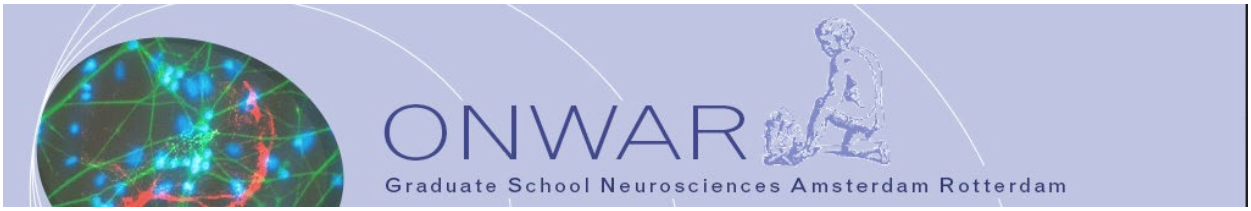


Program Experimental Neurophysiology: Theory and Practice
7 – 10 June 2022.

7 June – Tuesday
Principles of neuronal excitability (Organizer: Maarten Kole)

Location:
Morning: Colloquium room, 2nd floor, NIN, Amsterdam.
http://herseninstituut.nl/over-ons/contact/

Afternoon: *Half the students:* VU electrophysiology labs C4 wing (ring the bell for entrance), Boelelaan 1085 (**W&N building**), Amsterdam. http://www.vu.nl/nl/over-de-vu/contact-routebeschrijving/plattegronden/index.aspx
Other half: NIN colloquiem room

09:30 – 10:00	Welcome and general course introduction (M. Kole)
10:00 – 10:45	Biophysical basis of neuronal excitability (M. Kole)
10:45 – 11.00	Coffee break
11:00 – 12:00	Principles of patch-clamp recording (M. Kole)
12:00 – 13:00	Lunch (arranged by the NIN)
13:00 – 17:00	Half the students: Deconstructing the action potential with *Neurons in Action* (M.Kole / R. Min) – **Bring your own laptop!** Other half: Patch-clamp recordings of neurons in acute brain slices / autaptic cell culture (T. Heistek, N. Cornelisse, assistants)

8 June – Wednesday
Synaptic transmission and plasticity (Organizers: Rogier Min, Niels Cornelisse)

Location:
Morning: Vrije Universiteit (VU), Room WN-M143, Boelelaan 1085 (**W&N building**), Amsterdam. http://www.vu.nl/nl/over-de-vu/contact-routebeschrijving/plattegronden/index.aspx
Afternoon: *Half the students:* VU electrophysiology labs WN-C4 wing (ring the bell for entrance), Boelelaan 1085 (**W&N building**), Amsterdam. http://www.vu.nl/nl/over-de-vu/contact-routebeschrijving/plattegronden/index.aspx
Other half: NIN colloquiem room

09:30 – 10:30	Physiology of the presynaptic terminal and short-term synaptic plasticity (lecturer TBA)
10:30 – 10:45	Coffee break
10:45 – 11:45	The postsynapse and long-term synaptic plasticity (R. Min)

11:45 – 13.00	Lunch (arranged by VU. *Some students will need to travel to the NIN in this time period for afternoon program.*)
13:00 – 17:00	Half the students: Deconstructing the action potential with *Neurons in Action* (M.Kole / R. Min) – **Bring your own laptop!** Other half: Patch-clamp recordings of neurons in acute brain slices / autaptic cell culture (T. Heistek, N. Cornelisse, assistants)

9 June – Thursday
In vivo cellular physiology (Organizer: Gerard Borst)

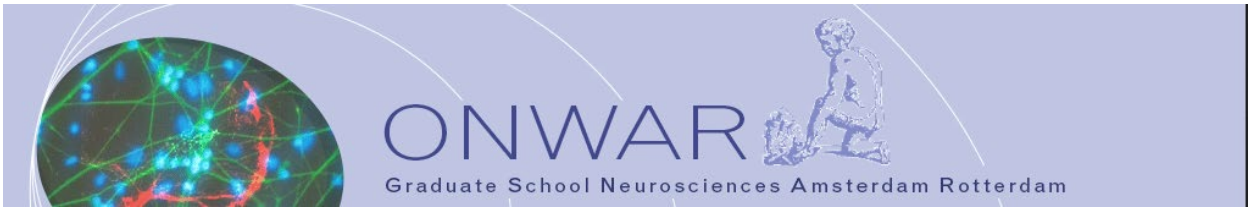
Location: Erasmus MC
Morning: room Ee-287 (OWR-73), 2nd floor faculty (Ee) building (https://www.erasmusmc.nl/-/media/ErasmusMC/PDF/0-Bereikbaarheid-NL-ENG/Building-Ee.pdf). To enter the Ee-building you need a visitors' pass, which you can get from the reception at the 3rd floor (and if there is no pass in your name, call 010-7043309).
Afternoon: room Ee1205, 12th floor Faculty (Ee) building

09:30 – 10:45	*In vivo* patch clamp and juxtacellular recordings (Gerard Borst)
11:00 – 12:00	Single unit recordings (Zhenyu Gao)
12:00 – 13.00	Lunch (arrange your own. There's an AH-to-go and a restaurant in the main hall (Passage) of Erasmus MC)
13.00 – 15.00	Practical demonstration single-unit recordings (divided into groups)

10 June – Friday
Masterclass / Human cellular neurophysiology (Organizers: Maarten Kole, Rogier Min)

Location:
Lectures/Masterclass: Vrije Universiteit (VU), Room WN-G076, Boelelaan 1085 (**W&N building**), Amsterdam.
Swammerdam Lecture: Vrije Universiteit (VU), Room WN-M143, Boelelaan 1085 (**W&N building**), Amsterdam.
http://www.vu.nl/nl/over-de-vu/contact-routebeschrijving/plattegronden/index.aspx

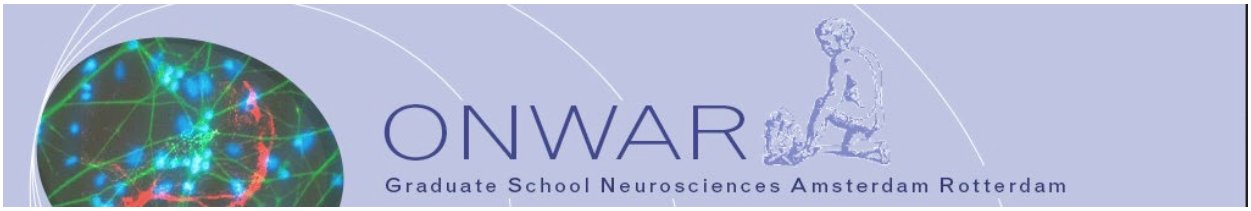
09:00 – 10:30	Additional time for reading of masterclass papers / designing of questions
10:30 – 12:00	Recap of course so far, and plenary discussion and design of questions for masterclass
12:00 – 13:00	Lunch (arranged by ONWAR)
13:00 – 14:30	Masterclass (Rafael Yuste)
14:30 – 14:45	Coffee/Tea break
14:45 – 15.15	Invasive electrophysiology in the human brain (Matt Self)
15:15 – 15:45	Patch-clamp recordings in human neurons (Natalia Goriounova)
15:45 – 16:00	Coffee/Tea break



16.00 – 17.00	Swammerdam Lecture Rafael Yuste (Columbia University, NY, USA) *"Can you see a thought? Neuronal ensembles as emergent units of cortical function"*
17.00 –	Discussion and drinks.

Contact details local organizers

Rogier Min	r.min@amsterdamumc.nl
Maarten Kole	m.kole@nin.knaw.nl
Niels Cornelisse	l.n.cornelisse@vu.nl
Gerard Borst	g.borst@erasmusmc.nl



Reading material for the course:

Reading material for the masterclass and on the different topics that are covered in the course can be found here:
https://drive.google.com/drive/folders/1ukz2JFfn40k9yp4c3czx1L_t-0PeI2Qh?usp=sharing

Workshop article by our invited speaker, Rafeal Yuste (read / prepare before the Friday sessions!):
Make sure to read these articles carefully before the Friday of the course. When reading, prepare questions for our masterclass guest (Rafael Yuste), so that we can have a dynamic and interesting masterclass!

Alejandre-García T, Kim S, Pérez-Ortega J, Yuste R (2022). Intrinsic excitability mechanisms of neuronal ensemble formation. *Elife* 11:e77470. doi: 10.7554/eLife.77470.

Carrillo-Reid L, Yang W, Bando Y, Peterka DS, Yuste R (2016). Imprinting and recalling cortical ensembles. *Science* 353(6300):691-4. doi: 10.1126/science.aaf7560. *(conceptual background for the Elife paper)*

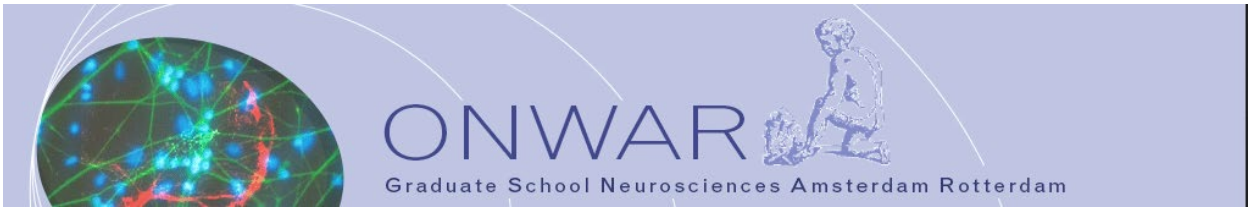
Background reading arranged per topic:
We advise you to look through this material in advance. People taking this course have very diverse neuroscience backgrounds, and this will help to equalize the background knowledge.

Neuronal excitability (day 1):
Bruce P Bean (2007). The action potential in mammalian central neurons. *Nat Rev Neurosci* 8(6):451-65. doi: 10.1038/nrn2148.

Synaptic transmission (day 2):
Very basic:
Synaptic transmission (*Neuroscience 6th edition* by: Purves *et al*, Chapter 5).
More on techniques:
Glasgow SD, McPhedrain R, Madranges JF, Kennedy TE, Ruthazer ES (2019). Approaches and Limitations in the Investigation of Synaptic Transmission and Plasticity. *Front Synaptic Neurosci* 11:20. doi: 10.3389/fnsyn.2019.00020.

In vivo recording techniques (day 3):
Buzsáki G, Anastassiou CA, Koch C (2012). The origin of extracellular fields and currents--EEG, ECoG, LFP and spikes. *Nat Rev Neurosci* 13(6):407-20. doi: 10.1038/nrn3241.

Human neuron activity (day 4):
Quiroga RQ (2012). Concept cells: the building blocks of declarative memory functions. *Nat Rev Neurosci* 13(8):587-97. doi: 10.1038/nrn3251.



Abstract Swammerdam Lecture:

"Can you see a thought? Neuronal ensembles as emergent units of cortical function"

Rafael Yuste, MD, PhD

Neurotechnology Center, Dept., Biological Sciences, Columbia University, New York, USA

How neural activity is transformed into thought is arguably the central question of neuroscience. The design of neural circuits, with large numbers of neurons interconnected in vast networks, strongly suggest that they are specifically build to generate emergent functional properties (*1*). To explore this hypothesis, we have developed two-photon holographic methods to selective image and manipulate the activity of neuronal populations in 3D in vivo (*2*). Using them we find that groups of synchronous neurons (neuronal ensembles) dominate the evoked and spontaneous activity of mouse primary visual cortex (*3*). Ensembles can be optogenetically imprinted for several days and some of their neurons trigger the entire ensemble (*4*). By activating these pattern completion cells in ensembles involved in visual discrimination paradigms, we can bi-directionally alter behavioral choices (*5*). Our results are consistent with the possibility that neuronal ensembles are functional building blocks of cortical circuits and serve as elementary elements for perception, memories and thoughts.

1. R. Yuste, From the neuron doctrine to neural networks. *Nat Rev Neurosci* **16**, 487-497 (2015).
2. L. Carrillo-Reid, W. Yang, J. E. Kang Miller, D. S. Peterka, R. Yuste, Imaging and Optically Manipulating Neuronal Ensembles. *Annu Rev Biophys*, 46: 271-293 (2017).
3. J. E. Miller, I. Ayzenshtat, L. Carrillo-Reid, R. Yuste, Visual stimuli recruit intrinsically generated cortical ensembles. *Proceedings of the National Academy of Sciences of the United States of America* **111**, E4053-4061 (2014).
4. L. Carrillo-Reid, W. Yang, Y. Bando, D. S. Peterka, R. Yuste, Imprinting and recalling cortical ensembles. *Science* **353**, 691-694 (2016).
5. L. Carrillo-Reid, S. Han, W. Yang, A. Akrouh, R. Yuste, (2019). Controlling visually-guided behavior by holographic recalling of cortical ensembles. *Cell* 178, 447-457. DOI:https://doi.org/10.1016/j.cell.2019.05.045.