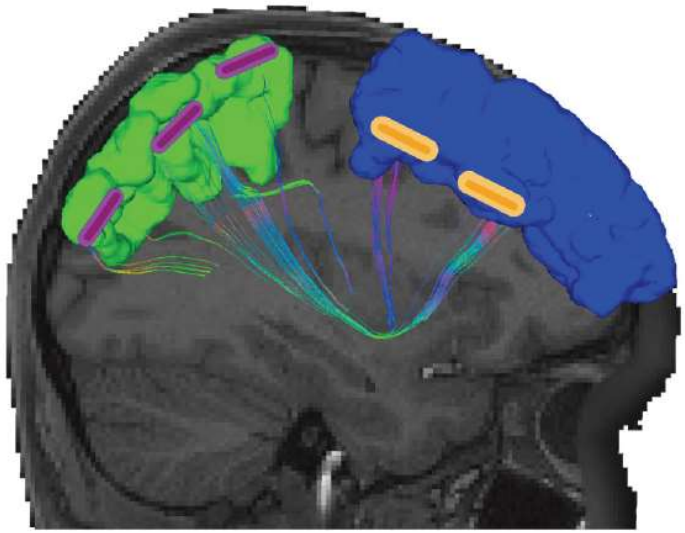
Super-resolution DTI: 50,000 nodes



Taylor et al., *Scientific Reports*, 2017

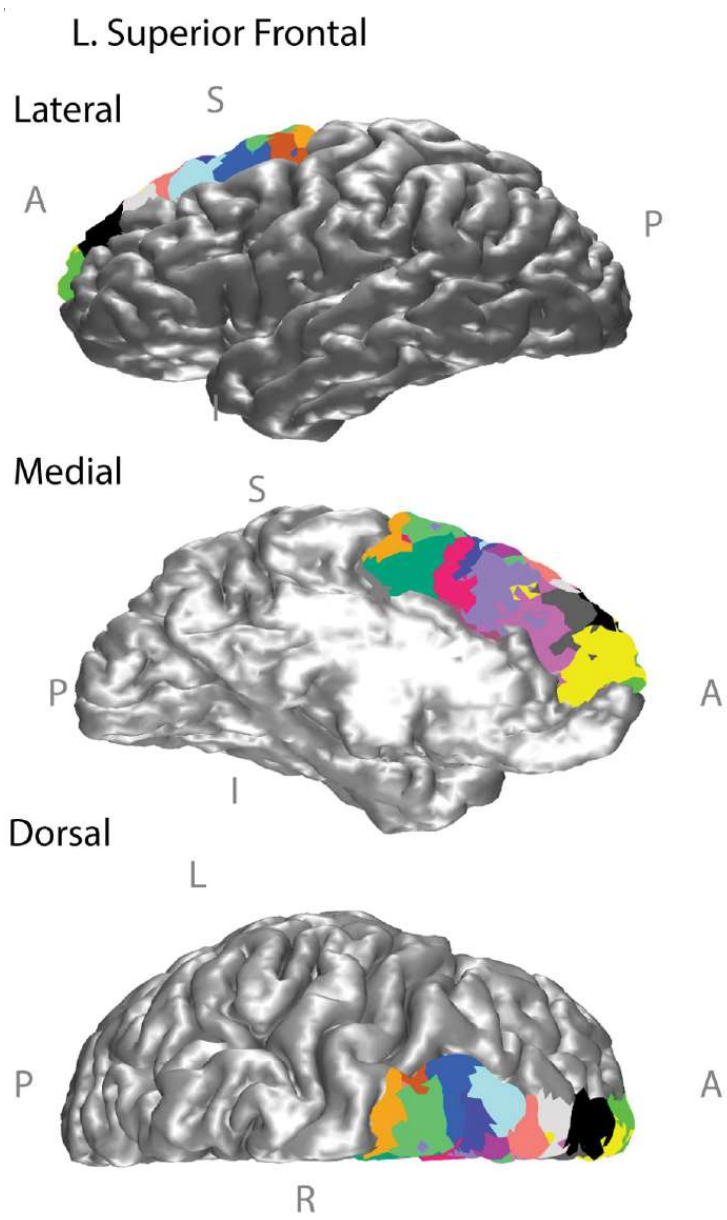
Super-resolution DTI: modules within brain regions

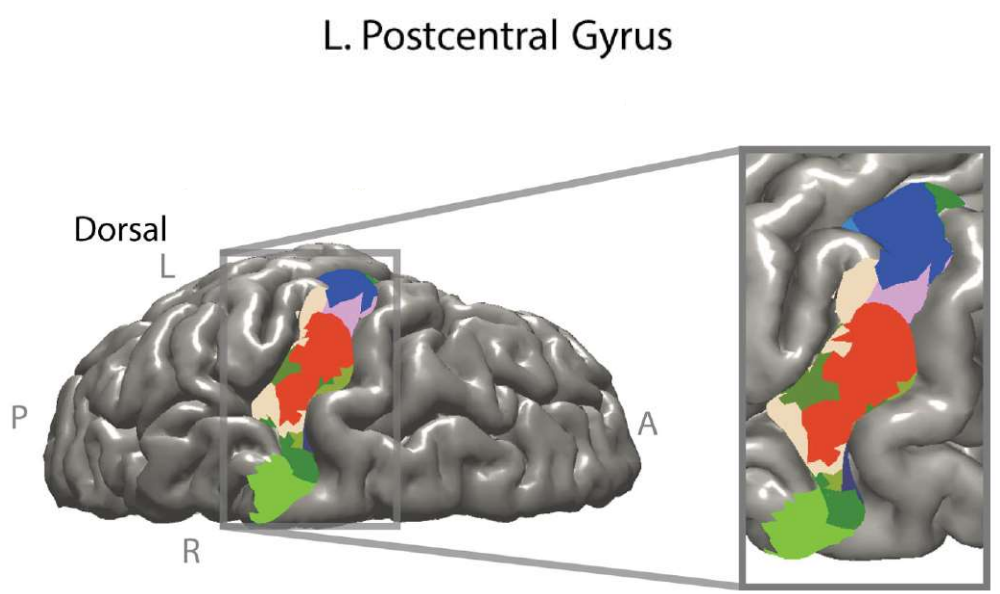


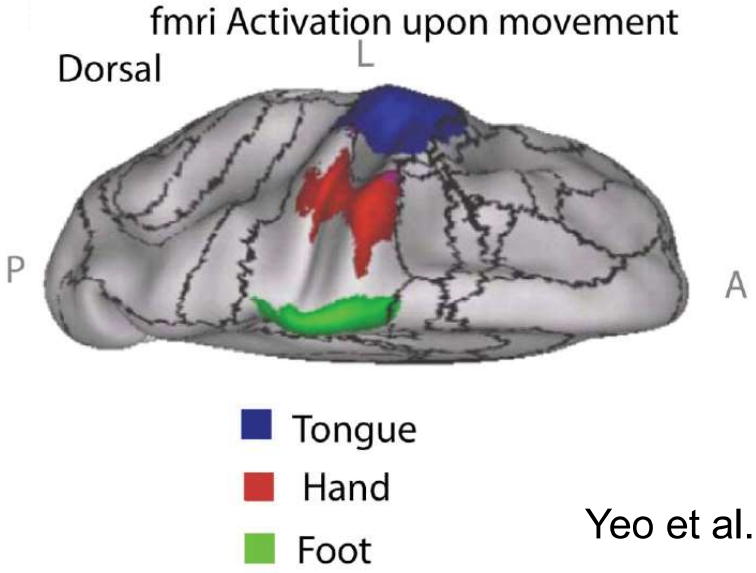


Taylor et al., *Scientific Reports*, 2017

Super-resolution DTI: spatial (and functional?) modules



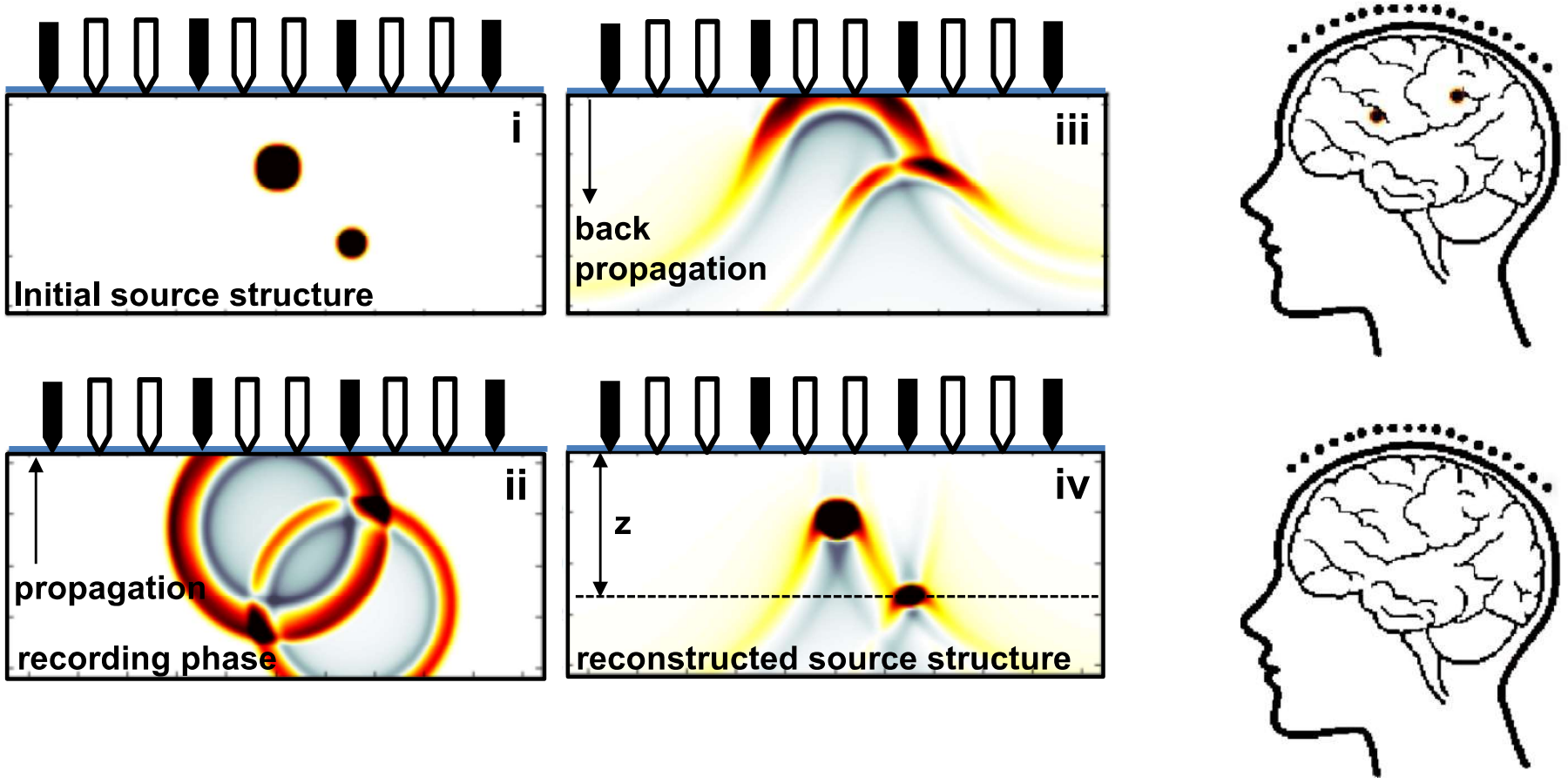




Yeo et al., *J. Neurophysiol.* 2011

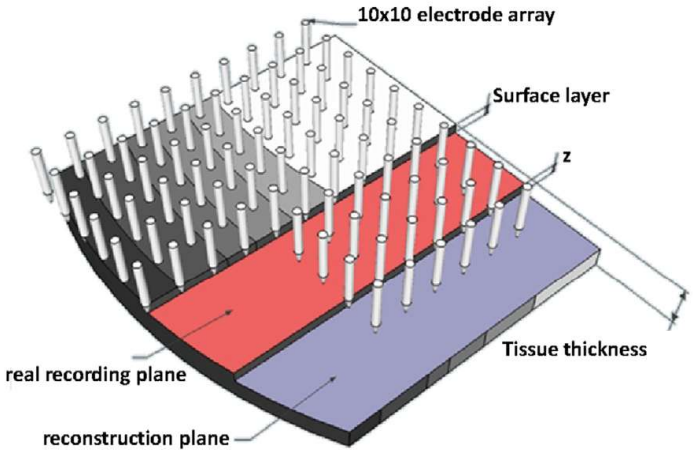
Taylor et al., *Scientific Reports*, 2017

Super-resolution imaging: near-field holography

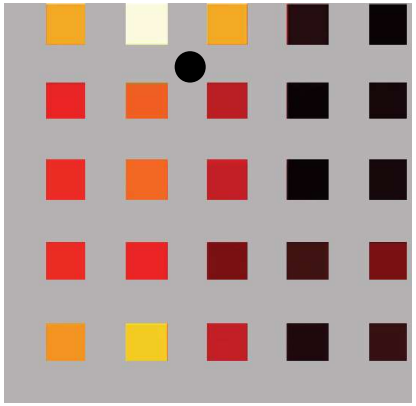


Kjeldsen, Kaiser, Whittington. *Journal of Neuroscience Methods,* 2015

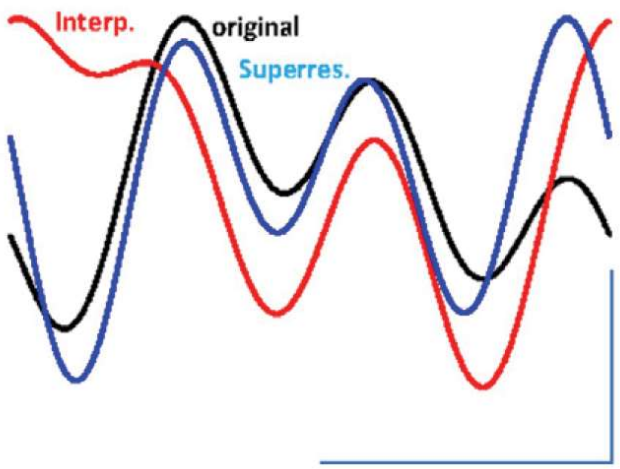
Super-resolution MEA: measuring delta rhythm activity



Signal reconstruction away from the recording plane



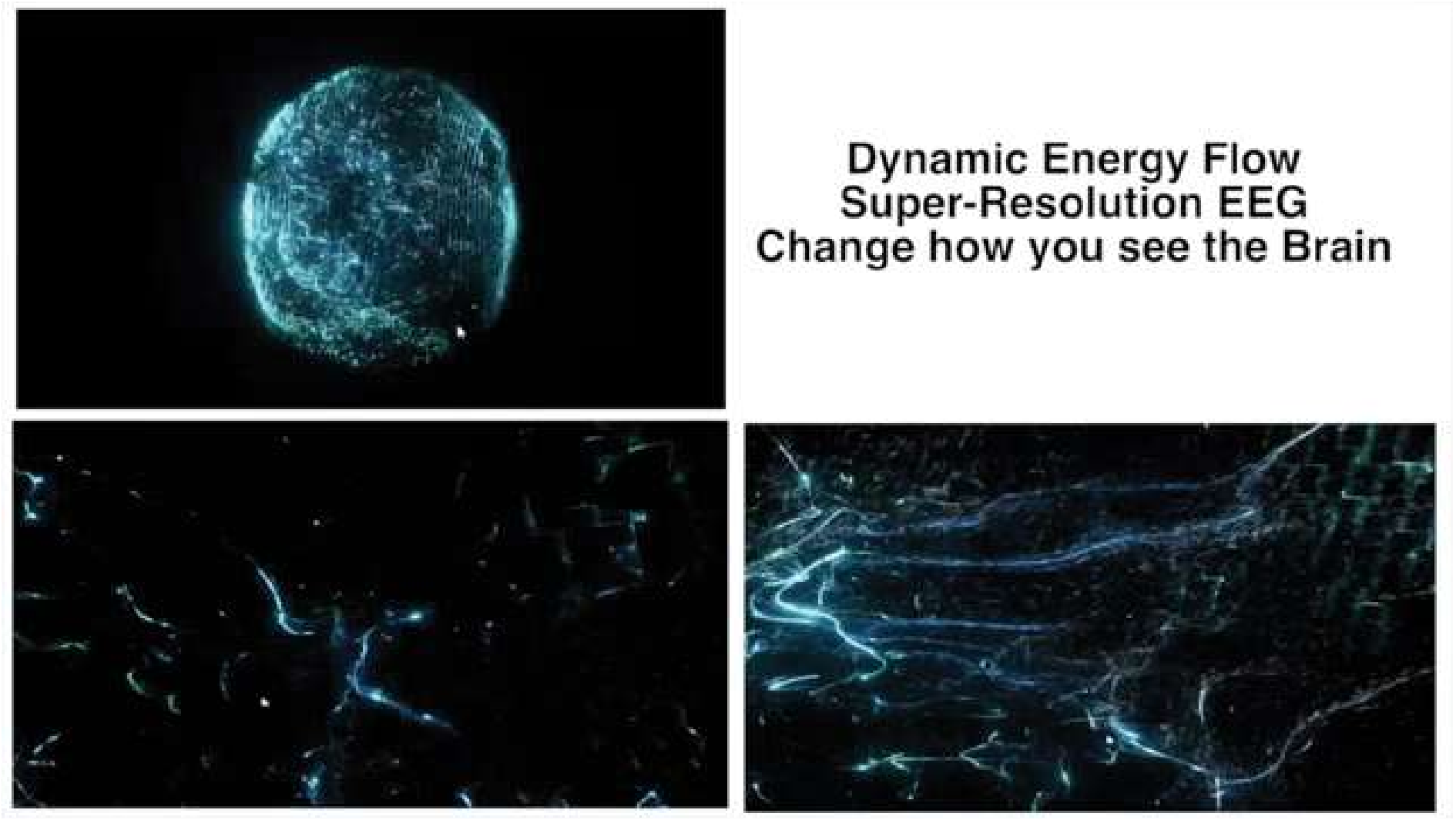
Compare real 10x10 data with super-resolution data based on down-sampled 5x5 data



Delta rhythm: semblance to original source signal

Kjeldsen, Kaiser, Whittington. *Journal of Neuroscience Methods,* 2015

Super-resolution EEG: Energy flow during processing

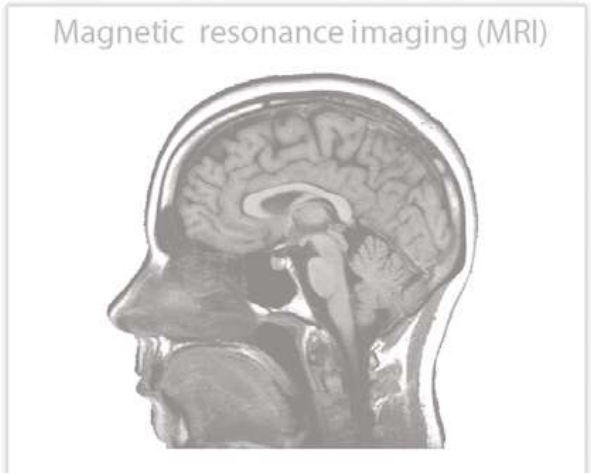


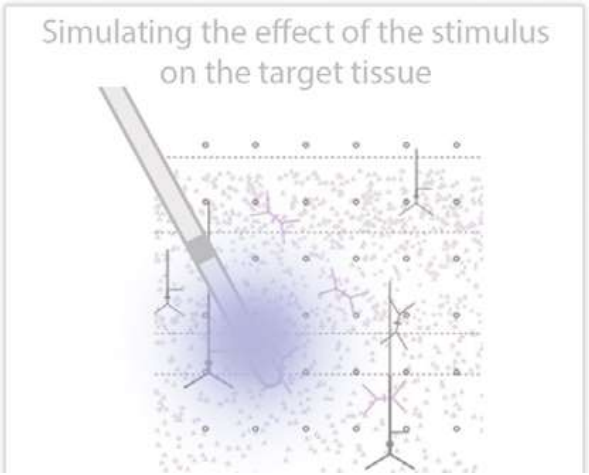
Henrik Kjeldsen, Truust Neuroimaging (patent pending)

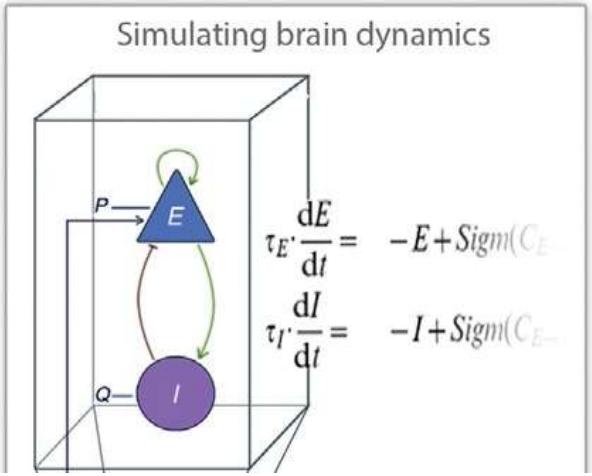
Computational models of effects and side effects

Not necessarily the ones that are most important for (altered) brain function

targeting involved nodes might lead to huge side effects





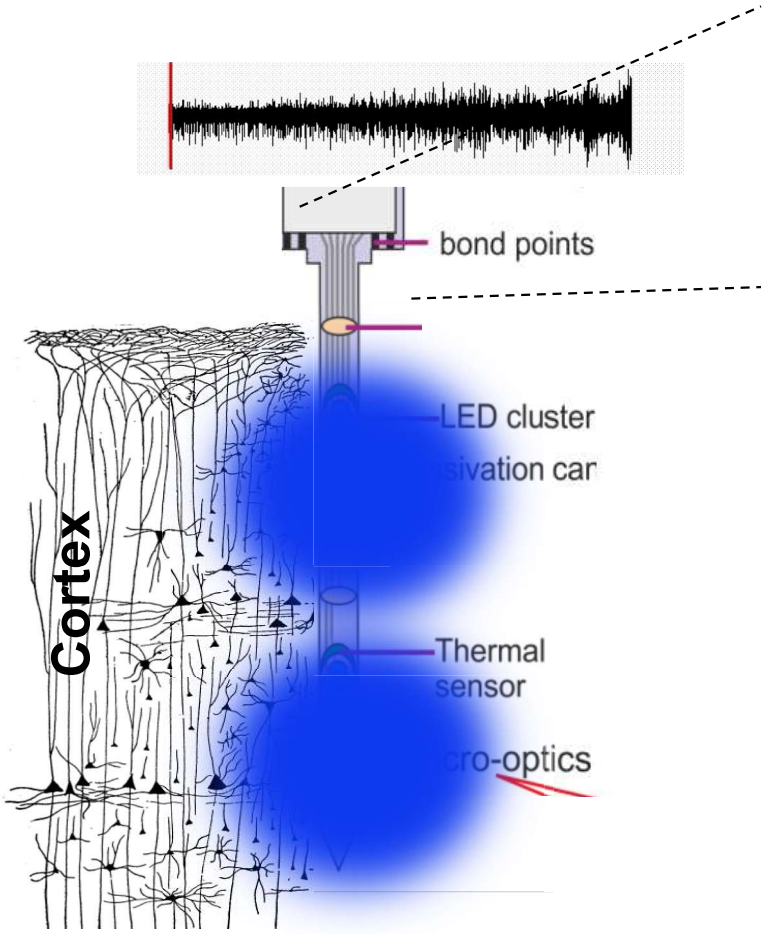


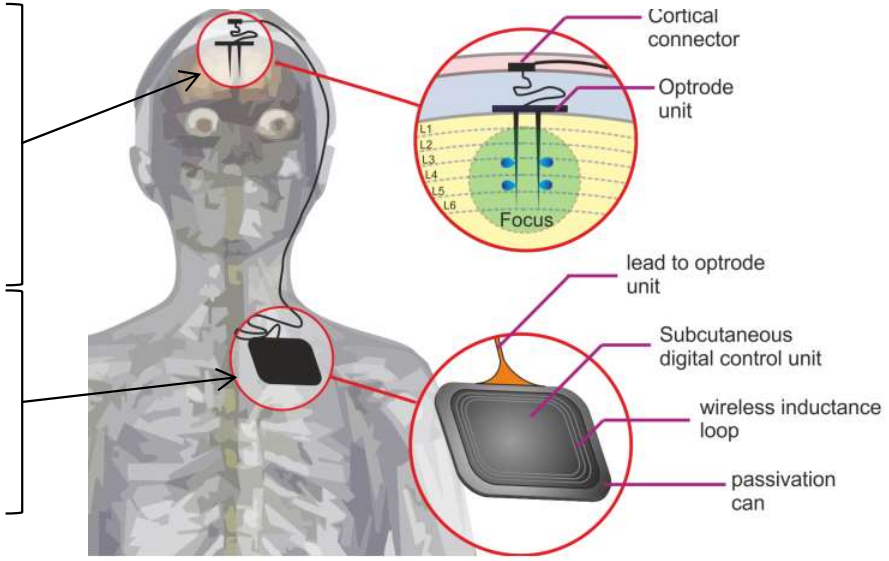
Computer simulations – predicting the effect of optogenetic stimulation

Controlling Abnormal Network Dynamics with Optogenetics (CANDO)

7yrs (till 2021), £10m www.cando.ac.uk

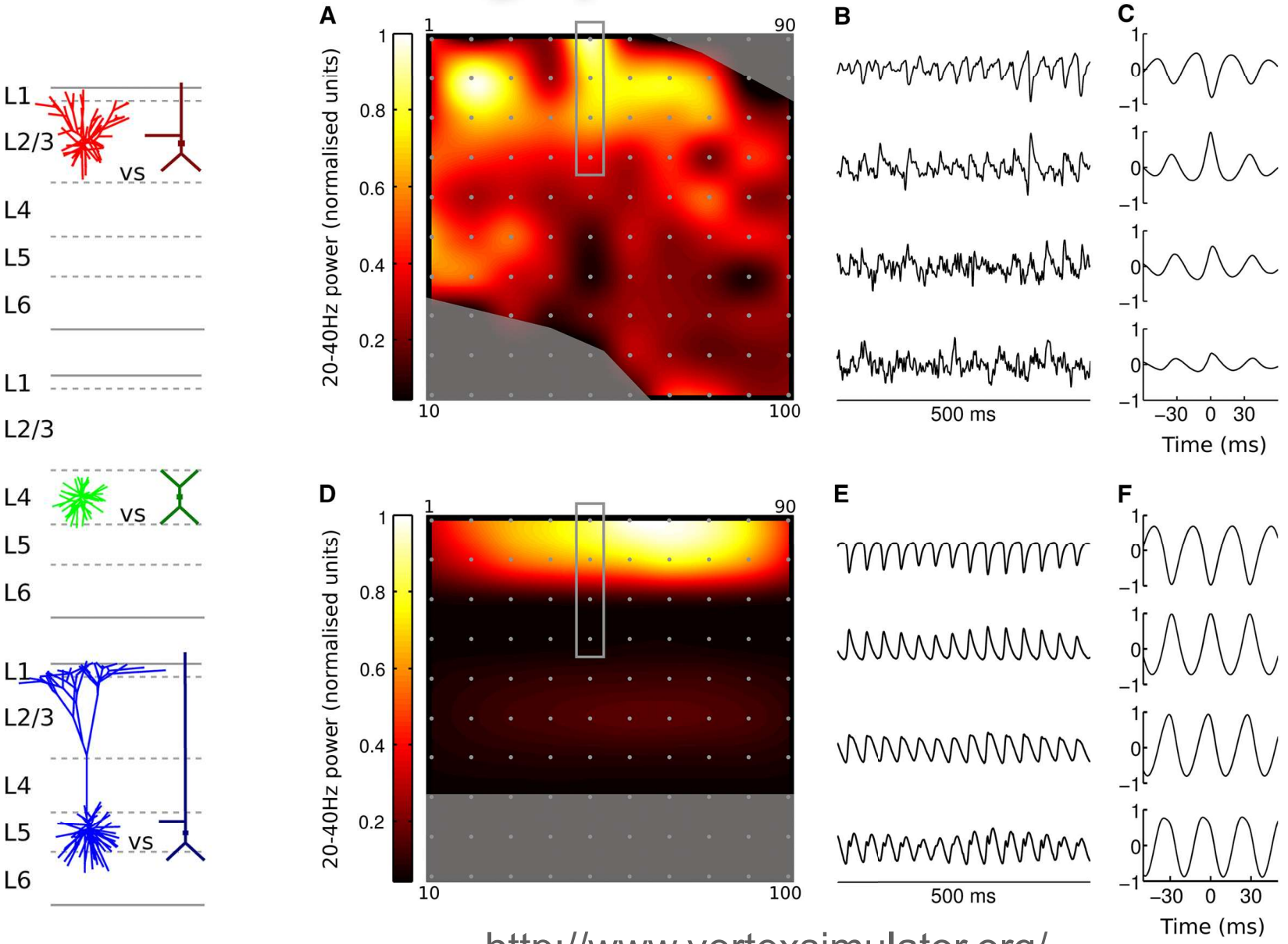
Newcastle University
Imperial College London
UCL





Stimulation off	Stimulation on

VERTEX: simulating dynamics within cortical columns

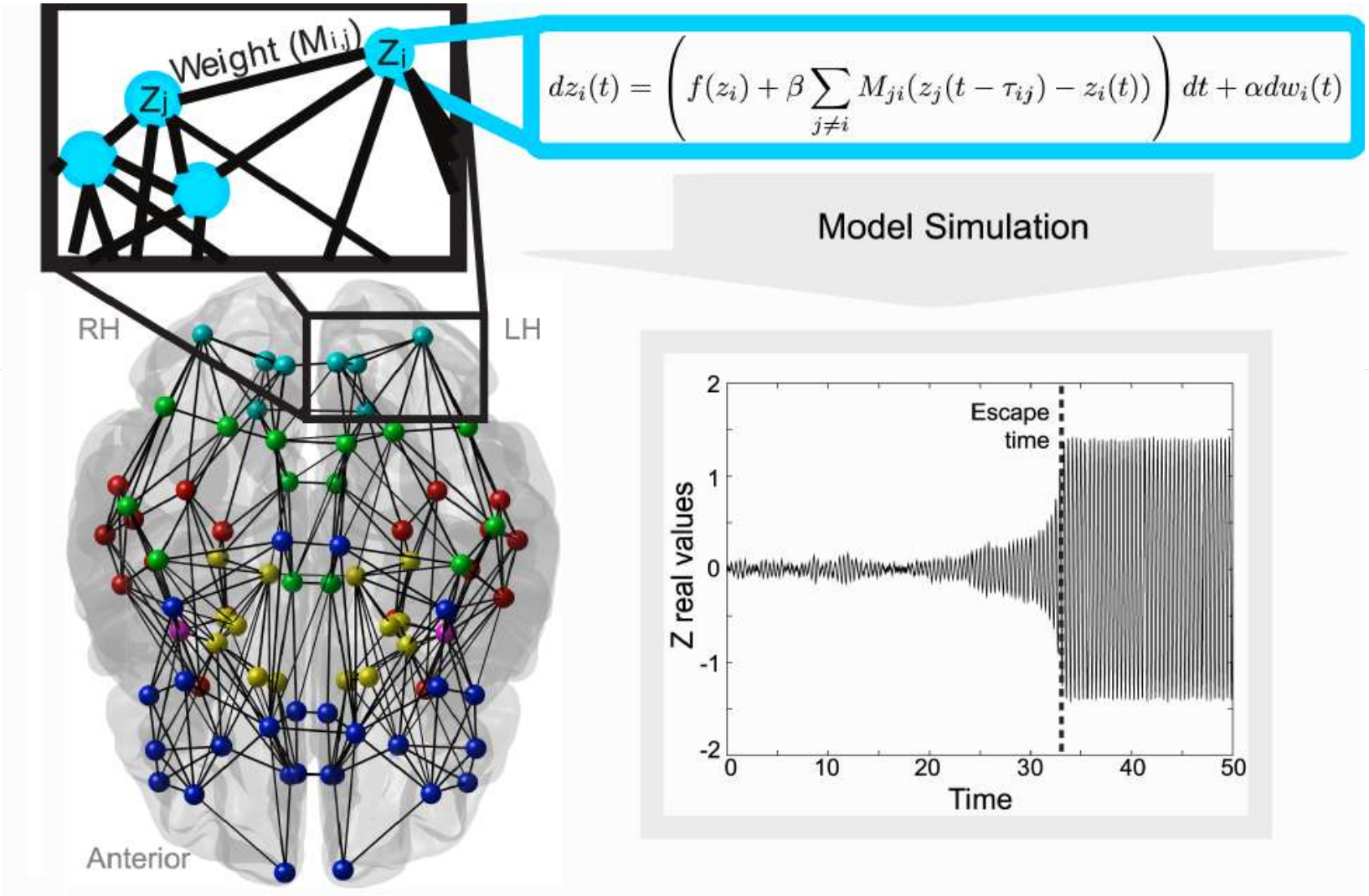


http://www.vertexsimulator.org/

Tomsett et al. *Brain Structure and Function, 2015*

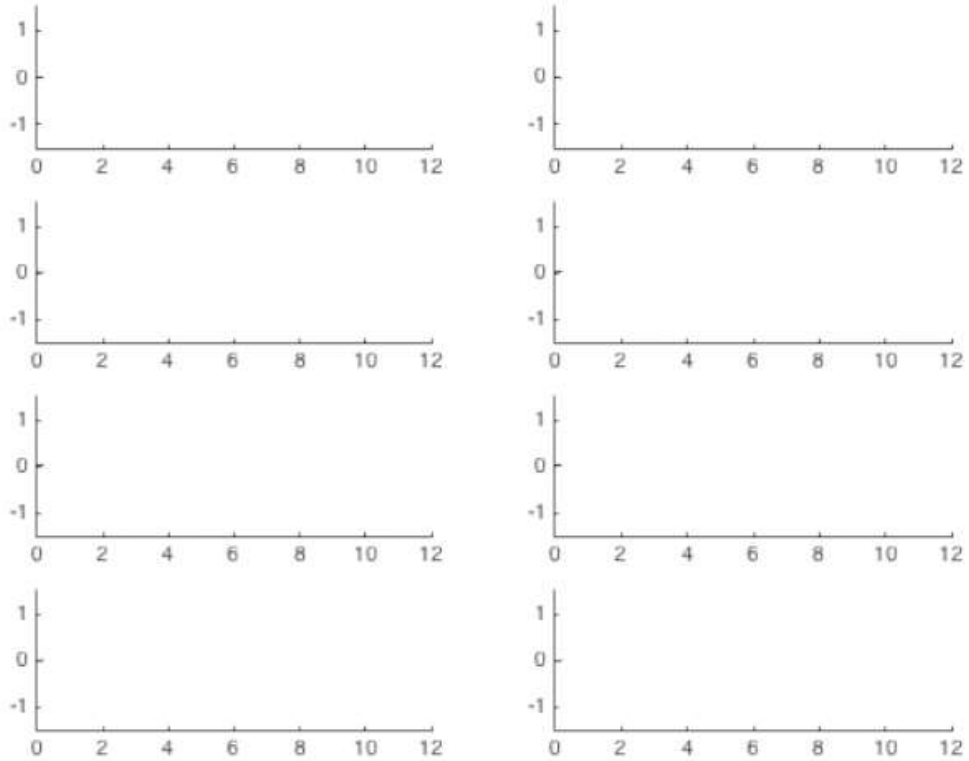
Roopun et al. *PNAS*, 2010

Computer simulations – predicting the location of epileptic tissue



Hutchings et al. *PLOS Computational Biology*, 2015

Computer simulations – predicting the location of epileptic tissue



Hutchings et al. *PLOS Computational Biology*, 2015

Computer simulations – predicting epilepsy surgery success

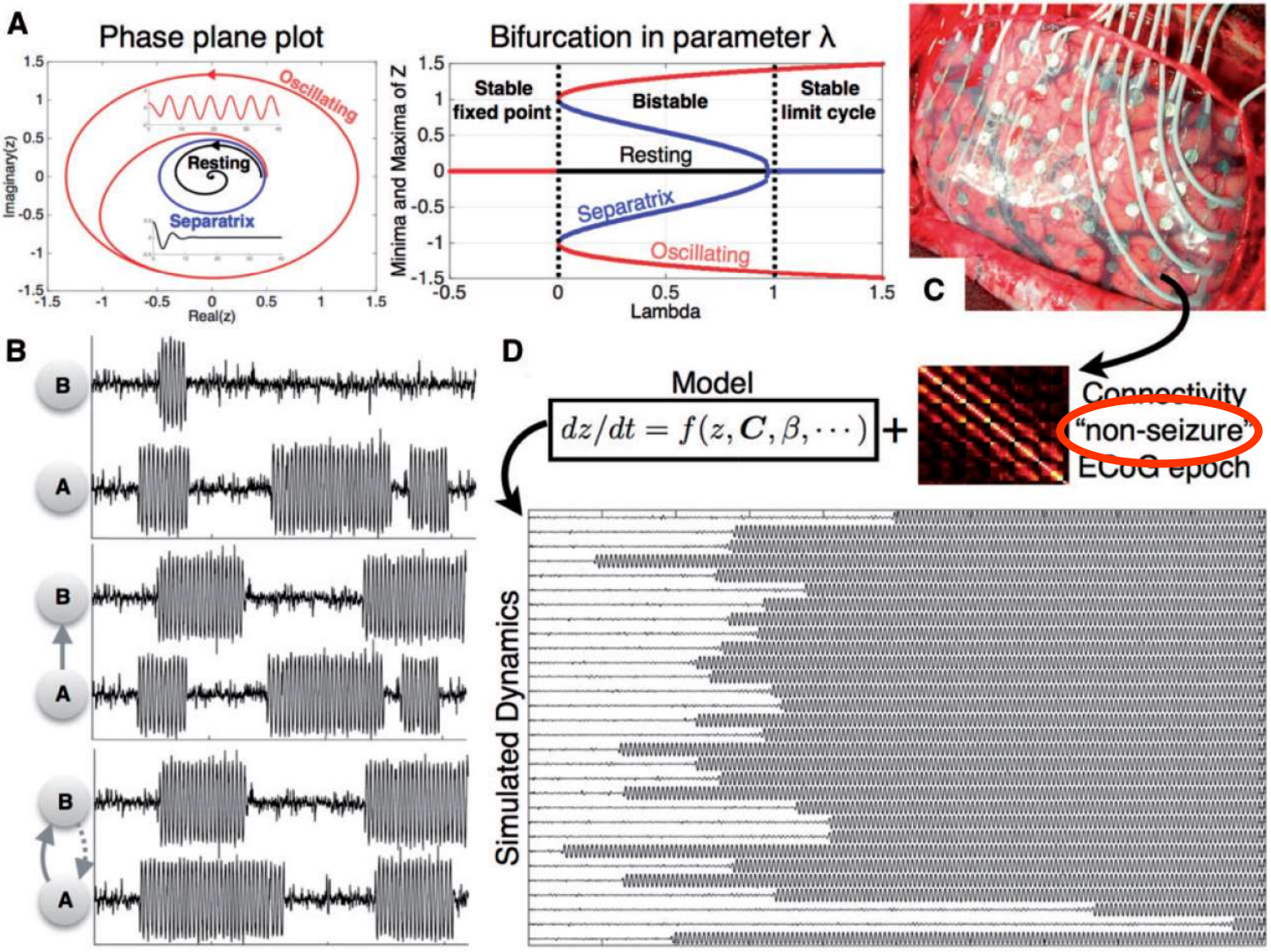
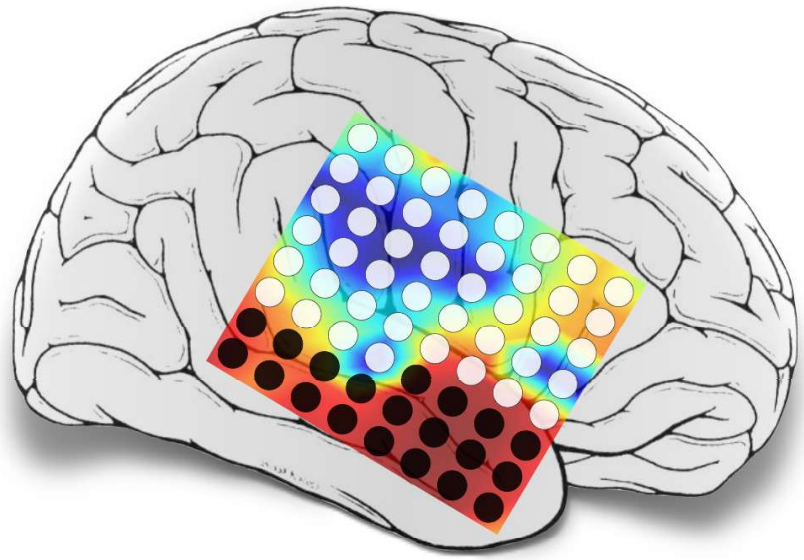
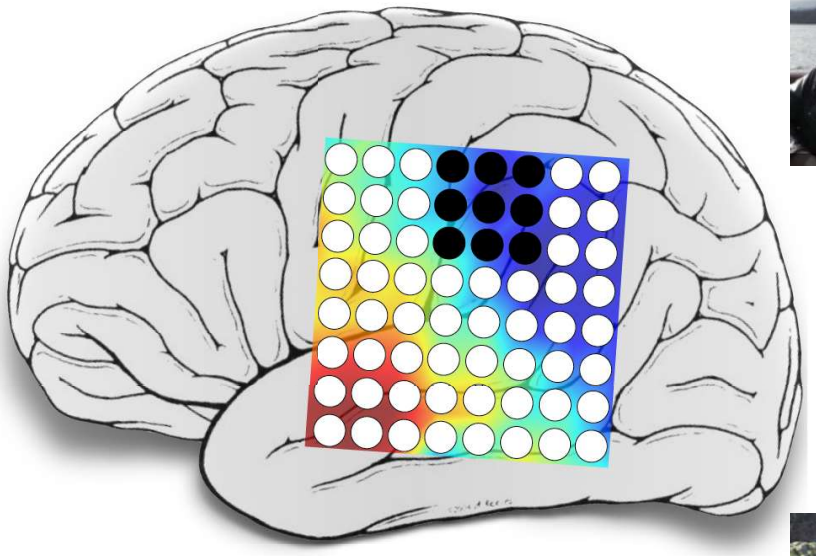


Figure 1 Illustration of model dynamics. (**A**) Deterministic dynamics of a single node representing the bi-stability of the model. (**B**) Stochastic dynamics in a two node network. The two nodes are initially disconnected having independent dynamics. Depending on the strength and direction of connections, the dynamics of each node is influenced by the other. (**C** and **D**) Patient-specific connectivity matrix is obtained from intracranial, interictal ECoG recording, which is incorporated as a model parameter to simulate the model dynamics.

Sinha et al. *Brain*, 2016

Computer simulations – predicting epilepsy surgery success





Location of surgical resection

Low Simulated Seizure likelihood High

Prediction			Real outcome
seizure-free	→	70%	seizure-free
	→	30%	
not seizure-free	→	*100%*	*not seizure-free*

Sinha et al. *Brain*, 2016

Summary

- Diagnosis for individual patients including aetiology (developmental origin) and disease subtype
- Identification of potential treatment targets
- Model for effects *and side effects* of treatment

All three components are needed to lead to new alternative treatments for brain network disorders

Team

Luis Peraza
PostDoc

Frances Hutchings
PhD student

Sol Lim
PostDoc

Roman Bauer
Now faculty

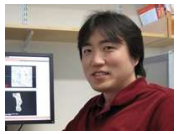
Chris Hayward
PhD student

Peter Taylor
Now faculty

Yujiang Wang
Now faculty

Chris Papasavvas
PhD student

Jinseop Kim
Now faculty



Michael Mackay
PhD student

Chris Thornton
PhD student

Cheol Han
Now faculty

USA
Roger Traub, IBM/Columbia Univ.
Olaf Sporns, Indiana-Bloomington
Sydney Cash, Harvard

Germany
Bernd Weber, Bonn
Claus Hilgetag, Hamburg
Marc-Thorsten Hütt, Bremen

United Kingdom
Miles Whittington, York
Stephen Eglen, Cambridge
Stephen Jackson, Nottingham
Peter Uhlhaas, Glasgow
Steve Furber, Manchester

Brazil
Luciano da F. Costa, Sao Paulo
Bruno Mota, Rio de Janeiro

South Korea
Joon-Kyung Seong, Korea Univ.
Cheol Han, Korea Univ.
Jinseop Kim, KBRI

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