
BIOGRAPHICAL SKETCH

NAME: Lutgarde Arckens

POSITION TITLE: Full Professor

EDUCATION/TRAINING

| INSTITUTION AND LOCATION | DEGREE | Completion Date | FIELD OF STUDY |
|--|-----------|-----------------|----------------------------|
| KU Leuven, Group Science & Technology, Belgium | Ba | 07/1985 | Biology |
| KU Leuven, Group Science & Technology, Belgium | Ma | 07/1987 | Biology, Animal Physiology |
| KU Leuven, Group Science & Technology, Belgium | Ph.D. | 02/1995 | Neurobiology |
| KU Leuven, Group Science & Technology, Belgium | PD fellow | 1995-2001 | Neuroscience |

A. Personal Statement

My research group *Neuroplasticity and Neuroproteomics* is embedded within the Biology Department, Group Science and Technology at KU Leuven (<http://bio.kuleuven.be/df/la/la>) since 2002. My research focuses on the impact of retinal damage on the functionality of the visual system in different visual impairment models (glaucoma, AMD, enucleation....) in order to better understand the need of developing treatments for visual disorders that target the eye and the brain. Our approach consists of a combination of molecular, cellular and systems approaches. We develop and apply state of the art technologies including functional proteomics, tract tracing and neuronal activity mapping. Hereto we combine a molecular read-out with single-cell and multiple electrode array (MEA) electrophysiology. We use the optogenetics approach to interfere with neuronal activity with high precision and cellular resolution.

For the identification and characterization of relevant marker genes/proteins we developed a multidisciplinary approach with an emphasis on proteomics technology. Next to having installed a 2D-DIGE platform we are currently actively implementing gel-free differential proteomics in this research. To further complement our competencies in morphological and anatomical neuroscience research, we invested in introducing, optimizing and implementing imaging mass spectrometry at KU Leuven.

B. Positions and Honors

Positions and Employment

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|-------------|--|
| 1995-1997 | PD fellow IUAP Research Program |
| 1997 –2004 | PD fellow of the National Fund for Scientific Research Flanders, Laboratory of Neuroendocrinology and Immunological Biotechnology, KU Leuven, Dept Biology |
| 2000 - 2003 | Visiting Professor (part time) KU Leuven, Dept. Biology |
| 2003 - 2006 | Associate Professor KU Leuven, Dept. Biology |
| 2006 - 2009 | Full Professor (Hoogleraar) KU Leuven, Dept. Biology |
| 2009 - | Full Professor (Gewoon Hoogleraar) KU Leuven, Dept. Biology |
| 2002 - | Head of the Research Group 'Neuroplasticity and Neuroproteomics', Dept Biology, KU Leuven (currently 1 postdoc, 6 PhD students, 1 technician) |
| 2007-2012 | Counselor for the PhD students for the Group of Science and Technology, KU Leuven |
| 2014-2018 | Head of the Division of Animal Physiology and Neurobiology, Dept Biology, KU Leuven |
| 2010 - | Member (and from 2014-2018 President) of the Advisory Board for hiring New Academic Personnel for the Faculty of Science, KU Leuven |
| From 2021 | Head of the Dept Biology, KU Leuven (now Head-elect) |

Professional experiences:

Reviewing activities

- Member Board of reviewing members 'Brain research group', 'Frontiers in Neuroanatomy' and 'Journal of Experimental Neuroscience'
- Member/Chair Bio2 expert panel FWO Flanders (2014-2019)
- Member of Expert Panels – Physiology, Medicine, Neuroscience for the IWT Flanders to evaluate PhD fellowship applications (Every few years since 2006)
- Founding Member, Member of the Steering Committee of LBI (Leuven Brain Institute)
- Reviewer ad hoc for Journal of Neuroscience, Proceedings of the National Academy of Science, Cerebral Cortex, Brain structure & Function, European Journal of Neuroscience, Neuroscience, Journal of Neuroscience Methods, Chemical Neuroanatomy, Journal of Comparative Neurology, Current Eye Research, Endocrinology, Zoological Science, Belgian Journal of Zoology, Biotechniques, Electrophoresis, Expert Reviews of Proteomics, Journal of Proteome Research, Proteome Science
- Reviewer ad hoc for the following granting agencies: Dutch National Science Foundation, Canadian Science Foundation, Australian Science Foundation, Polish National Science Centre, Multiple Sclerosis Society (England), Research Council KU Leuven

Memberships

- Society for Neuroscience (SfN) - Federation of European Neurosciences (FENS) - Belgian Society for Neuroscience

Honors and awards

- Phytofar Scientific Prize, November 8, 2011 (Phytofar Institute for Research and Development of Sustainable Agriculture)
- Price for Science and Innovation, awarded by the Faculty of Science, to my PhD student Dr. Ir Annelies Laeremans, December 14, 2013

Invited lectures and co-organizer of scientific meetings

On average three each year within Europe and/or USA. Some examples:

- Reprogramming sensory cortex to compensate for vision loss in mice, *Window on Brain plasticity*, May 7, 2018, Royal Academies for Sciences and the Arts of Belgium.
- Reprogramming of sensory cortex: brain adaptations to vision loss in mice. *Annual Meeting of the Swiss Society for Neuroscience*, February 1, 2019, Geneva, Switzerland.
- Opto- and chemogenetics - exploring cell type specific contributions to cortical plasticity induced by visual impairment; 10-11 October 2019 – Visit University of Mainz – invited by Thomas Mittmann.

Co-organizer of scientific meetings:

- Board Member Belgian Society of Neuroscience (Bi-annual Meetings, upcoming in 2021).
- 28th Conference of European Comparative Endocrinologists, CECE, Aug 21-25, 2016, Leuven.
- Neuroplasticity and neuromodulation at different scales, fTALES, June 6-7, 2019, Antwerp.
- Local LBI activities for Brain Awareness week; Consciousness, the ultimate challenge, a cross-disciplinary debate, March 12, 2019.

Valorization activities and patent applications (published and issued)

- Performance of contract research for industrial partners (industrial collaborations). With Oxurion NV:
 - Application Nr: EP 14 169 969 – *MMP-9 for enzymatic posterior vitreous detachment*, Inventor(s): B. Jonckx, T.T. Hu, L. Arckens, L. Moons; Assignee(s): ThromboGenics NC, KU Leuven
- Co-founder of the 'Vision Core Leuven', a service platform comprising state-of-the-art technology to study ocular pathologies at morphological and functional level, which aims to establish a preclinical animal platform for the identification of novel targets and drug testing in ocular diseases and beyond (<http://www.visioncore.be>).
- Co-promotor of two 'Strategic Basic research projects' (SBO-IWT): 'Peptidomics' and 'Optobrain'
- Promotor of a 'Landbouwkundig Basis Onderzoeksproject' (LBO-IWT): " Nevenwerking van gewasbeschermingsmiddelen op bijen" – awarded by Phytofar, Scientific Prize 2011.
- Experience with management of medium-sized research infrastructure:
 - Founder of the first 2D-DIGE platform at KU Leuven

- Founding member/member of the Core Committee of Prometa/SyBioMa, the core facility for systems biology based mass spectrometry at KU Leuven
- Co-applicant and member of the Management Committee of COST action BM1104 – Mass Spectrometry imaging: new tools for healthcare research

Scholastic experiences

I have trained more than 10 junior laboratory technicians, more than 80 MSc students, about 30 Belgian/foreign PhD students and more than 15 post-doc fellows, some of which currently have high-profile academic positions as independent group leaders, or a research related position in industry. Currently I am mentoring 7 PhD students and 1 postdoctoral student.

Since 2002 I (did) teach Basic Biology, Immunological Biotechnology, Neurobiology, Modern Methods courses to bachelor and master students of Biology, Biochemistry & Biotechnology, Biomedical Sciences, and (Bio)engineering and coach external internships in Industry for KU Leuven, Belgium.

C. Contributions to Science (see [ORCID: 0000-0002-2909-8449](https://orcid.org/0000-0002-2909-8449))

My scientific output consists of >180 research papers in peer-reviewed international journals, of which many in the field of Visual Neuroscience. Citations (Google scholar Sept 20, 2020: 5776, current h-index of 43. A complete publication list can be found at: <https://lirias.kuleuven.be/cv?u=U0003832>

I. My research projects (current and completed) are focused on better understanding how the visual system of mammals responds to vision loss. In mice, with one eye enucleated in adulthood, we demonstrated for the first time that whisker inputs invade the deprived visual cortex. We observed that a different modality can take over the visual cortex, not only when mice are born blind, but also upon insult later in life. Studying the underlying mechanisms in this **newly-established visual impairment model** should open up opportunities to manipulate cross-modal plasticity to treat human patients. We demonstrated a central role of the GABAA alpha 1 subunit in cross-modal brain plasticity, as published in *Journal of Neuroscience*.

Nys J,.. Arckens L. (2015). Journal of Neuroscience, 35(32):11174-89.

II. My lab focuses on studying the structural, molecular, cellular and functional adaptations of the mammalian visual system to partial vision loss. One primary goal is to **develop better treatments for visual disorders that target the eye and the brain**. These studies already resulted in several important papers. Based on these studies I was granted, together with L. Moons, I. Stalmans and S. Heymans, two prestigious Hercules awards (2010 & 2014), which enabled the founding of the **'Vision Core Leuven'**, a service platform comprising state-of-the-art technology to study ocular pathologies at morphological and functional level, which aims to establish a preclinical animal platform for the identification of novel targets and drug testing in ocular diseases and beyond. This Core has also been granted with C3 funding of the Research Council KU Leuven (fall 2016).

Hu TT, ..., Arckens L (2011). Cerebral Cortex, 21(12):2883-92.

Aerts J, Nys J, Moons L, Hu TT, Arckens L. (2015). Brain Structure Function. 220(5):2675-89.

Burnat K, ..., Arckens L. (2017). Journal of Neuroscience. 37(37):8989-8999.

Scheyltjens I, ..., Arckens (2018) L. Brain Structure and Function. 223(5):2073-2095. Received the '2019 Editors' Choice Award', (best article published in 2018) at the Cajal Club, SFN, 2019.

Geeraerts E., ..., Arckens L, Moons, G (2019). Journal of Neuroscience 39(12):2313-2325.

III. **Targeted profiling of the plasma membrane proteome**, and specifically the proteome exposed at the cell surface, is key to the identification of cell surface biomarkers or the isolation of tissue-specific cell types. Plasma membrane proteins like (G-protein coupled) receptors, ion channels, transporters are crucial for a wide variety of fundamental physiological processes. Their role in cell-cell interactions, molecular transport, and signaling explains their potential as important therapeutic targets. I therefore decided to **expand the proteomics toolbox** with a new plasma membrane proteomics approach to boost the quest for new drug targets, preferably applicable to small, functionally defined tissue samples. My lab developed and validated a successful pipeline relying on acute slice biotinylation followed by mass spectrometry, which was published in *Scientific Reports*.

Smolders K, Baggerman G, Arckens L. (2015). Scientific Reports, 5:10917

IV. In the context of a three-year interdisciplinary project involving researchers of the biology, psychology, and kinesiology departments of KU Leuven, we developed the necessary behavioral protocols to prove that **rodents and humans use homologous brain regions for spatial navigation**. This collaboration involved the application of a very diverse set of technologies to analyze brain activity changes in the brain of humans and mice in the context of water maze learning, either in a Morris Water Maze setup for the mice, or a virtual reality basin for the human subjects. The data were accepted for publication by the *Proceedings of National Academy of Sciences* in 2013.

Woolley DG, Laeremans A, ..., Wenderoth N*, Arckens L*, D'Hooge R*. (2013) * *Proceedings of National Academy of Sciences U S A*, 110(8):3131-6.

V. My drive to understand the impact of age - ageing on brain plasticity made me decide to invest in setting up a **unique research consortium** around the **new** upcoming **gerontology model**, ***Nothobranchius furzeri* or killifish**. I convinced Eve Seuntjens, Lieve Moons and Joris Winderickx to team up with colleagues Brendonk and Pinceel, experts in natural (killi)fish population ecology research, to build a new breeding and husbandry facility to support killifish physiology research, unique in Belgium. Since the summer of 2016 we jointly established the facility, and secured 3 FWO-SB PhD fellowships and an FWO project, and the first exciting findings about peculiar stem cells, their role in recovery from TBI, and the factor ageing therein are being prepared for publication. We also attracted a postdoc with bioinformatics skills to investigate single cell transcriptome data for the young and aged killifish telencephalon to capture the factor **healthy ageing** at single cell level.

D. Research Support (past 3 years)

Over the past decade I participated in many projects and grants, including EU grants, international and national research grants, both as promoter or co-promoter. A few most recent completed/ongoing applications:

Completed research support projects (ending 2015 or beyond)

- IWT 110068 De Byzer (PI) 2011 - 2015 SBO-OPTOBRAIN Role: co-PI
Goal: implement, optimize and develop optogenetics approaches for neuroscience research at the level of the opsins, viral vectors, optrodes and in vitro and in vivo animal models for brain plasticity research
- GOA/12/008 R. D'Hooge (PI) 2011 - 2016 Role: co-PI
Neuroplastic mechanisms that underlie the involvement of prefrontal cortex and hippocampus in extinction, reversal and category learning
Goal: Multicenter and interdisciplinary effort to understand complex learning in mammals from molecules, over cells, to cellular networks and at behavioral level.
- C1 KUL Research Fund 2016 – 2020 Role: PI
Cross-modal brain plasticity upon vision loss: unraveling the large-scale structural, functional and molecular reorganization of cortical circuits.
Goal: Understand how and why visual cortex is taken over by other senses due to vision loss.
- FWO G.0659.13 2013 – 2018 Role: PI
Optogenetic interrogation of the role of interneuron subtypes in age-dependent visual cortex plasticity in mice
Goal: Dissect the role of different interneuron cell types in visual cortex plasticity in the context of visual deficits.
- FWO G.0A65.13 2013 - 2018 Role: PI
Validation of the role of the cystine/glutamate antiporter or system Xc- in visual system disorders
Goal: Validate if Xc- is an ideal target for pharmacological interventions in the context of vision repair as a treatment of visual disorders.
- AKUL/13/09 Moons: PI 2014 – 2018 Animal Vision Center Role: co-PI
Goal: Set up a platform, including a HRA, OCT, optomotor, Y maze, to investigate the anatomical and functional integrity of the visual system of zebrafish, mice, rats and rabbits.
- AKUL038(HER/09/005) Moons: PI 2010 - 2017 Role: co-PI
Motorized fixed stage microscope with dedicated multiphoton system configuration and motorized inverse microscope for confocal system configuration
Goal: Set up a microscopy facility for in vitro applications in animal physiology research at KU Leuven
- AKUL/13/06 Op de Beek: PI 2014 - 2018 Role: co-PI

An integrated platform to investigate the neural mechanism underlying adaptive behavior and complex learning.

Goal: Set up a facility (running ball setup for in vivo electrophysiology in awake animals, optical imaging, learning boxes) to investigate brain activity in the context of complex learning, including visually guided behavior at KU Leuven

- AKUL032(HER/09/047) Joris: PI 2010 - 2017 Role: co-PI
Optical measurement of neural activity in vivo and with (sub)cellular resolution – a customized multiphoton setup
Goal: To build a customized in vivo multiphoton setup for monkey, gerbil and rat brain research

Ongoing Research Support

- FWO G061216N 2016 – 2021 Role: PI
Characterization of the distinct impact of one-eyed vision on monocular cortex: a molecular, cellular and systems level analysis of cross-modal brain plasticity in the adult mouse
Goal: Understand how and why visual cortex is taken over by other senses like somatosensation and audition due to severe vision loss later in life
- FWO G02618N 2018 - 2023 Role: PI
Notobranchius furzeri: New types of neuronal stem cell - new insights in neuro(re)genesis.
Goal: Finding new therapies to adapt the non-permissive environment of the aged mammalian brain to combat neurodegenerative disease.
- C1 KUL Research Fund 2017 - 2020 Role: PI
Cross-modal brain plasticity upon vision loss: unraveling the large-scale structural, functional and molecular reorganization of cortical circuits.
Goal: Understand how and why visual cortex is taken over by other senses due to vision loss.
- C1 KUL Research Fund 2021 - 2024 Role: PI
Cell subtype-specific neuron-glia contributions to cortical plasticity
Goal: Unravel the contribution of astrocytes and astrocyte subtypes to adult cortex plasticity
- Central Europe Leuven Strategic Alliance CELSA/19/036 2019 – 2021 Role: PI
Treating cognitive decline by targeting energy production in the central nervous system.
Goal: Discover novel drugs that signal via the same pathways as noradrenaline to boost energy production in the brain in order to slow, or stop, cognitive decline.
- AKUL/HER/17/011: FACsorting platform 2018 - 2023 Role: PI
Goal: Establish a single cell(-type) platform for biological applications in diverse model organisms

PhD & PD Fellowships (2016-2020)

Over the past 5 years I secured national (academic and industrial) funding for 18 PhD and PD fellowships.