



COGNIGRON

Creating a blueprint for future-proof computing

Inspired by the brain

Annual Report
CogniGron 2025



university of
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UEF

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Foundation

Moving science forward.

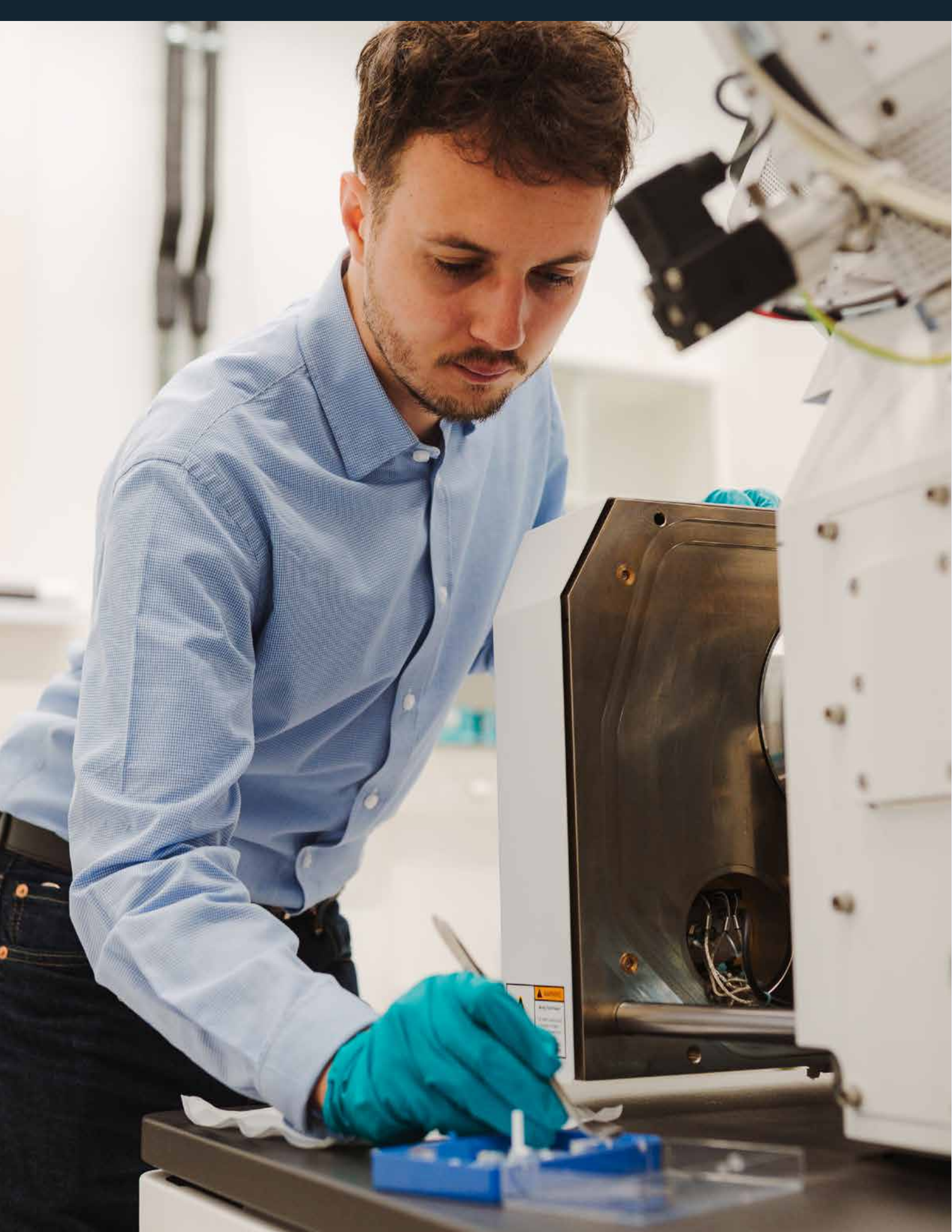


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FOREWORD

Foreword CogniGron Annual Report 2025

2025 has been a year of key transitions that will allow CogniGron to expand its scope and lay the basis for a sustainable future. With the start of a second phase of funding by the Ubbo Emmius Foundation, CogniGron started its Demonstrator Programme, which will enhance ongoing fundamental research through applied research and development efforts.

A major step in securing a long-term perspective for CogniGron has been the submission of a proposal for a 10-year project: 10^X-Factor(y). Following a positive evaluation, this project will start in 2027.

We have started developing our first three demonstrators. They will tackle real-life issues in three distinct domains: high-velocity data stream processing, mobility and monitoring, and health monitoring and diagnostics. A team consisting of two PhD students and one research lead will be assigned to each demonstrator. The Demonstrator Programme will establish a foundation for enhancing economic impact in the Groningen region by focusing on use cases relevant to businesses. Thanks to everyone's efforts and multiple meetings, the demonstrators are taking shape and will bring neuromorphic computing outside our labs in the near future.

In 2025, the CogniGron team was completed and updated. It now includes a scientific director, a managing director, a scientific coordinator, a communication officer, and a management assistant. With the transition to the second phase, Beatriz Noheda resigned as scientific director after having done a remarkable job to establish CogniGron as founding director. I am honoured to take on this task to guide CogniGron into this new phase. I am confident that this will be possible together with the efforts of everyone at our research centre. This year, the university institute ENTEG joined CogniGron, and we welcomed several new PIs.

A new Strategic Advisory Board was formed alongside the new phase of CogniGron. Its members originate from various regions of Europe and the United States. We can already express our gratitude for their support and advice.



This year, Ximplic was officially established as the second spin-off of CogniGron following the creation of IMChip. We are proud to count with researchers that want to translate advances in neuromorphic computing into products, and we will continue to support them in their efforts.

CogniGron continued to be a key driver for establishing a national and European ecosystem. We participated in several initiatives such as the Future of Compute innovation mission to the United Kingdom and the EBRAINS-Neurotech consortium. With our strong support, yet another national community event could be organised in 2025. These events have resulted in the establishment of NC-NL, a national ecosystem organisation for neuromorphic computing, by the end of the year. At European level, CogniGron supported a meanwhile approved proposal for a pan-European collaborative network.



Overall, in 2025 CogniGron has achieved significant progress and matured as an organisation. We can look ahead with confidence in realising our ambitions, and remain dedicated to our long-term mission of establishing brain-inspired computing as a future-proof approach to meet the ever-increasing needs for computational power. In a rapidly evolving world, we are making significant progress in discovering innovative computational solutions, which are increasingly acknowledged, especially beyond academic circles.

Dirk Pleiter,
Scientific Director of CogniGron



ACCELERATING THE PATH TO ENERGY-EFFICIENT COMPUTING

Brain-inspired, future-proof

The human brain uses a fraction of the energy of today's computers, yet it outperforms them in countless ways. It stores and processes information in the same place. It forgets, remembers, predicts, constantly adapting to its environment.

Neuromorphic computing draws lessons from the brain to create a new kind of system: energy-efficient, adaptive, and radically future-proof. With self-learning materials, smart architectures, and interdisciplinary collaboration, we're creating the blueprint for future-proof computing.

Modern computing faces a critical sustainability challenge, as data centers and emerging technologies such as autonomous systems, edge AI and personalized medicine demand enormous amounts of energy and real-time processing. At CogniGron, we are reimagining the future of computing: one inspired by the remarkable efficiency of the human brain. Founded in 2018 thanks to a generous donation from the **Ubbo Emmius Foundation**, CogniGron collaborates with FSE's Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence, the Engineering and Technology institute Groningen and the Zernike Institute for Advanced Materials, uniting expertises across disciplines to pioneer a new generation of **brain-inspired computing**.

Our **mission** is to make a lasting difference in the field of neuromorphic computing: developing materials, devices, and algorithms that work together in harmony, just as neurons and synapses do in the brain. We aim to move beyond the limits of conventional silicon technology, crafting computing architectures that are not only powerful, but profoundly energy-efficient and sustainable.

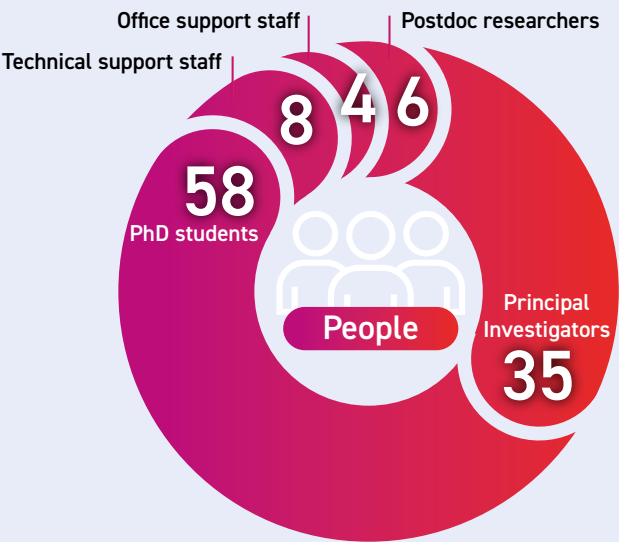
What makes this mission possible is our belief in synergy: progress happens when physicists, materials scientists, computer scientists, mathematicians and engineers speak a common language. At CogniGron, we cultivate this **interdisciplinary** dialogue and train a new generation of researchers who embody it. We do this across three across three dynamic layers:

- **Fundamental Research:** At the core of CogniGron, our world-class scientists investigate the materials, physics, and technology that will shape the future of computing.
- **Demonstrators:** We translate theory into proof-of-concept systems. These demonstrators bring abstract ideas to life and push the boundaries of what neuromorphic systems can do.
- **Applied Research:** Together with partners, we explore how these breakthroughs can solve real-world challenges — from edge AI and smart sensors to sustainable computing infrastructure.

Our ultimate goal is not just to create better chips, but to help build an open, interdisciplinary **ecosystem**, where scientific breakthroughs become shared building blocks. Where engineers, physicists, designers, and entrepreneurs work side by side. And where brain-inspired, energy-efficient computing moves from the lab into the world. As we look ahead, we see computing evolving into something more organic: efficient, adaptive, and ready for what's next.



KEY FIGURES COGNIGRON 2025



Organized and participated in online/offline events



15

Engagement



10

Hosted invited speakers at CogniGron seminars



02

Start-ups/spin-offs



4.1 million

Research budget



Q&A INTERVIEW WITH COGNIGRON'S MANAGING DIRECTOR, JESSE SIEGERS

In July of 2025, Jesse Siegers started as the new Managing Director of CogniGron, where he helps translate the center's ambitious goals into a multi-year strategy. After the work of interim Manager Directors Annechien Pronk and Sander Baesjou had proven essential in positioning CogniGron as a central player in the neuromorphic computing ecosystem, CogniGron is now ready for the next step in bridging academia and industry. In this Q&A article, we will find out how Jesse's background and expertise is precisely what makes him a key asset to CogniGron's success.

Q: Can you tell us a little bit about your background and experience?

J: I grew up in the North of the Netherlands, in a small village close to the Wadden Sea. I later moved to Groningen city for my studies, where I studied History and International Political Economy. After graduating, I worked in the public sector for roughly ten years, first at the municipal and provincial level, and later for the Ministry of Foreign Affairs and the Topsector ICT, now Digital Holland. Most of my work has been on the economic and innovation side of public policy: how do we support entrepreneurs, strengthen ecosystems, and help new technologies find their way into society and the economy? That has always been the common thread in my work.

MY ROLE IS TO HELP CREATE THE CONDITIONS IN WHICH THE SCIENCE AT COGNIGRON CAN HAVE LONG LASTING IMPACT: MORE CONNECTIONS, MORE VISIBILITY, MORE FUNDING OPPORTUNITIES AND A STRONGER REGIONAL AND INTERNATIONAL NETWORK

Q: You also started your own company to help organizations find and apply for relevant grants, how was the switch from working at a public institution to having your own business?

J: Running a company was a very different experience from working with companies from a policy perspective. It gave me much more freedom to choose a direction and move quickly, but it also forced me to be very concrete: are we solving a real problem, can we find customers, and can we build something that is financially sustainable?

Q: So how did you find out about CogniGron, and what moved you to apply for this Managing Director position at this moment in time?

J: I already knew CogniGron from the regional innovation ecosystem and from my previous work around digitalisation and key technologies. So when I heard they were looking for someone to help increase the impact of the research being done there, I immediately felt it would be a very interesting job. It combined many of the themes I had worked on before: building ecosystems, supporting innovation, connecting public and private partners, and helping promising technology move closer to real-world use.





What attracted me to the role was the combination of scientific depth and practical relevance. CogniGron brings together researchers from very different disciplines, from materials science and physics to AI, hardware and cognitive systems. That makes it a fascinating place, but also a place with real potential beyond academia.

Because my position was made possible via a secondment (detacheren in Dutch) from the NOM (Investment and Development Company for the Northern Netherlands), it makes it easier to connect CogniGron to the wider regional ecosystem. Through NOM, I bring in a perspective that is perhaps a bit more different from traditional academia, more focused on regional innovation, business development and ecosystem building.

Q: Now that you have been working for more than a year as Managing Director, what do you think CogniGron as an organisation does uniquely well today, and where are our current challenges?

J: What CogniGron does uniquely well today is bringing together very different scientific disciplines around one shared question: how can we build new forms of computing that are inspired by the brain and better suited to the physical world? That full-stack, interdisciplinary approach is one of our biggest strengths.

At the same time, that is also one of the challenges. True interdisciplinarity does not happen automatically just because different disciplines are present in the same organisation. It requires people to find each

IF WE CAN CREATE AN ENVIRONMENT WHERE RESEARCHERS CAN KEEP DOING WORLD-CLASS SCIENCE, WHILE INDUSTRY, PUBLIC PARTNERS AND FUNDERS INCREASINGLY UNDERSTAND AND SUPPORT THAT WORK, I WOULD CONSIDER THAT A GREAT SUCCESS

other, understand each other's language, and work together on shared questions. That is something we need to keep investing in.

Q: So what does success for CogniGron look like for you in the coming years? What are your top priorities as CogniGron's Managing Director?

J: My main priority is to help CogniGron make the step from being a strong research centre to becoming a visible and recognised hub for neuromorphic computing. For me, that means three things. First, we need a sharper story about CogniGron and neuromorphic computing. Second, we need more concrete collaborations and demonstrators that show what this research could enable in the real world. Third, we need to strengthen the ecosystem around us, with companies, public partners, funders and talent.

For me, success would be that the excellent research already being done at CogniGron gets the recognition, support and connections it deserves. I do not see my role as changing what CogniGron fundamentally is. The scientific depth is exactly what makes it special.

Q: What are you most excited about the next phase of CogniGron?

J: What excites me most is that CogniGron is entering a phase where we can translate our strong scientific foundation into broader economic and societal impact. Neuromorphic computing is becoming increasingly relevant for major questions around energy use, AI at the edge, autonomous systems, robotics and sensing. That creates a real opportunity for CogniGron to show why its work matters.

With programmes such as 10^X Factor(y), stronger links to industry, and growing regional support, we have a chance to position Groningen as a place where the next generation of computing is not only studied, but also developed and connected to real-world challenges.



THE NEXT PHASE:

NEUROMORPHIC COMPUTING IN ACTION

As the digital world accelerates, so does its appetite for energy. Artificial intelligence models grow larger, data flows multiply, and conventional computing architectures are pushed to their limits. At CogniGron, we believe that the future of computing must be adaptive, brain-inspired, and fundamentally more energy-efficient. That ambition did not emerge in isolation. It was made possible by trust placed early on.

The **Ubbo Emmius Foundation** recognised the importance of forward-looking, interdisciplinary research at a time when research into neuromorphic computing was still a bold bet. Their support allowed us to move from vision to reality — to establish a centre where physics meets computer science, where hardware meets cognition. Their long-term commitment makes it possible for us to invest in what matters most: fundamental research, young talent, and real-world applications.

In 2025, we marked an important milestone: the kick-off of the next phase of the Ubbo Emmius Foundation-funded programme. This moment signalled the beginning of CogniGron 2.0: a new phase in which we move beyond foundational neuromorphic science towards tangible impact, we establish close collaborations with industry and private organizations, and bring our research closer to the end-users with our demonstrators programme.

With this renewed support, and under the leadership of our new Scientific Director, Prof. Dirk Pleiter, and Managing Director, Jesse Siegers, CogniGron is ready to take the next step: translating cutting-edge research into technologies that respond to real-world use cases and practical challenges. A mission made possible by the continued belief and partnership of the foundation.

We are deeply grateful to the Ubbo Emmius Foundation for their enduring trust and partnership. Their support empowers us to push neuromorphic computing beyond the laboratory, positioning it as a serious, scalable alternative to conventional architectures in an era where computing demands are rapidly evolving.

UEF Ubbo
Emmius
Foundation

Moving science forward.



ZERNIKE INSTITUTE FOR
ADVANCED MATERIALS (ZIAM)

 **PHYSICS & MATERIALS
SCIENCE**

BERNOULLI INSTITUTE FOR
MATHEMATICS, CS & AI (BI)

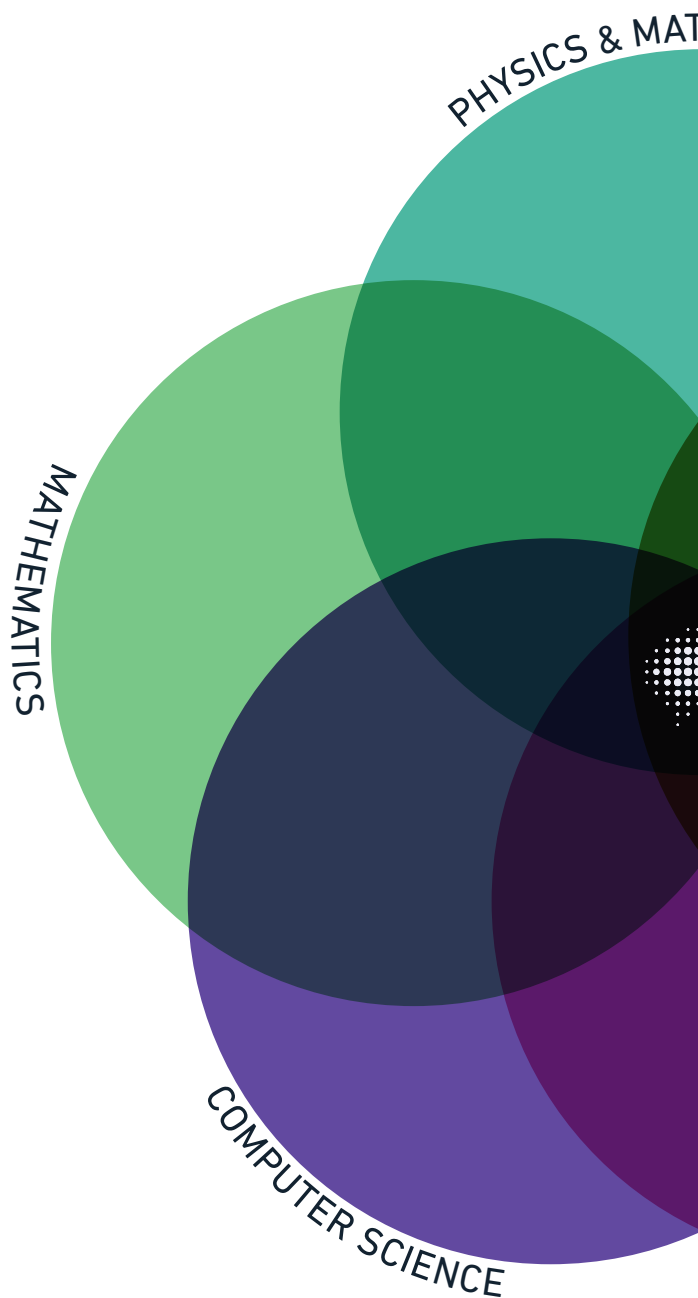
 **MATHEMATICS**

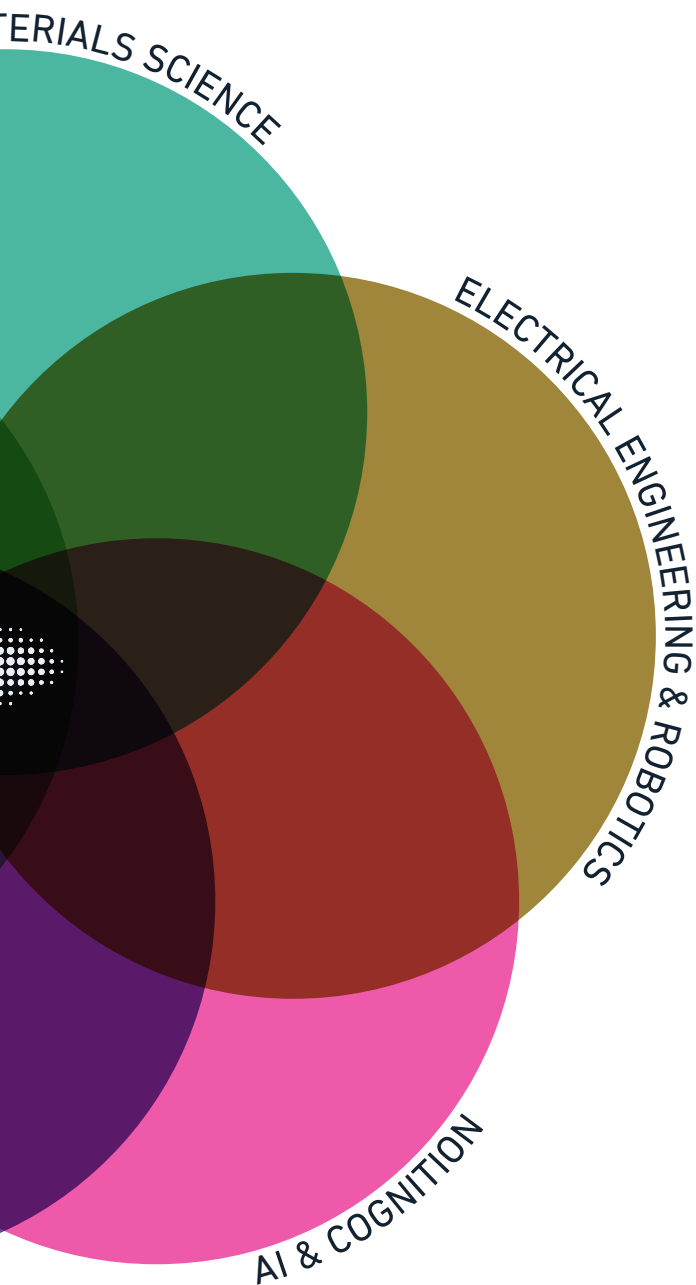
 **COMPUTER SCIENCE**

 **AI & COGNITION**

ENGINEERING & TECHNOLOGY
INSTITUTE (ENTEG)

 **ELECTRICAL
ENGINEERING, ROBOTICS
AND MECHATRONICS**





PHYSICS & MATERIALS SCIENCE

- Materials and Devices with nanoscale functionality
- Oxide electronics
- Carbon electronics
- Molecular electronics
- Spintronics
- Valleytronics
- Phase change materials
- Memristors
- Optoelectronics
- Ionic transport

MATHEMATICS

- Complex networks
- Dynamical systems
- Statistical networks
- Statistical mechanics
- Materials modeling
- Computer algebra
- Network synthesis theory

COMPUTER SCIENCE

- Systems engineering
- Neuromorphic computing
- Image processing/Computer vision
- Pattern recognition/Machine learning
- Computer algebra
- Security & privacy

AI & COGNITION

- Machine learning
- Computer vision
- Neuroscience
- Neural networks
- Neuromorphic computing
- Cognitive science

ELECTRICAL ENGINEERING, ROBOTICS AND MECHATRONICS

- Materials for mechatronics
- Electrical Engineering
- Robotics

OUR PEOPLE

Experts

PHYSICS AND MATERIALS SCIENCE

- **Prof. Tamalika Banerjee**
Spintronics of Functional Materials
 - **Prof. Elisabetta Chicca**
Bio-inspired Circuits and Systems
 - **Dr. Erika Covi**
Cognitive Devices
 - **Prof. André van Schaik**
Neuromorphic Engineering and Computational Neuroscience
 - **Prof. Bart Kooi**
Nanostructured Materials and Interfaces
 - **Prof. Maria Loi**
Photophysics and Opto-Electronics
 - **Prof. Beatriz Noheda**
Solid State Materials for Electronics
 - **Prof. George Palasantzas**
Physics - Surface Interactions and Nanostructures
- In the course of 2025,
Prof. Petra Rudolf left CogniGron.

MATHEMATICS

- **Prof. Bart Besselink**
Systems and Control Theory
 - **Dr. Gilles Bonnet**
Stochastic Studies and Statistics
 - **Dr. Serte Donderwinkel**
Probability Theory
 - **Prof. Marco Grzegorzcyk**
Computational Statistics
 - **Dr. Hildeberto Jardón Kojakmetov**
Mathematics, Interdisciplinary Applications
 - **Dr. Alef Sterk**
Dynamical Systems Theory
 - **Prof. Holger Waalkens**
Dynamical Systems Theory
- In the course of 2025,
Prof. Holger Waalkens left CogniGron.

ARTIFICIAL INTELLIGENCE

- Prof. Jelmer Borst
Computational (Cognitive) Models
- Prof. Matthew Cook
Cortex-inspired Computing
- Prof. Davide Grossi
Cognitive Multiagent Systems
- Prof. Herbert Jaeger
Computation in Cognitive Materials
- Prof. Lambert Schomaker
Artificial Intelligence
- Prof. Niels Taatgen
Artificial Intelligence
- Prof. Bart Verheij
Computational Argumentation

COMPUTER SCIENCE

- Prof. George Azzopardi
Information Systems
- Prof. Michael Biehl
Intelligent Systems
- Prof. Georgi Gaydadjiev
Innovative Computer Architecture
- Dr. Farhad Merchant
Innovative Computer Architecture
- Prof. Dirk Pleiter
Innovative Computer Architecture
- Dr. Revantha Ramanayake
Theory of Computation
- Prof. Jos Roerdink
Scientific Visualization and Computer Graphics
- Prof. Fatih Turkmen
Computer and Network Security
- Dr. Michael Wilkinson
Digital image analysis and computer vision

ELECTRIC ENGINEERING, ROBOTICS AND MECHATRONICS

- Prof. Mónica Acuautla Meneses
Materials for Mechatronics
- Dr. Bahar Haghighat
Robotics and Automation
- Prof. Ming Cao
Networks and Robotics
- Prof. Elisabeth Wilhelm
Healthcare robotics

TECHNICAL SUPPORT

CogniGron depends on the skills and experience of several technicians that, in addition to ensuring smooth running of the lab, also have important roles in training young researchers.

- **Dr. Majid Ahmadi**
CogniGron - Support Electron Microscopy
- **Gert ten Brink**
Nanostructured Materials and Interfaces
- **Vincent Jassies**
Bio-inspired Systems and Circuits
- **Ir. Jacob Baas**
Solid State Materials for Electronics
- **Johan Holstein**
Physics of Nanodevices
- **Joost Zoestbergen**
Solid State Materials for Electronics
- **Henk Bonder**
Solid State Materials for Electronics
- **Dr. Arjun Joshua**
CogniGron - Support Clean room/Nanolab



NEW STAFF

In 2025, CogniGron had the privilege of the Engineering and Technology institute Groningen (ENTEG) joining as a new collaborating FSE institute, expanding the scientific expertise within CogniGron with expertise on electrical engineering, robotics and mechatronics. With this addition, several ENTEG scientists have become official CogniGron Principal Investigators in 2025. With their knowledge and research experience, they bring valuable expertise to our team.



Bahar Haghighat

Dr. Bahar Haghighat joined CogniGron as a PI in March of 2025. Bahar obtained her PhD in Robotics, Control, and Intelligent Systems in 2018 from the Swiss Federal Institute of Technology in Lausanne (EPFL), and has been a postdoctoral research associate at Princeton and a postdoctoral research fellow at Harvard. She was appointed as assistant professor at the Faculty of Science and Engineering in September 2022.

Her work investigates building novel miniaturized robotic swarms and algorithmic frameworks that enable sensing, surveying, and inspection applications. Bahar's research is applied and interdisciplinary, spanning the fields of mechatronics, electronics, embedded systems, embedded artificial intelligence and machine learning, and distributed

systems. Her vision is to produce novel surface, aquatic, and aerial miniaturized robot swarms and small-scale intelligent devices that can both serve as tools for basic research and also benefit several commercially promising applications in domains such as inspection of complex structures, environmental monitoring, space exploration, and search-and-rescue robot swarms.



Elisabeth Wilhelm

Prof. Elisabeth Wilhelm became an official CogniGron PI at the end of 2025. Elisabeth is professor in Control of Robotic Systems for Assistance and Rehabilitation at the Engineering and Technology Institute of the University of Groningen. She earned her PhD in Mechanical Engineering in 2015 from the Karlsruhe Institute of Technology. She further expanded her expertise as a postdoctoral researcher at the Human Robotics Group

at Imperial College London and the Sensory-Motor Systems Lab at ETH Zurich. Since joining ENTEG in September 2020 as an Assistant Professor, she has been a driving force in advancing research at the intersection of artificial intelligence, wearable technology, and personalized healthcare solutions.

Elisabeth's research focuses on robotics for rehabilitation and assistive devices, artificial sensory stimulation, real-time bio-feedback and human-machine interaction. In particular, she uses artificial sensory stimulation to help people with neurological diseases and sleep disorders. To achieve this, Elisabeth combines microtechnology with robotics and artificial intelligence. A key aspect of her research is to combine advanced bio-signal processing with machine learning techniques to develop algorithms that allow robots to react to the physiological state of the human user in a closed-loop manner.



Introducing Dr. Raluca Chitic, Research Leader in CogniGron's Demonstrators Programme

Starting in 2026, CogniGron enters its next phase with the Demonstrators Programme, which will bring neuromorphic computing technologies into real-life, industry-driven use cases. To lead this ambitious programme, we are proud to introduce the **first CogniGron Research Lead, Dr. Raluca Chitic**. Starting her new position in March 2026, Raluca has a background in physics, machine learning and computer vision. She has experience working in industry as a computer vision engineer, and also as a postdoctoral researcher in Dr. Elisabetta Chicca's group, where she focused on insect-inspired navigation. When asked about what drew her to this position, she answered "I'm excited about the possibility of creating research work that is directly applicable to industry. With my experience in both academia and industry, I believe I have a good understanding of the requirements from the two sides and can bridge them effectively."

CogniGron's Demonstrators Programme is designed so that academia and private organizations work together in industry-driven use cases: organizations can benefit from the fundamental research and expertise within our centre, and our researchers can deploy neuromorphic computing solutions in real-life applications. Raluca sees an interesting opportunity in helping promising research prototypes progress beyond the laboratory. "Too many prototypes are never explored further because of limited funding or time," she says. "I would like to contribute to filling the gap between research prototypes and industry products.". Doing this requires maturing

promising research prototypes into technologies that are ready for practical testing and deployment, from an industry perspective.

The Demonstrators Programme is designed to bridge the gap between scientific innovation and practical application. While academic research often proves that a concept works under controlled conditions, organisations need solutions that can operate reliably in complex, real-life environments. Bridging that gap is at the heart of the programme: rather than developing technologies in isolation, researchers and industry partners will work together from the outset to tackle concrete

challenges and develop demonstrators that can be validated in real-world settings.

This set up will allow use-case providers and technology developers to jointly develop brain-inspired prototypes and proof-of-concept solutions, bringing together research, innovation and education in demand-driven environments. As a Research Lead, the focus of Raluca's work is not on publications but on creating tangible demonstrators. Specifically, the programme focuses on three demonstrators: high-velocity data stream processing, low-power neuromorphic systems for robotics and monitoring, and health monitoring and diagnostics.



For Raluca, the areas with the highest neuromorphic potential are in robotics, which typically has strong energy constraints and requirements for fast reactions to the environment, and space, where constraints are even stronger.

This co-design approach benefits both sides. Industry partners gain access to cutting-edge neuromorphic expertise and early-stage innovations, while researchers can develop solutions with a clear understanding of operational requirements and potential impact. As a Research Lead, Raluca will be responsible for interactions with stakeholders, setting up research projects in a co-design process and taking a leading role in delivering concrete

demonstrators (prototypes, proofs of concept) that showcase how the new technology can be applied in practice. In her view, successful partnerships depend on frequent communication and clear expectations. "Although academia and industry often have very different perspectives, I hope this collaboration will encourage our industry partners to see neuromorphic computing as an option for solving current traditional computing challenges, while inspiring researchers to consider the industry context when defining research topics," she says.

These demonstrators will not only show how neuromorphic computing can be faster and significantly more energy efficient in industrial applications,

but also provide a cutting-edge competitive edge to industrial partners, positioning them as frontrunners in adopting and exploiting this new technology. It will enable academic and industrial partners to jointly define problems, share infrastructure, and validate results under real-world conditions. By bringing together researchers and industry partners around concrete challenges, the Demonstrators Programme represents an important next step in CogniGron's ambition to accelerate the adoption of neuromorphic computing. Under Raluca's leadership, CogniGron will be a step closer to making brain-inspired computing solutions a reality.



THE NEXT GENERATION

PhD candidates

NEWLY STARTED PHD CANDIDATES IN 2025:

- **Renzo Barraza Altamirano (2025-2029)**
Memristive Time Difference Encoder: characterization and integration of memristors in a CMOS chip
Bio-Inspired Circuits and Systems group (PI: Elisabetta Chicca)
- **Tangwei Cao (2025-2029)**
Neuromorphic Control for Mobile Robots
Discrete Technology and Production Automation group (PIs: Ming Cao/Hildeberto Jardon Kojakhmetov)
Funding source: Chinese Scholarship Council PhD fellowship
- **Yuehai Chen (2025-2029)**
FPGA-based Computing Systems Design
Innovative Computer Architecture group (PI: Farhad Merchant)
- **Yaiza Cintora Perez (2025-2029)**
Epitaxial Oxides for Low-Power Devices
Solid State Materials for Electronics group (PI: Beatriz Noheda)
Funding source: EU HORIZON Marie Skłodowska-Curie Actions (MSCA) - Doctoral Networks (DN) (MASAUTO)
- **Mahima Gautam (2025-2029)**
Hierarchical Spatio-temporal Receptive Fields
Cognitive Modelling group (PI: Matthew Cook)
- **Lingyu Gong (2025-2029)**
Privacy-Preserving Computer Architectures
Innovative Computer Architecture group (PI: Farhad Merchant/Erika Covi)
Funding source: Cross-disciplinary CogniGron PhD project (Neuroprivate)
- **André Herrera Gama (2025-2029)**
Simulators for Post-Von Neumann Architectures
Innovative Computer Architecture group (PI: Georgi Gaydadjiev/Dirk Pleiter)
Funding source: Dutch Research Agenda (NWA) (NL-ECO)
- **Milad Jabri (2025-2029)**
Flexible piezoelectric touch sensor for bio-inspired neuromorphic systems
Discrete Technology and Production Automation group (PIs: Mónica Acuautla Meneses/Elisabetta Chicca)
Funding source: Cross-disciplinary CogniGron PhD project (NeuroTACT)
- **Federico Loi (2025-2029)**
Bio-inspired neuromorphic touch-sensing system
Bio-Inspired Circuits and Systems group (PIs: Elisabetta Chicca/Mónica Acuautla Meneses)
Funding source: Cross-disciplinary CogniGron PhD project (NeuroTACT)

STARTED BEFORE 2025

- **Steven Abreu (2021-2025)**
Computing in non-digital substrates
Computing in Cognitive Materials group (PI: Herbert Jaeger)
- **Jhon Kevin Astoquillca Aquilar (2021-2025)**
Synchronization in random networks
Stochastics and Statistics group (PI: Holger Waalkens)
Funding source: Cross-disciplinary CogniGron PhD project (NANOPER)
- **Ishitro Bhaduri (2023-2027)**
Low power probabilistic-bits enabled reckoning
Spintronics of Functional Materials group (PIs: Tamalika Banerjee/ Gaydadjiev)
Funding source: Cross-disciplinary CogniGron PhD project (LOPPER)
- **Remi Brandt (2020-2024)**
Neural networks with observable decisions
Innovative Computer Architectures (PI: Georgi Gaydadjiev)
- **Hitesh Chhabra (2024-2028)**
Spin and Charge Based Oscillators for Tactile Internet
Spintronics of Functional Materials group (PIs: Tamalika Banerjee/ Elisabetta Chicca)
Funding source: CogniGron matching to Dutch Research Agenda (NWA) (NL-ECO)
- **Lijun Chen (2021-2025)**
Robust metal halide perovskites for solar cells and memristors
Photophysics and Optoelectronics group (PI: Maria Loi)
Funding source: China Scholarship Council (CSC)
- **Radu Cimpan (2022-2026)**
The development of ordinary differential equation (ODE) theory and computational models for sense of smell
Systems Control and Applied Analysis group (PIs: Alden Waters & Stephan Trenn)
Funding source: Cross-disciplinary CogniGron PhD project (SMARTEN)
- **Davide Cipollini (2021-2025)**
Adaptive random non-linear mappings for neural computing in ferroelastic films
Artificial Intelligence group (PI: Lambert Schomaker)
Funding source: EU HORIZON Marie Skłodowska-Curie Actions (MSCA) - Innovative Training Networks (ITN) (MANIC)
- **Otavio Citton (2023-2027)**
Statistical physics of learning in layered systems of adaptive elements
Intelligent Systems Group (PI: Michael Biehl)
Funding source: Cross-disciplinary CogniGron PhD project (SPARROW-NETS)
- **Madison Cotteret (2021-2025)**
Neuromorphic memristive VLSI architectures for cognition
Bio-inspired Circuits and Systems group (PI: Elisabetta Chicca)
Funding source: German Research Foundation (DFG) (NMVAC)
- **Vladimir Darbroodi (2024-2028)**
Reconfigurable Computing Systems
Computer Architecture (PI: Farhad Merchant)

- **Leah Dijkshoorn (2024-2028)**
Artificial Intelligence and Mathematics for Cognitive Devices
Stochastic Studies and Statistics group (PI: Marco Grzegorzczuk/ Bart Verheij)
Funding source: Cross-disciplinary CogniGron PhD project (ID-CODE)
- **Maxime Fabre (2021-2025)**
On-chip training on analog circuits with memristive devices and bio-plausible learning algorithms
Bio-inspired Circuits and Systems group (PI: Elisabetta Chicca)
- **Luca Fehlings (2022-2026)**
Integration of emerging memory devices into neuromorphic CMOS circuits
Cognitive Systems (PI: Erika Covi)
Funding source: EU European Research Council (ERC) Starting Grant (StG)
- **Paolo Gibertini (2022-2026)**
Hybrid memristive-CMOS neuromorphic systems for edge computing
Cognitive Systems (PI: Erika Covi)
Funding source: EU European Research Council (ERC) Starting Grant (StG)
- **Hugh Greatedorex (2021-2025)**
Memristive time difference encoder
Bio-inspired Circuits and Systems group (PI: Elisabetta Chicca)
Funding source: German Science Foundation (DFG) (MemTDE)
Cognitive Systems (PI: Erika Covi)
Funding source: EU European Research Council (ERC) Starting Grant (StG)
- **Ruben Hamming-Green (2021-2025)**
Combined volatile/non-volatile memristive ferroelectric arrays
Solid State Materials for Electronics group & IBM Research-Zurich (PI: Beatriz Noheda and Bert Offrein)
Funding source: CogniGron-IBM fellowship
- **Paul Hansch (2022-2026)**
Smart electronic olfactory system
Photophysics and Optoelectronics group (PI: Maria Loi)
Funding source: Cross-disciplinary CogniGron PhD project (SMARTEN)
- **Marieke Heidema (2022-2026)**
Learning in memristive electrical circuits
Systems and Control Theory Research group (PI: Bart Besselink)
- **Anne-Men Huijzer (2019-2024)**
Memristor networks
Systems and Control Theory Research group (PI: Bart Besselink)
- **Fabian Ijpelaar (2022-2026)**
Qualitative modeling, simulation and exploration of multi-phenomenal materials dynamics
Computing in Cognitive Materials group (PI: Herbert Jaeger)
Funding source: Cross-disciplinary CogniGron PhD project (Q-MAT)
- **Memoona Ismail (2024-2028)**
Edge of stability for enhanced memristive functionality
Solid State Materials for Electronics group (PI: Beatriz Noheda)
Funding source: EU HORIZON Marie Skłodowska-Curie Actions (MSCA) - Doctoral Networks (DN) (TOPOCOM)
- **Azminul Jaman (2020-2024)**
Towards a cognitive computer architecture based on memristive devices: developing short- and long-term memory
Spintronics of Functional Materials group (PI: Tamalika Banerjee)
Funding source: Cross-disciplinary CogniGron PhD project (MEMSTO)
- **Foelke Janssen (2022-2026)**
Qualitative modeling, simulation and exploration of multi-phenomenal materials dynamics (Q-Mat)
Solid State Materials for Electronics group (PI: Beatriz Noheda)
Funding source: Cross-disciplinary CogniGron PhD project (Q-MAT)
- **Ram Eshwar Kaundinya (2024-2028)**
Cognitive Architectures for Touch Based Applications
Cognitive Modeling group (PIs: Niels Taatgen / Jelmer Borst)
Funding source: CogniGron matching to Dutch Research Agenda (NWA) (NL-ECO)

- **Henrieke Krijgsheld (2024-2028)**
Mathematical Methods of Neuromorphic Computing and Control
Dynamical Systems, Geometry & Mathematical Physics group (PIs: Hildeberto Jardón-Kojakhetov/ Ming Cao)
Funding source: Cross-disciplinary CogniGron PhD project (MOTION)
- **Safiere Kuijpers (2023-2027)**
Memristive models for faster material design cycles towards applications
Computational & Numerical Mathematics group (PI: Julian Koellermeier)
Funding source: Cross-disciplinary CogniGron PhD project (MEMO)
- **Giuseppe Leo (2024-2028)**
Stochastic Spiking Wireless Multimodal Sensory Systems
Bio-Inspired Circuits and Systems group (PI: Elisabetta Chicca)
Funding source: EU European Research Council (ERC) Synergy (SWIMS)
- **Mian Li (2020-2025)**
Morphological image analysis of conduction maps Scientific Visualization and Computer Graphics
(PIs: Michael Wilkinson & Jos Roerdink)
Funding source: EU HORIZON Marie Skłodowska-Curie Actions (MSCA) - Innovative Training Networks (ITN) (MANIC)
- **Jesse Luchtenveld (2021-2025)**
Analogue phase-change memory cells for neuromorphic computing
Nanostructured Materials and Interfaces group & IBM Research-Zurich (PIs: Bart Kooi and Abu Sebastian)
Funding source: CogniGron-IBM fellowship
- **Davide Maioli (2024-2028)**
Neuromorphic High Level Information Processing
Cognitive Modeling group (PI: Matthew Cook)
- **Ton Juny Pina (2022-2026)**
Neuromorphic odor classification
Bio-inspired systems and circuits group (PI: Elisabetta Chicca)
Funding source: Cross-disciplinary CogniGron PhD project (SMARTEN)
- **Guillaume Pourcel (2020-2025)**
Theory of neuromorphic computing
Computing in Cognitive Materials group (PI: Herbert Jaeger)
Funding source: EU HORIZON Marie Skłodowska-Curie Actions (MSCA) - Innovative Training Networks (ITN) (POSTDIGITAL)
- **Himanshu Rai (2024-2028)**
Memristive models for faster material design cycles towards applications
Spintronics of Functional Materials group (PIs: Tamalika Banerjee/ Julian Koellermeier)
Funding source: Cross-disciplinary CogniGron PhD project (MEMO)
- **Julien van der Ree (2021-2024)**
Nanoparticle based percolating networks towards neuromorphic computing
Physics - Surface interactions and Nanostructures group (PIs: George Palasantzas/ Bart Kooi)
Funding source: Cross-disciplinary CogniGron PhD project (NANOPER)
- **Jan Rieck (2019-2024)**
Memristor networks from self-assembled domain walls in oxides
Solid State Materials for Electronics (PI: Beatriz Noheda)
Funding source: EU HORIZON Marie Skłodowska-Curie Actions (MSCA) - Innovative Training Networks (ITN) (MANIC)
- **Saad Saleh (2020-2024)**
New switching architectures with memristors for neuromorphic computing
Computer Networks group (PI: Boris Koldehofe)
- **Mart Salverda (2018-2023)**
Neuromorphic phenomena in thin film perovskite oxides
Solid State Materials for Electronics (PI: Beatriz Noheda)
- **Floor Schipper (2024-2026)**
The Geometry of Coupled Neurons towards Analog Computing
Dynamical Systems, Geometry & Mathematical Physics group (PIs: Hildeberto Jardón-Kojakhetov/ Ming Cao)
Funding source: Cross-disciplinary CogniGron PhD project (MOTION)



- **Albert Silvans (2024-2028)**
Physics and Statistics for Cognitive Devices
Stochastic Studies and Statistics group (PIs: Marco Grzegorzczuk/Beatriz Noheda)
Funding source: Cross-disciplinary CogniGron PhD project (ID-CODE)
- **Willian Soares Girão (2020-2024)**
Neuromorphic circuits for novel devices
Bio-inspired Circuits and Systems (PI: Elisabetta Chicca)
Funding source: EU HORIZON Marie Skłodowska-Curie Actions (MSCA) - Innovative Training Network (ITN) (MANIC)
- **Pablo Sorrentino (2024-2028)**
Security and Privacy in Neuromorphic Computing Device: Opportunities and Challenges
Information Systems Group (PIs: Fatih Turkmen/ Tamalike Banerjee)
Funding source: Cross-disciplinary CogniGron PhD project (NC-PRYSE)
- **Jordi Timmermans (2022-2026)**
Nb-doped SrTiO₃ memristive interfaces for bio inspired computing
Artificial Intelligence group (PI: Lambert Schomaker)
Funding source: Cross-disciplinary CogniGron PhD project (MEMSTO)
- **Haoran Yu (2024-2028)**
Ferroelectric memristors for energy-efficient computing
Solid State Materials for Electronics group (PI: Beatriz Noheda/ Georgi Gaydadjiev)
Funding source: CogniGron matching to Dutch Research Agenda (NWA) (NL-ECO)
- **Peter van der Wal (2023-2027)**
Robust learning of sparse representations: brain-inspired inhibition and statistical physics analysis
Information Systems group (PI: George Azzopardi)
Funding source: Cross-disciplinary CogniGron PhD project (SPARROW-NETS)
- **Bojian Zhang (2024-2028)**
Development, modelling, and characterisation of RRAM-based circuits for analog computing
Cognitive Systems (PIs: Erika Covi/ Farhad Merchant)
Funding source: Cross-disciplinary CogniGron PhD project (Neuroprivate)
- **Yiming Zhang (2024-2028)**
Low Power Probabilistic-bits Enabled Reckoning
Innovative Computer Architecture (PIs: Georgi Gaydadjiev/ Tamalika Banerjee)
Funding source: Cross-disciplinary CogniGron PhD project (LOPPER)
- **Jingtian Zhao (2023- 2027)**
Ferroelectric memristive devices
Solid State Materials for Electronics (PI: Beatriz Noheda)
Funding source: Chinese Scholarship Council (CSC) fellowship

Postdoctoral researchers

NEWLY STARTED POSTDOCTORAL FELLOWS IN 2025:

- **Dr. Simranjeet Singh**
Innovative Computer Architecture group (PI: Farhad Merchant)
Funding source: FSE Deep Tech Fellowship (Ximplic)

STARTED BEFORE 2025:

- **Dr. Martin F. Sarott (2024-2025)**
Reservoir Computing with ferroelectric devices
Solid State Materials for Electronics group (PI: Beatriz Noheda)
Funding source: EU HORIZON CL4 Digital Emerging programme (CONCEPT) and CogniGron stimulus grant.
- **Dr. Horatio Cox (2024-2026)**
Crystalline Oxides For Next Generation Computation and Emerging Photonic Technologies
Solid State Materials for Electronics group (PI: Beatriz Noheda)
Funding source: EU HORIZON CL4 Digital Emerging programme (CONCEPT)
- **Dr. Fernando Quintana Velázquez (2024-2026)**
Highly integrated Hardware-Software Co-Development for Adaptive AI
Cognitive Systems (PI: Erika Covi)
- **Dr. Alejandro Pequeño Zurro (2023-2027)**
Tactile Internet: remote sensing with neuro-morphic technology
This project has received funding from the Dutch NWA Project NL-ECO.
Bio-inspired Circuits and Systems (PI: Elisabetta Chicca)
Funding source: Dutch Research Agenda (NWA) (NL-ECO)
- **Dr. Gaurav Vats (2023-2025)**
SMART: Synchronised neuro-Memristive Architecture for Reinforced learning Technology
Solid State Materials for Electronics (PI: Beatriz Noheda)
Funding source: EU HORIZON Marie Skłodowska-Curie Actions (MSCA) - Individual fellowship (IF) (FAST; grant agreement ID: 892669)

COGNIGRON TALENT NETWORK (CTN)

With researchers from CogniGron spread across different departments and disciplines, there was a clear need to strengthen connections and deepen scientific understanding across the centre. Enter the CogniGron Talent Network (CTN), which took shape in early 2024 with one goal in mind: to bring together the PhD candidates and postdoctoral researchers who form the heart of CogniGron.

The CTN acts as a platform for connection, collaboration, and communication across CogniGron's diverse research community. Throughout 2025, the CTN board organised a monthly lecture series introducing fundamental concepts in neuromorphic computing in an accessible way for researchers from different disciplines.

Alongside these academic activities, the board also organised social events every other month, ranging

from lab tours and poster sessions to bowling nights and boat trips. These gatherings give researchers the opportunity to connect beyond their individual projects and help foster a stronger sense of community across the centre.

In addition to organising activities, the CTN board serves as a sounding board for the CogniGron community. By sharing feedback with the CogniGron office, the board helps ensure that the perspectives of PhD candidates and postdocs are represented within the centre.

The CTN board of 2025 consisted of Otavio, working at the intersection of physics, computer science, and machine learning; Martin, focusing on materials science; Jordi, combining physics and artificial intelligence; and Safiere, specialising in computational mathematics.



Caption: From left to right, Octavio Citton, Martin Sarott, Jordi Timmermans, and Safiere Kuijpers.

HIGHLIGHTS

IN THE NEWS

DUTCH ECOSYSTEM IN NEUROMORPHIC COMPUTING IS DEVELOPING RAPIDLY

Following the publication of the White paper on Neuromorphic Computing in the Netherlands in November 2024, the Dutch Neuromorphic ecosystem has rapidly advanced and CogniGron was a key contributor to this development. In 2025, CogniGron representatives joined two Innovation Missions on Neuromorphic and Future-proof computing organized by the Netherlands Enterprise Agency in close collaboration with the Dutch Embassy for the UK. Furthermore, the Dutch Neuromorphic community gathered at the second ecosystem meeting, Neuromorphic Now, in Delft. At these events, important steps were taken to develop a national roadmap for Neuromorphic technologies in the Netherlands.

COGNIGRON IN THE SPOTLIGHT AT THE OFFICIAL OPENING OF THE FERINGA BUILDING

The TEXEL Chip, the first neuromorphic processor developed at CogniGron, was symbolically handed to Prince Constantijn of the Netherlands (special envoy Techleap) by CogniGron PI Elisabetta Chicca during the official opening of the Feringa Building on June 17th. CogniGron PI Tamalika Banerjee was part of the panel discussion on 'From Knowledge to Impact' to represent IMChip, a start-up founded by her in 2024.



COGNIGRON IN THE MEDIA

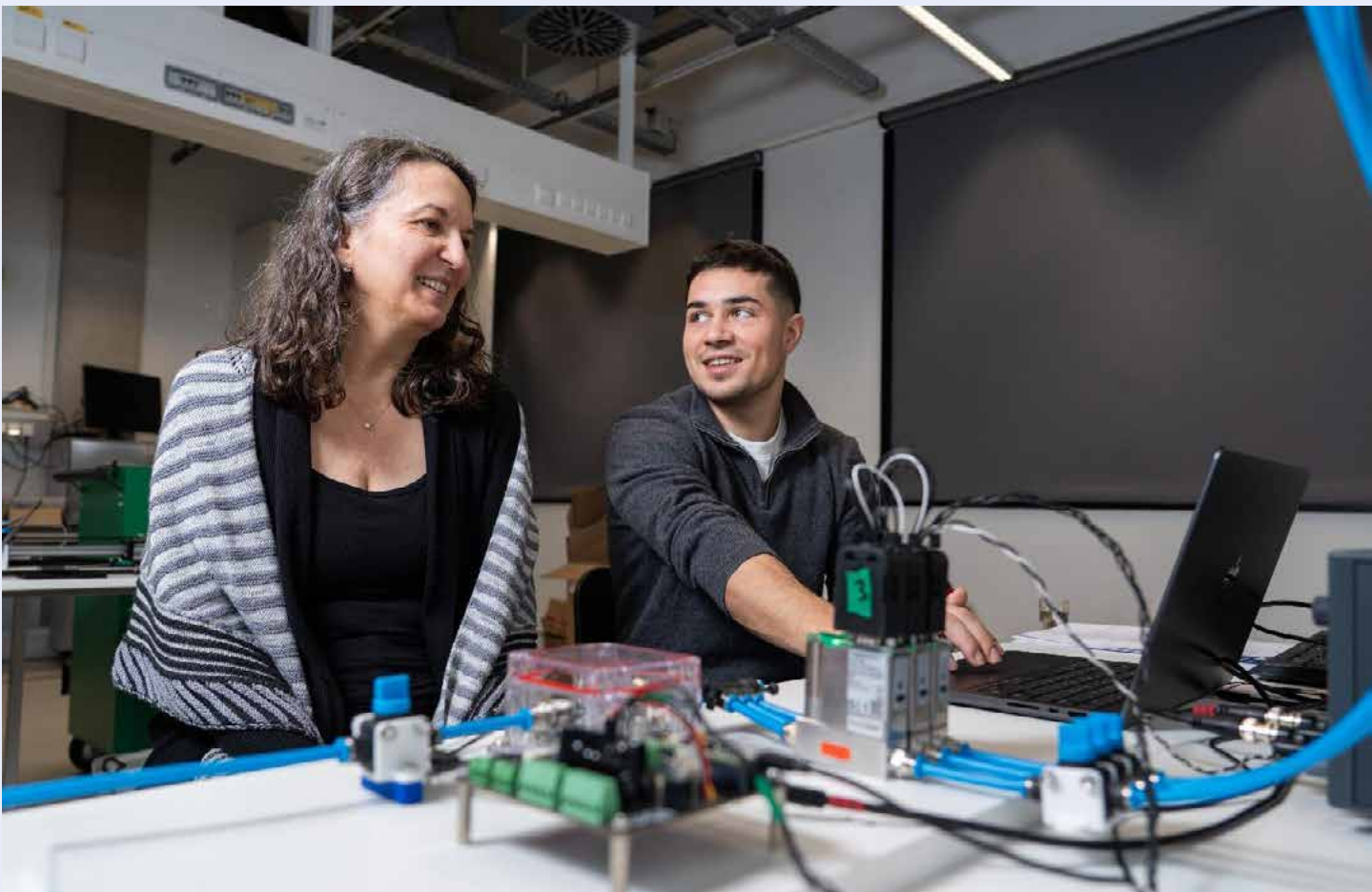
In 2025, CogniGron and IMChip received national media attention through outlets such as NRC and NPO Radio 1. This coverage contributed to positioning Groningen as a leading location for neuromorphic computing and energy-efficient AI hardware, and increased the visibility of both the research and its associated valorization activities. For instance, the NRC article describes how our researchers develop neuromorphic computers by drawing inspiration from the brain of a fruit fly. The groundbreaking work of Prof. Elisabetta Chicca and Prof. Beatriz Noheda is highlighted in the article.

NEW PIs JOIN THE COGNIGRON TEAM

In 2025, two PIs from the Engineering and Technology institute Groningen (ENTEG), Bahar Haghighat and Elisabeth Wilhelm, joined CogniGron. They bring valuable expertise on robotic systems that will be especially valuable for the demonstrator programme that is aimed towards application of neuromorphic technologies for real-world applications.

NEW COGNIGRON START-UP COMPANY XIMPLIC OFFICIALLY REGISTERED

Future Tech Ventures has invested in Groningen-based startup Ximplic, the second CogniGron spin-off. This spin-off is focussing on developing technology to dramatically reduce the energy consumption of artificial intelligence applications. Ximplic develops patented Computing-in-Memory solutions that significantly improve the energy efficiency of AI systems. Ximplic's technology enables chip designers to build faster, smarter and more sustainable AI-enabled products.



HIGHLIGHTED PUBLICATIONS

TEXEL CHIP PUBLISHED IN NATURE COMMUNICATIONS

Developed in Prof. Chicca's group at CogniGron, the TEXEL chip introduces a mixed-signal neuromorphic architecture, designed to integrate novel two- and three-terminal devices with silicon-based circuits. The chip serves as a flexible platform for testing on-chip learning algorithms and exploring how emerging materials and device technologies can be applied to bio-inspired computing.

By co-locating memory and processing, TEXEL reflects key features of neural systems, paving the way for low-power, scalable alternatives to traditional computing architectures. The publication highlights both experimental results and simulations, demonstrating the chip's readiness for integration with next-generation neuromorphic components.

The chip exemplifies CogniGron mission: transforming fundamental science into hardware innovations that move us closer to energy-efficient, intelligent systems.

[A neuromorphic processor with on-chip learning for beyond-CMOS device integration.](#)

Greatorex, H., Richter, O., Mastella, M., Cotteret, M., Klein, P., Fabre, M., Rubino, A., Soares Girão, W., Chen, J., Ziegler, M., Bégon-Lours, L., Indiveri, G., & Chicca, E. Nature Communications, 16(1), 6424.

MATHEMATICAL MODELLING OF MEMRISTOR NETWORKS PUBLISHED IN AUTOMATA

The mathematical study of the predicted behavior of newly developed devices such as memristors for future chip technologies is very important from a material science perspective. Memristors are resistors with memory storage. They are of special interest for future neuromorphic computing applications because they can act as non-volatile memory, which means they can retain stored information even after power is removed. It was previously shown that networks of memristors are more robust to failure and variability than individual memristor devices, and they show an increased tunability of their properties. Therefore, memristors constitute promising elements to apply in neuromorphic hardware as mimics of biological neuronal synapses.

To understand their predicted behaviour better, the article by CogniGron researchers from the Bernoulli Institute introduces a mathematical framework for modeling memristor networks, proving that their port behavior can be described by a single "effective memristor." The work bridges mathematics and materials science, reflecting CogniGron's interdisciplinary approach. It is a valuable example demonstrating how mathematical modeling can inform design of neuromorphic hardware by providing and predicting explicit bounds and characterizations for newly developed materials and devices before testing them in neuromorphic hardware implementations.

[Modelling of memristor networks and the effective memristor.](#)

Huijzer, A.-M., van der Schaft, A., & Besselink, B. (2025).

Automatica, 171, 111922.

GRANTS

RESEARCH GRANT SUCCESS FOR COGNIGRON RESEARCHERS

In 2025, CogniGron researchers achieved remarkable success in securing external funding. Through their proposals, they secured over €4.1 million in grants. This underscores both the scientific excellence of CogniGron's research and its strong alignment with national and international funding programs.

NWO Large-Scale Research Infrastructure grant

One of the successful projects is the [EBRAINS-Neurotech](#) project within the NWO Large-Scale Research Infrastructure programme. This consortium, led by the University of Amsterdam (UvA), aims to accelerate progress in brain technology and neuromorphic computing. Part of the project will focus on neuromorphic chips – processors that mimic how neurons process and transmit information.

[EC MSCA-Doctoral network project REACT](#)

Coordinated by CogniGron PI Dr. Farhad Merchant, the REACT project brings together 15 early-stage researchers (PhDs) across

13 leading research institutions working at the forefront of developing neuromorphic platforms that are energy-efficient, reliable, and secure — all crucial qualities for the future of sustainable, AI-driven computing.

[ERC Proof of Concept Grant for Erika Covi's Brain-Inspired AI Hardware Project "FELICE"](#)

This project addresses a key challenge in artificial intelligence: the need for compact, low-power hardware capable of real-time learning and decision-making at the edge. Covi's project introduces a new neuromorphic architecture based on ferroelectric leaky integrate-and-fire (FeLIF) neurons, built from non-volatile FeFET memory technology. These components enable efficient on-chip learning and temporal data processing, while significantly reducing power and area requirements.

[Tamalika Banerjee is awarded the NWO Take-off grant](#)

Banerjee's project, "Brain-inspired integrated memory chips for energy-efficient computing", addresses a growing challenge in the field of artificial intelligence: the unsustainable energy

demands of current AI hardware, which is based on the conventional von Neumann architecture. Her research group investigates brain-inspired computing as an alternative, using memristor devices — nano-scale components capable of mimicking neuronal behaviour.

[Prof. Bahar Haghighat awarded NWO-Vidi grant](#)

This project led by CogniGron PI Prof. Bahar Haghighat develops a new system of miniature robots that move across steel structures to detect signs of structural damage. Working together as an intelligent swarm, the robots analyze vibration signals to identify potential defects and adapt their inspection strategy in real time.

[IMChip awarded SNN VIA subsidy to advance brain-inspired chip technology](#)

IMChip, CogniGron's first spin-off company, has been awarded the SNN VIA subsidy from the Just Transition Fund. The funding will support IMChip's project SIMS-AI, which focuses on developing scalable cleanroom processes for manufacturing brain-inspired chips — hardware designed to emulate the efficiency and adaptability of the human brain.

AWARDS

Three CogniGron researchers awarded Marie Skłodowska-Curie fellowships

Serte Donderwinkel, Fernando Quintana Velázquez, and Martin Sarott were awarded the prestigious Marie Skłodowska-Curie Fellowships. Fernando's project, MALEFICENT, focuses on sustainable AI at the edge, using emerging memory technologies and advanced learning techniques; In GraPhTra, Serte investigates the universality of phase transitions in random graphs; and Martin's project, RECOMPUTE, explores in-materialio reservoir computing, developing thin layers of complex oxides with customisable properties to perform computational tasks.

Beatriz Noheda receives first-ever WISE Award

Beatriz received the WISE (Women in Science and Engineering) Award. The award celebrates UG colleagues whose leadership, creativity, and advocacy improve the participation, experience, and success of women in science and engineering at the Faculty of Science and Engineering.



Dr. Serte Donderwinkel receives Bernoulli Society New Researcher Award

Serte was awarded the Bernoulli Society New Researcher Award: an international early-career award recognises outstanding contributions in Probability Theory and Mathematical Statistics, highlighting researchers who are shaping the future of these fundamental mathematical disciplines.

Dr. Martin Sarott wins FSE Postdoc Prize 2025 and Prix Schläfli 2025 in Physics

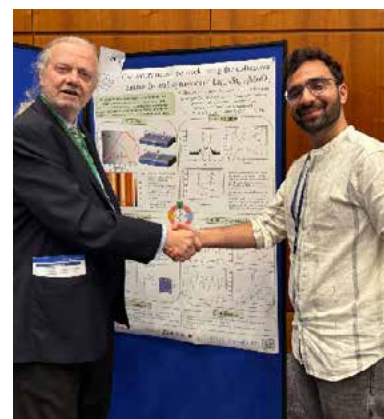
Martin, a postdoctoral researcher within Beatriz Noheda's research group, received the FSE Postdoc Prize for his outstanding and forward-looking research on complex oxide thin-films for sustainable and energy-efficient computing.



Martin's outstanding performance has also been recognised by the Swiss Academy of Sciences (SCNAT), from which he received the Prix Schläfli 2025 for his dissertation on ferroelectricity. These awards showcase Martin's remarkable creativity, independence, and potential for scientific leadership.

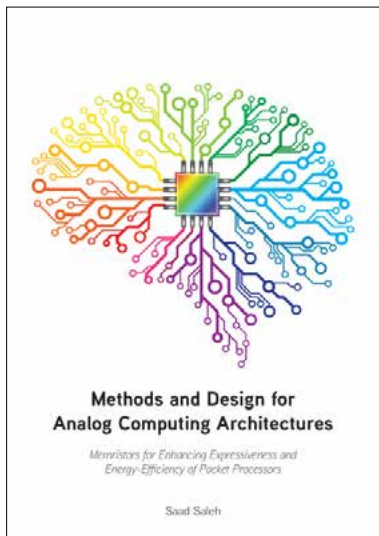
Poster prizes

PhD student Hitesh Chhabra from Tamalika Banerjee's research group won a Poster prize at the Memrisys conference 2025 in Edinburgh.



AWARDED PHD DEGREES

METHODS AND DESIGN FOR ANALOG COMPUTING ARCHITECTURES - Memristors for Enhancing Expressiveness and Energy-Efficiency of Packet Processors



PhD candidate: Saad Saleh
Defended: 7 January 2025
Supervisors: Prof. Boris Koldehofe, Prof. Alexander Lazovik

Abstract

The Internet heavily relies on packet processors for establishing the communication links between senders and receivers of network traffic. Despite their promising performance, the current generation of packet processors consume a huge amount of energy and provide limited support for more expressive functions like brain-inspired cognitive computing models. The major reason is the underlying

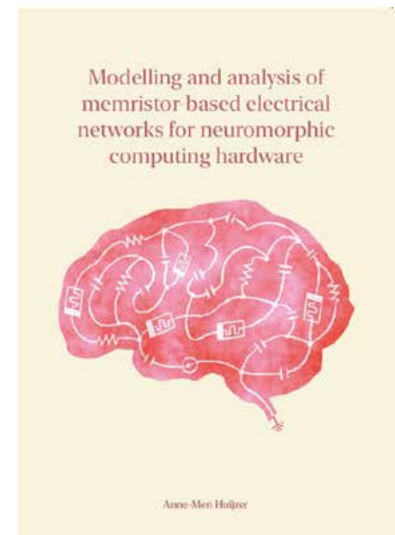
transistor-based technology, which builds on digital computations and requires energy intensive data movements between storage and computational units inside these components. In this research, we show that the recent emerging technologies from the analog domain, especially Memristors, have a huge potential for increasing energy efficiency and supporting cognitive functions in packet processors.

This thesis proposes an analog architecture for packet processors in order to support energy-efficient and cognitive functions in computer networks. Central to this design is a novel analog memory abstraction called Probabilistic Content Addressable Memory (pCAM). It provides both digital and analog outputs for supporting more expressive functions in packet processors. In order to support traditional digital operations, we propose a novel memristor-based TCAM memory. Building on analog computations, we further propose a congestion control mechanism, called derivative-based active queue management (dAQM), for better management of network traffic.

The performance of the proposed analog architecture was analyzed over a physically fabricated Nb doped SrTiO₃ memristor chip. The results showed that analog processing consumes up to 50 times less energy than digital processing. Moreover, the analog dAQM

function provides up to 39.7% better performance than the state-of-the-art algorithms.

MODELLING AND ANALYSIS OF MEMRISTOR-BASED ELECTRICAL NETWORKS FOR NEUROMORPHIC COMPUTING HARDWARE



PhD candidate: Anne-Men Huijzer
Defended: 24 February 2025
Supervisors: Prof. Bart Besselink, Prof. Arjan van der Schaft, Prof. Beatriz Noheda

Abstract

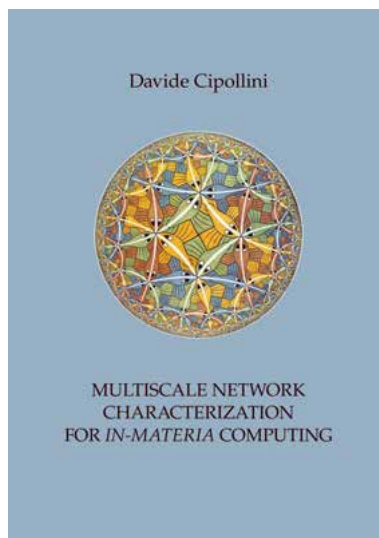
Recent developments in artificial intelligence (AI) have stimulated the design of software programs that use AI techniques, also called AI applications. These new applications are very convenient for their users. However, a big drawback is that they consume

a lot of energy. This motivates the development of new computing technology that makes AI applications more energy-efficient. The field of neuromorphic computing aims to develop this technology by taking inspiration from the brain. To do so, new analogue computing hardware is required.

The new nanoscale materials used in this computing hardware are developed in specialised labs. Due to the small scale of these materials, it is difficult to grasp the behaviour of these materials. However, it is predicted that these materials behave like electrical networks constructed of electrical components such as resistors, memristors (i.e., resistors with memory), and capacitors.

Motivated by this, in this thesis, we use mathematical modelling and analysis techniques to study the behaviour of electrical networks comprising resistors, memristors, and capacitors. The objective of this study is, first, to obtain more insight into the behaviour of networks constructed of these electrical components, and, second, to understand if and how these networks can be used to mimic the behaviour of neurons and synapses in the brain.

MULTISCALE NETWORK CHARACTERIZATION FOR IN-MATERIA COMPUTING



PhD candidate: Davide Cipollini
Defended: 25 March 2025
Supervisors: Prof. Lambert Schomaker, Prof. Beatriz Noheda

Abstract

Developing new computer systems is necessary to address the ever-increasing demand for energy for digital information processing. The research on neuromorphic systems combines material sciences with mathematical modeling and methods from AI.

Novel materials are currently proposed for creating unconventional hardware and corresponding tailor-made algorithms. A potentially fruitful paradigm involves random self-assemblies of nonlinear conducting elements, enabling coupling between structure and function for neurally inspired computation 'in matter'.

In this thesis, these systems are addressed using the mathematical perspective of network modeling, as it can describe structural properties, such as modularity and hierarchical organization, using concepts from statistical physics, information theory, and thermodynamics.

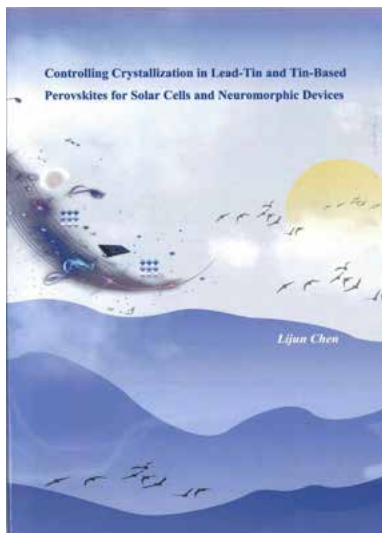
Within this network-based framework, we present a model of disordered memristor-resistor networks describing the functional properties of self-assembled materials in which a random fraction of plain Ohmic, i.e., resistive elements are present.

The intricate structural organization of so-called 'domain wall' networks in bismuth ferrite thin films is replicated by a novel tessellation-based stochastic model optimized with a multiscale quantity for networks, the spectral entropy.

Structure and function can be characterized simultaneously through multiscale analyses of self-organizing structures generated by an algorithm that creates tree structures from a dataset of patterns. We show that the measured complexity of the dataset is encoded in the highly efficient structural traits of such self-organized networks.



CONTROLLING CRYSTALLIZATION IN LEAD-TIN AND TIN-BASED PEROVSKITES FOR SOLAR CELLS AND NEUROMORPHIC DEVICES



PhD candidate: Lijun Chen

Defended: 25 March 2025

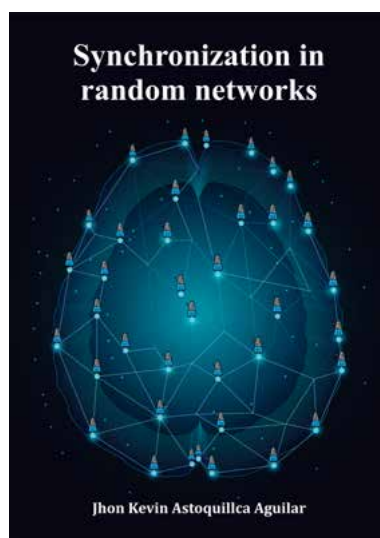
Supervisors: Prof. Maria Loi, Prof. C.J. Brabec

Abstract

Metal halide perovskites, renowned for their exceptional optoelectronic properties, have emerged as promising candidates for next-generation semiconductor materials, addressing critical challenges such as the energy crisis and the increasing demands of information technology. Building on these advantages, perovskite solar cells have achieved significant advancements in recent years, while perovskite memristors have also risen as a promising frontier. However, the path toward commercialization remains hindered by several challenges, including large-scale production, material toxicity, long-term stability, and other factors.

In this thesis, we present the first exploration of blade coating technology for fabricating high-efficiency, stable, and low-toxicity lead-tin (Pb-Sn) and tin (Sn)-based perovskite solar cells, achieving efficiencies exceeding 16% and 10%, respectively. These results rank among the highest efficiencies for large-scale production methods. Additionally, we investigated the use of non-toxic solvents for perovskite device fabrication. Moreover, low-dimensional Pb-Sn perovskites were applied to memristors for the first time, exhibiting repeatable and highly stable memristive properties with potential applications in neuromorphic computing. The excellent performance of these devices contributes to advancing sustainable and multifunctional applications of metal halide perovskites.

SYNCHRONISATION IN RANDOM NETWORKS



PhD candidate: Jhon Astoquillca Aguilar

Defended: 22 April 2025

Supervisors: Prof. Holger Waalkens, Prof. Rodrigues Valesin

Abstract

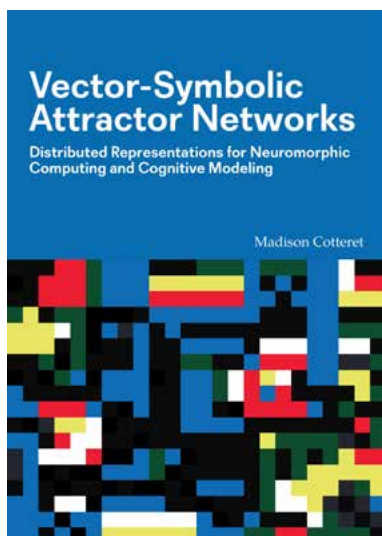
At CogniGron, the research group aims to develop a new generation of computers that emulate the behavior of the most efficient computer known—the human brain. Inspired by the study of brain connectivity, this project is part of a broader collaboration with physicists working toward the creation of a neuromorphic computing device modeled after human cognitive processes.

Our primary goal is to propose a stochastic model that captures key properties observed in experimental research. Specifically, our model incorporates two fundamental aspects: (1) the synchronization of interacting agents and (2) the dynamic and randomly evolving nature of the environment in which these agents operate.

We propose the voter model as a model of synchronization and obtain a detailed characterization of the equilibrium states and its properties when the model runs in regular networks and random dynamic networks.

VECTOR-SYMBOLIC ATTRACTOR NETWORKS

- Distributed
representations
for neuromorphic
computing and
cognitive modeling



PhD candidate: Madison Cotteret
Defended: 6 May 2025
Supervisors: Prof. Elisabetta Chicca, Prof. Martin Ziegler

Abstract

Neuromorphic computing aims to match the efficiency and adaptability of human intelligence by emulating the computational principles of biological cognitive function. In doing so, it promises to overcome the limitations of conventional AI systems which, despite impressive performance, often lack generalisable capabilities and require vast computational resources. More faithfully emulating biological processing elements has yielded success in small-scale sensory tasks, but scaling up this approach to more difficult tasks has proven challenging. As the size and demands of neuromorphic systems grow, issues of reliability and program-

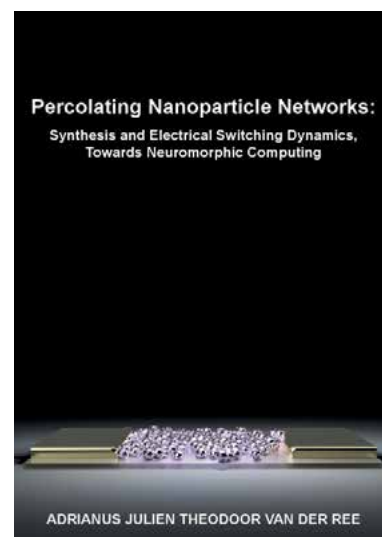
ming complexity emerge, prohibiting the development of extended neuromorphic systems for real-world application.

This thesis addresses these challenges by combining two biologically-inspired areas of study: Vector-Symbolic Architectures (VSAs) and attractor networks. VSAs are a systematic framework for representing data structures with high-dimensional vectors, such that the encoded information is distributed equally across all neurons. Attractor networks endow neuromorphic and biological systems with emergent stability and have found widespread use as state-holding autoassociative memories, but their potential for broader computational use remains underexplored. Both paradigms are particularly appealing for neuromorphic hardware, where scale and parallelism are cheap, but the reliability of individual components is far from assured.

The combination of VSAs and attractor networks enables a scalable approach to directly map symbolic data structures and computational primitives onto large unreliable networks. By leveraging the insensitivity to component failure of attractor networks, this approach achieves a previously unattainable degree of simultaneous flexibility and robustness in neuromorphic systems. This is a necessary advancement for neuromorphic systems to mature into more general and reliable computing platforms, enabling the development of low-power neuromorphic hardware capable of performing extended cognitive tasks.

PERCOLATING NANOPARTICLE NETWORKS

- Synthesis
and electrical
characterization,
towards
neuromorphic
computing



PhD candidate: Julien van der Ree
Defended: 16 September 2025
Supervisors: Prof. George Palsantzas, Prof. Bart Kooi

Abstract

This dissertation addresses the urgent need for sustainable computing alternatives in light of the global energy crisis. Inspired by the efficiency of the human brain, neuromorphic computing has emerged as a promising paradigm. Within this context, percolating nanoparticle networks are explored as potential building blocks for low-power, adaptive computation.



The work begins with the development of precise measurement setups, enabling controlled creation of networks at the percolation threshold and reliable in-operando electrical analysis. Using these methods, molybdenum nanoparticle networks were fabricated that exhibit unprecedentedly low-voltage resistive switching in the millivolt range—over a thousand-fold improvement compared to previous reports. Structural analysis revealed stellate “porcupine-like” nanoparticles, whose sharp features concentrate local fields and enable stable switching, establishing molybdenum as a prime candidate material.

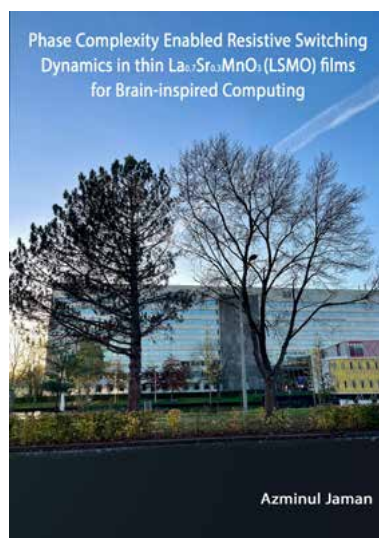
Building on this, scanning electron microscopy uncovered intensity contrasts arising not from morphology or composition but from electrically driven changes in connectivity. In situ correlative measurements demonstrated that these intensity fluctuations coincided with resistive switching events, providing new insight into network dynamics.

Copper networks were also investigated to benchmark against established materials such as tin, silver, and gold. However, copper required oxide stabilization and exhibited poor long-term stability, with irreversible melting and reconfiguration under bias. These findings clarified material requirements for functional networks and highlighted stability as a central challenge.

Finally, new directions are proposed, including semi-conducting, magnetic, and phase-change nanoparticles for

multifunctional neuromorphic architectures. Together, the results establish molybdenum nanoparticle networks and novel characterization approaches as important advances, paving the way for energy-efficient neuromorphic computing.

PHASE COMPLEXITY ENABLED RESISTIVE SWITCHING DYNAMICS IN THIN $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$ (LSMO) FILMS FOR BRAIN-INSPIRED COMPUTING



PhD candidate: Azminul Jaman
Defended: 30 September 2025
Supervisors: Prof. Tamalika Banerjee, Prof. Niels Taatgen

Abstract:

Our modern computers face a major problem: they waste enormous amounts of energy constantly moving data back and forth between memory and processors. This is like having a chef who keeps all ingredients in a distant pantry and must run back and forth for every single item—highly inefficient! The

human brain, however, stores and processes information in the same place, making it incredibly energy-efficient for complex tasks like recognizing faces or understanding speech.

This research explores a special class of materials called manganites that could help build brain-inspired computers. These materials have a remarkable property: they can switch between different electrical states, essentially acting as both memory and processor simultaneously. By carefully controlling the material's structure—like tuning a piano—we can create different behaviors ranging from simple switches to complex oscillators that mimic brain neurons.

The key breakthrough is understanding how tiny structural changes in the material create dramatically different electrical properties across a single chip. Some regions behave like volatile memory (information disappears when power is off), while others act like permanent storage. Most excitingly, some regions show random, probabilistic behavior—exactly what's needed for artificial intelligence that can learn and adapt like biological brains.

This work opens the door to revolutionary computer chips that could run AI applications while consuming thousands of times less energy than today's computers, potentially enabling everything from ultra-smart smartphones that never need charging to powerful AI systems that don't require massive data centers.

ULTRA-LOW-POWER MACHINE INTELLIGENCE



PhD candidate: Hugh Greatedorex
Defended: 18 November 2025
Supervisors: Prof. Elisabetta Chicca, Prof. Regina Dittmann

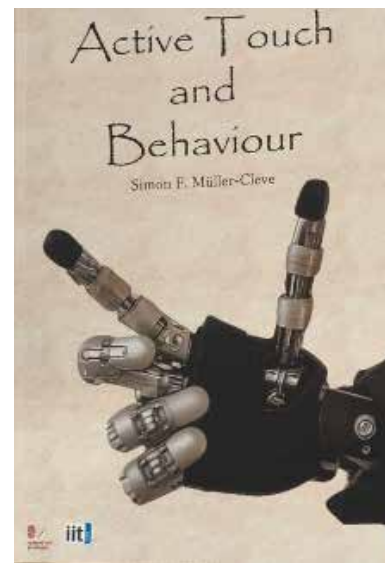
Abstract:

The combination of efficiency and adaptive intelligence exhibited by biological systems is seen as a holy grail of Artificial Intelligence (AI). As the world witnesses accelerating advances in AI capabilities, there is a parallel urgency to explore how to maintain intelligence while scaling down computational resources and energy consumption. Neuromorphic computing addresses this challenge by fundamentally rethinking hardware architectures and principles of computation to align with biology. Thus, artificial systems can move closer to the properties that make biological systems so energy efficient: in-memory computation, sparse event-driven communication, and massively parallel processing.

Among biological systems, simpler neural architectures such as that of the fruit fly have been researched extensively by neuroscience. Their small brain size offers a tractable system for understanding neural computation, yet despite this small size, flies demonstrate precise and rapid motor control, process complex sensory information, and learn from experience, all capabilities that current artificial systems require orders of magnitude more energy to achieve.

By abstracting insights from neuroscience, this thesis translates computational principles from fruit fly neural circuits into dedicated neuromorphic hardware designed for ultra-low-power computation and event-based processing. By emphasising principles such as precise temporal coding and sparse neural activation, this work develops specialised intelligent systems capable of operating within tight energy constraints. This demonstrates how marrying the computations observed in biology with appropriate hardware enables perception and intelligence to be applied at the extreme edge where power budgets are most stringent and the latency of sensory motor loops should be as low as possible.

ACTIVE TOUCH AND BEHAVIOUR



PhD candidate: Simon Müller-Cleve
Defended: 24 November 2025
Supervisors: Prof. Elisabetta Chicca, Dr. Chiara Bartolozzi

Abstract

Humanoid robots have garnered significant attention for their adaptability to dynamic tasks. Despite advancements in vision-based sensing and deep learning, tactile sensing -- crucial for safe human-robot interaction and dexterous manipulation -- remains underutilized. This thesis addresses the challenges of integrating touch, a fundamental human sensory modality, into robotic systems, focusing on bio-inspired approaches and neuromorphic computation.

The human tactile system, characterized by mechanoreceptors, neural pathways, and proprioceptive integration, provides a blueprint for designing tactile sensors. Drawing

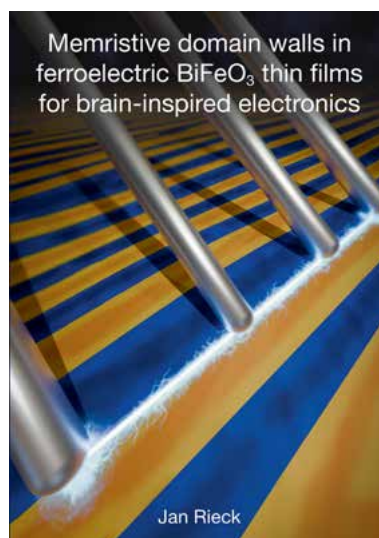
on these principles, recent developments in tactile sensing technologies are reviewed, from low-resolution designs to high-resolution sensors enabled by advanced manufacturing. This work highlights the advantages of event-driven processing for efficient tactile encoding, which mimics biological systems by transmitting data only upon input changes. Using these methods, a novel tactile Braille dataset was created, featuring the iCub fingertip sliding over 3D-printed Braille letters. Encoding strategies inspired by Fast Adaptive (FA) mechanoreceptors reduced data by up to 122 times. Neuromorphic hardware (Intel Loihi) demonstrated significant power savings during letter classification, achieving efficiency gains over traditional GPU-based methods, though at a cost to accuracy.

To further advance encoding methods, the WiN-GUI was developed, allowing researchers to visualize and optimize spike-pattern encoding in real-time. This tool integrates temporal, spatial, and spatio-temporal datasets to evaluate neuron behavior and classification performance, with applications extending beyond tactile sensing. Complementing this, human haptic object exploration was analyzed to uncover kinematic synergies and Exploratory Procedures (EPs). Using a multimodal dataset of blindfolded participants solving tactile discrimination tasks, this study identified recurring movement patterns and dimensionality reduction strategies that could inform robotic hand control.

By bridging insights from biology, neuromorphic engi-

neering, and robotics, this work offers scalable solutions for touch-sensitive robots designed for dynamic and human-centric environments, paving the way for safer and more capable systems.

MEMRISTIVE DOMAIN WALLS IN FERROELECTRIC BIFE03 THIN FILMS FOR BRAIN-INSPIRED ELECTRONICS



PhD candidate: Jan Rieck
Defended: 9 December 2025
Supervisors: Prof. Beatriz Noheda, Prof. Lambert Schomaker
Co-supervisor: Dr. S.F. Karg

Abstract:

Today's technology demands ever-increasing computational power for applications such as the Internet of Things and self-driving cars. Tasks such as image recognition consume large amounts of energy on current computers, while further transistor scaling is approaching physical limits. Inspired by the brain's exceptional efficiency in processing information, neuro-

morphic computing seeks to develop powerful yet energy-efficient hardware. Advanced materials may play a key role in solving these problems.

One promising class of materials concerns multiferroic oxides. When grown as a thin film, they self-assemble into nano-scale domains that differ in the orientation of a specific order parameter, such as the electric polarization in the case of ferroelectrics. These regions are separated by domain walls, forming complex and interconnected networks. Interestingly, domain walls display higher conductivity than the host material and can be tuned to some extent by applying electrical signals, similar to a resistor with memory (a so-called memristor). As a result, the domain walls form conductive pathways within the network - resembling the connections between neurons in the brain.

This thesis examines domain walls in the prominent multiferroic material bismuth ferrite (BiFeO₃) and their potential for brain-inspired electronics. To this end, the lateral electrical transport along domain walls through the network is characterized in detail using both established advanced measurement techniques and novel nanotechnology methods applied to this material for the first time. The findings highlight the fascinating transport properties of self-assembled domain wall networks and address both the possibilities and challenges of realizing neuromorphic hardware based on these systems.



OUR RESEARCH

Research Projects

CROSS-DISCIPLINARY PHD PROJECTS

Cross-disciplinary PhD projects

In the first phase of CogniGron, Principal Investigators from different disciplines developed shared research projects on which several PhD students were appointed. The proposed research was aimed

to contribute solutions beyond the state of the art and should enhance the collaboration between the different disciplines present within CogniGron. The proposals were awarded based on reviews by the CogniGron Programme board.

RUNNING PROJECTS:

Bio-inspired neuromorphic touch-sensing system (NEUROTACT) (awarded in 2024)

Humans perceive and identify their environment by touch, but this sensation requires sophisticated physical and neuronal mechanisms that involve physical stimuli, mechanoreceptors in the skin, bioelectrical signals and neuronal information processing, etcetera. Thus, multidisciplinary research is crucial to successfully develop and emulate artificial touch-sensing systems and their implementation in daily life applications. Therefore, we propose the development of bio-inspired neuromorphic sensing systems interfacing the tactile capabilities of flexible piezoelectric sensors with dedicated neuromorphic systems. We will focus on the fabrication and integration of flexible sensors, circuit interfaces and neuromorphic spiking neuronal networks.

Project leaders: Mónica Acuautla Meneses (Engineering) and Elisabetta Chicca (Electronics)

PhD students: Milad Jabri and Federico Loi

The multiple timescales of neuromorphic systems and control (MOTION) (awarded in 2024)

A neuromorphic device can be regarded as a multi-scale input-output system comprised by a

network of interconnected neurons. With the purpose of making neuromorphic computing more explainable, our project will develop a mathematically rigorous approach to analyze dynamic networks involving multiple timescales to improve our understanding of the capabilities of neuromorphic devices and their applications. In particular, we will a) better understand how complex ensembles of neurons behave, and b) ask how one can design such ensembles for specific purposes utilizing tools from systems and control engineering. Towards this end, we make full use of recent advances in perturbation theory, system's theory and control, group theory, graph theory, mean-field and reduction techniques. Furthermore, we will make original contributions to the design of reliable neuromorphic controllers within the context of multi-agent systems and control.

Project leaders: Ming Cao (Engineering) and Hildeberto Jardón-Kojakhmetov (Mathematics)

PhD students: Henrieke Krijgsheld and Floor Schipper

Opportunities and challenges of the state-of-the-art Neuromorphic Computing devices for security and privacy (NC-PRYSE) (awarded in 2024)

Inspired from how the human-brain works, neuromorphic computing has the promise that many of the AI tasks can be performed in orders of magnitude more efficiently in terms of energy consumption and computational requirements than the current AI solutions. In this cross-disciplinary project, we aim to investigate the security of neuromorphic chips against side channel attacks and their suitability for implementing security-critical functionality. Starting

the investigation at the level of circuits, our particular focus will be on memristor-based designs (and the commonly used materials in their construction), their security relevant properties (e.g., stochasticity and indistinguishability) and some of the high level choices during their design/usage. Our project can contribute to better choices in the design/implementation of memristor-based neuromorphic devices, at the stage before their large-scale industrial production and adoption takes place.

Project leaders: Fatih Turkmen (Computer science) and Tamalika Banerjee (Materials science)

PhD student: Pablo Sorrentino

COGNIGRON PHD CANDIDATE FLOOR SCHIPPER ABOUT HER PROJECT

"I've only worked on my project for a year, and whilst the intent and motivation behind it is interdisciplinary, the project is not yet at a phase where this can be used in an interdisciplinary setting. We are currently in the process of explaining what we see mathematically in a precise way and how we can exploit the properties we have, for one particular artificial neuronal model (Fitz-Hugh Nagumo).

This particular model does not quite behave the way that biological neurons in our brain behaves, nor does it behave exactly like the neuron-mimicking materials and devices that some of the physicists and material scientists in Cognigron are working with. However all the models of neurons are very 'similar' in a mathematical sense. After we can mathematically explain our particular model to a satisfactory level, we plan to generalize it to an entire class of neuron models, which could then be used to predict how a neuromorphic system such as an analog chip with specific materials and devices built by material scientists will behave without actually needing to build and test it. Such a mathematical model can also be used to predict how coupling of individual artificial neurons would change the overall system and the outcome of specific tasks."



Privacy preserving architecture using novel cognitive ReRAM devices (Neuroprivate) (awarded in 2024)

The emergence of the Internet of Things (IoT) has provided a large surface for bad actors to carry out various types of attacks, ranging from denial of service to side-channel attacks. The obvious solution to this challenge is to apply homomorphic encryption to this sensitive data to ensure that the leaked information is useless for an attacker. However, the homomorphic encryption in its present form with the classical CMOS-based hardware incurs unacceptable area and energy footprints. In this project, we incorporate post-CMOS technology, such as Resistive Random Access Memory (ReRAM), coupled with innovative computer architecture design to achieve the energy-efficient homomorphic processing element. Fast device and array models will be built to be incorporated into a system-level simulation and energy estimation framework that will eventually be validated against the hardware prototype for its accuracy.

Project leaders: Erika Covi (Electronics) and Farhad Merchant (Computer science)

PhD students: Lingyu Gong and Boijan Zhang

Low power probabilistic bits enabled reckoning (LOPPER) (awarded in 2023)

The collaborative goal of this project is to achieve a proof of concept of an in-memory random number generator using probabilistic bits as well as probabilistic hardware for solving optimisation problems efficiently.

Project leaders: Tamalika Banerjee (Materials science) and Georgi Gaydadjiev (Computer science)

PhD students: Ishitro Bhaduri and Yiming Zhang

Implementation and design of cognitive devices (ID-CODE) (awarded in 2023)

The understanding and control of existing cognitively relevant hardware is still limited. We will build on existing research on innovative materials, such as HfO₂ based memristors, to develop new statistical techniques and analysis pipelines to investigate their behaviour. In parallel we will address the problem of aligning, learning and reasoning in cognitive hardware design. For the design of new cognitive devices we will develop new artificial intelligence methods that are meaningful in the target domain and make sense of the data. The two projects are connected by a shared mathematical modelling technique, namely

COGNIGRON PHD CANDIDATE ALBERT SILVANS ABOUT HIS PROJECT

"My work broadly falls under the disciplines Physics and Bayesian Statistics. My current work focuses on time series analysis of thin-film oxide device data collected by other Cognigron researchers from the materials science discipline. To characterize such a thin-film device, we must understand what kind of underlying processes can be expected that lead to its behavior. While experimental data from Physics and Material Science approaches is important, appropriate statistical methods must be chosen to develop valid models of materials and devices based on the experimental data.

So, a fruitful dissection of device property behavior begins where, for example, Physics proposes a model that should make sense based on known device characteristics. Next, we use Statistics to ask how likely such a model is in view of the actual experimental data collected. Conversely, application of Statistics methods could yield a model that explains the variance in the experimental data very well. Next, we must ensure that the model makes predictions that are actually physically possible in the device. Hence, an interdisciplinary attitude is important here, as it makes that the result is greater than the sum of its parts."

Bayesian networks. Bayesian networks are a flexible and easy-to-interpret tool for modelling the dependencies in complex data.

Project leaders: Marco Grzegorzczak (Mathematics), Bart Verheij (Artificial Intelligence), Beatriz Noheda (Materials science)

PhD students: Albert Silvans and Leah Dijkshoorn

Robust learning of sparse representations: brain-inspired inhibition and statistical physics analysis (SPARROW-NETS) (awarded in 2022)

Sparsity is among the key factors that contribute to high energy-efficient processing in the brain. Neuroscientists believe that inhibition is a crucial property that results in sparse and thus highly energy efficient representations. Sparsity and inhibition are the focus of this project, consisting of two key objectives: the investigation of push-pull inhibition embedded in convolutional and spiking neural networks, and the systematic study of learning processes in model situations.

Project leaders: George Azzopardi (Artificial Intelligence) and Michael Biehl (Computer Science)

PhD students: Otavio Citton and Peter van der Wal

Memristive models for faster material design cycles towards applications (MEMO) (awarded in 2022)

Long development cycles for memristive devices and materials are inhibiting innovation due to large parameter spaces, complex manufacturing processes, and necessary measurement series. This limits physical insight, performance, and applications of memristors. The project tackles this challenge by a close interaction of mathematical modelling and material science, in which newly acquired experimental data and models from material scientists are used in a closed design loop together with state-of-the-art mathematical techniques.

The goal of this project is to combine mathematical and material models to improve understanding of memristive materials, speedup memristor design and extend memristors' application areas.

Project leaders: Tamalika Banerjee (Materials science) and Julian Koellermeier (Mathematics)

PhD students: Safiere Kuijpers and Himanshu Rai

Smart electronic olfactory system (SMARTEN) (awarded in 2021)

The use of so-called electronic noses has spread widely in many industrial sectors thanks to their ability to detect chemicals in very small concentrations. In the healthcare sector, this technology is starting to play a key role as a rapid and low-cost diagnostic tool for many diseases. In this project we are specifically interested in the development of electronic noses for lung cancer detection.

Project leaders: Elisabetta Chicca (Electronics), Maria Loi (Physics) and Alden Waters/Stephan Trenn (Mathematics)

PhD students: Radu Cimpean, Paul Hansch and Ton Juny Pina

Qualitative modelling, simulation and exploration of multi-phenomenal materials dynamics (Q-MAT) (awarded in 2021)

Current approaches to computing based on digital hardware have limitations and call for novel alternatives. The aim of this project is to pioneer a new qualitative physics formalism, together with a qualitative physics engine that is able to simulate a wide range of phenomena while being fast to run, replacing numerical accuracy by qualitative validity.

Project leaders: Herbert Jaeger (Artificial Intelligence) and Beatriz Noheda (Materials science)

PhD students: Foelke Janssen and Fabian IJperlaar

Nanoparticle based percolating networks towards neuromorphic computing (NANOPER) (awarded in 2020)

Nanoparticle percolating networks exhibit interesting switching behaviour and potentiation, which are characteristics of the brain with neurons and synapses. In this project, phase change material nanoparticles are designed, synthesised and mathematically modelled. These materials are expected to have a richer network activity and therefore excellent materials used for neuromorphic computing.

Project leaders: George Palasantzas & Bart Kooi (Physics), Holger Waalkens & Daniel Valesin (Mathematics)

PhD students: Jhon Kevin Astoquillca Aquilar and Julien van der Ree

Memristor networks from self-assembled domain walls in oxides (WALLNET) (awarded in 2019)

This project investigates materials that self-organise in conducting networks that can transmit signals and host memory elements in a similar way to biological neurons and synapses.

Project leaders: Bart Besselink and Arjan van der Schaft (Mathematics), Beatriz Noheda (Materials science)

PhD students: Anne-Men Huijzer and Jan Rieck

Nb-doped SrTiO₃ memristive interfaces for bio-inspired computing (MEMSTO) (awarded in 2019)

This project studies the physics of interface-based memristive devices on semiconducting SrTiO₃ substrates and develops phenomenological models to predict the performance of such devices.

Project leaders: Tamalika Banerjee (Materials science) and Lambert Schomaker (Artificial Intelligence)

PhD students: Azminul Jaman and Jordi Timmermans



COGNIGRON FELLOWSHIPS

Staff can also participate and contribute to the CogniGron research programme through a PhD student who works in close collaboration with external partners, preferably industry partners with a strong track record or interest in cognitive systems and materials. The goal of these CogniGron Fellowships is to strengthen interaction with industry. Additionally, it will give the PhD student the opportunity to take an inside view and collaborate with a world-leading industrial partner on cognitive computing. The primary supervisor will hold a position at the Faculty of Science and Engineering and the PhD degree will be awarded by the University of Groningen.

COGNIGRON-IBM FELLOWSHIPS

Two CogniGron-IBM fellowships were awarded. CogniGron has partnered with IBM in these projects to work on novel materials for neuromorphic computing.

Combined volatile/non-volatile memristive ferroelectric arrays

The project aims to develop synaptic devices, similar to those in the brain, based on ferroelectric materials. In particular, the goal is to build arrays of these (memristive) devices that can show both short-term and long-term potentiation and depression, which is important for the implementation of neural networks.

Project leaders: Beatriz Noheda (CogniGron), Sigi Karg and Bert Jan Offrein (IBM-Research Zurich)

PhD student: Ruben Hamming-Green

Analogue phase-change memory cells for neuromorphic computing

Phase-change memories are, to date, arguably the most advanced resistive memory technologies. Phase-change memories are also being explored for in-memory computing applications, such as performing logical operations as well as realising hardware substrates for neuromorphic computing. It has been shown that phase-change memory devices can emulate some of the key synaptic and neuronal functionalities, thus facilitating the realisation of ultra-low power and dense neuromorphic hardware. In this project, we propose a relatively new concept of phase-change memory.

Project leaders: Bart Kooi (CogniGron) and Abu Sebastian (IBM-Research Zurich)

PhD student: Jesse Luchtenveld



START-UPS/SPIN-OFFS

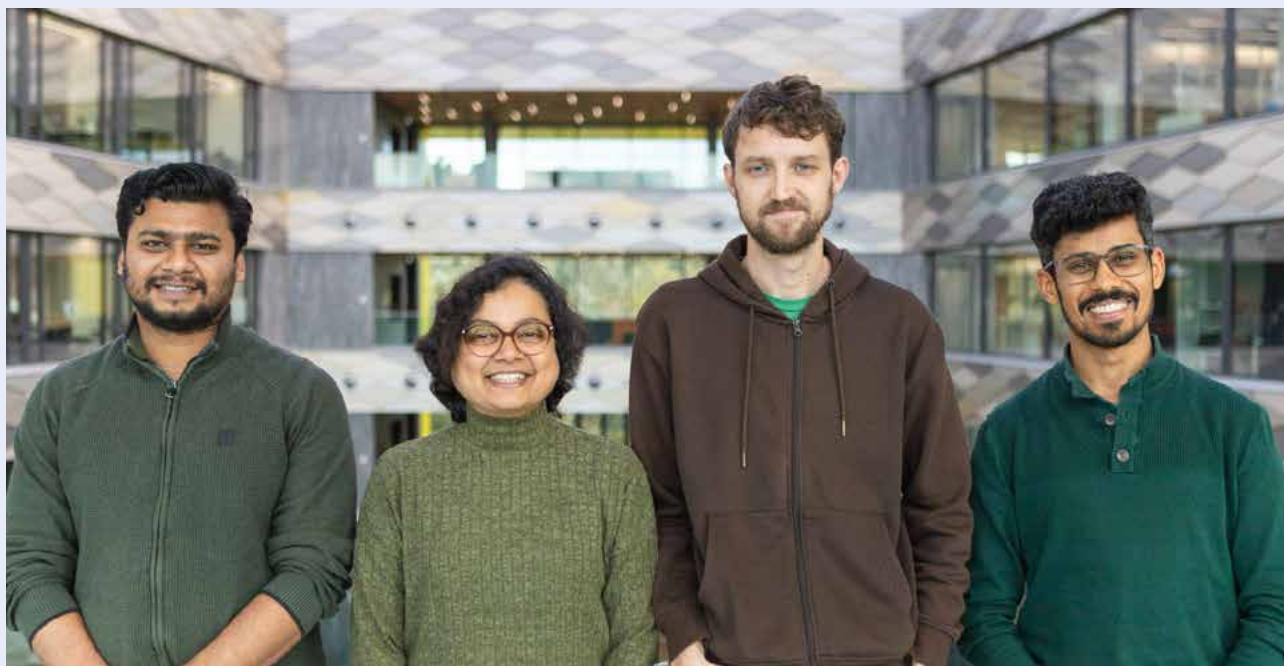
At CogniGron, we support entrepreneurial talent that push the boundaries of neuromorphic systems, drive innovation, and bring future-proof computing into everyday applications. These start-ups and spinoffs have emerged from our research ecosystem, translating advances in neuromorphic computing into scalable technologies, products, and services. They represent our mission to bridge fundamental science and societal impact, making the leap from laboratory insight to market-ready systems that redefine how we compute.

IMCHIP

The current generation of computers has three specific problems: (1) memory and processing are not in the same location, (2) it can take about one to two seconds for data to be retrieved from the cloud, and (3) after years of innovation, we are now reaching the end of what is possible with current materials. IMChip was founded in 2024 by CogniGron PI Prof. Tamalika Banerjee to tackle this challenge. Their solution: in-memory chips with a combination of old and new materials, in which memory and processing take place in the same location. IMChip develops chips that use memristors, which basically act like the synapses in our brains. Their goal is to have a prototype in the next two years.

2025 Highlights:

- **Top 10 winner of Academic Startup Competition, the youngest startup from Groningen to win ASC 2025, organised by Techleap**
- **IMChip received in June and July 2025 investment from Future Tech Ventures, a SNN feasibility grant to develop neuromorphic technology, and the NWO Take Off 1 grant for technical and commercial feasibility check of energy-efficient chips.**
- **IMChip had multiple media appearances in IO+, Dagblad van het Noorden, BNR Nieuwsradio podcasts, RTV Noord, and UG's In science podcasts**



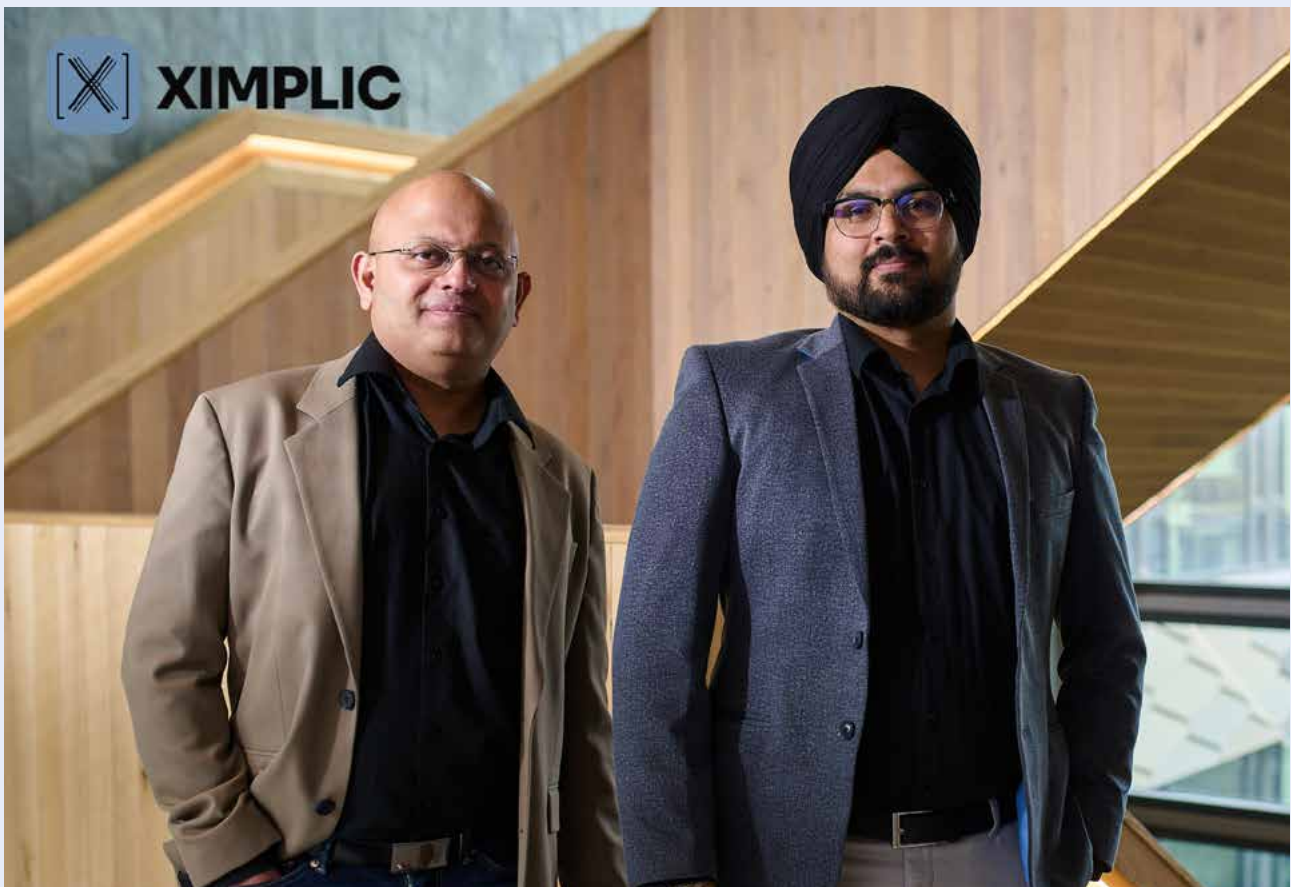
Team IMchip from left to right: Azminul Jaman (Co-founder, Circuit Engineer), Tamalika Banerjee (Founder, CSO), Ruben Hamming-Green (Co-founder, Head of R&D), Saurabh Soni (Chief Technology Officer)

XIMPLIC

Despite its promises, Compute-In-Memory (CIM) technology remains largely inaccessible: it is costly, time-intensive to develop, and typically tailored to highly specific applications. Ximplic addresses this challenge by developing advanced design tools that make energy-efficient CIM chip design more accessible, flexible, and scalable. Founded in 2025 by Dr. Farhad Merchant and Dr. Simranjeet Singh, Ximplic aims to democratize CIM technology through intelligent hardware design solutions. The Ximplic platform integrates modeling, simulation, logic synthesis, and hardware prototyping into a unified environment. This enables designers to move seamlessly from concept to silicon, independent of the underlying memory technology. Ximplic's mission is to simplify complexity in hardware design and accelerate innovation across the entire stack, from device physics to system-level implementation.

2025 Highlights:

- In November 2025, Ximplic was officially registered with the Dutch Chamber of Commerce. The company also launched its website and LinkedIn presence.
- Dr. Simranjeet Singh was awarded the UG DeepTech Pioneer Fellowship.
- Ximplic received the 2025 HiPEAC Technology Transfer Award.



Ximplic: Farhad Merchant (Co-founder & CSA) and Simranjeet Singh (Co-founder, CTO & CEO)



KEY FACILITIES - FROM 'LAB TO FAB'

CogniGron aims to make fundamental advances towards a disruptive technology, and the efforts in this direction require sophisticated research facilities to synthesise and characterise materials and build devices. These facilities are in large part present at the University of Groningen. However, CogniGron has seen the opportunity to excel by supporting two advanced research facilities: the Electron microscopy centre and NanoLabNL.

ELECTRON MICROSCOPY CENTRE

The electron microscopy centre of the Zernike Institute for Advanced Materials was founded in 2019 to maintain and provide a coherent and accessible infrastructure for electron microscopy at the University of Groningen. The microscopy centre is made possible by and will primarily be used by the Zernike Institute for Advanced Materials and CogniGron. Electron microscopy is of key importance for the research of CogniGron as it facilitates studying the ultimate origin of memristive behaviour in the materials that will function as artificial (electronic) synapses or neurons. To this end, CogniGron invested (together with the Zernike Institute for Advanced Materials) in the purchase of a new transmission electron microscope (TEM) that enables studying the structure of materials in unprecedented detail. One of its unique abilities is to produce images of both heavy and very light atoms simultaneously. The purchase also included a second system: a scanning electron microscope, combined with a focused ion beam, which allows scientists to study the general structure of materials (using an electron beam) and extract interesting sections using the ion beam for detailed study in the new TEM. Professor Bart Kooi is primarily responsible for running the new microscope. The daily activities at the TEM lab are running thanks to the expertise, dedication and involvement of Majid Ahmadi.

NANOLABNL: NANOFABRICATION FACILITY

NanoLabNL is a national consortium that was created to build, maintain and provide a coherent and accessible infrastructure for nanotechnology research and innovation in the Netherlands. However, with recent funding developments, maintaining the NanoLabNL facility through necessary updates — especially to keep up with developments in other countries in our region — is becoming a challenge.

The long-term stability of NanoLabNL is vital for CogniGron and we believe there is a need for CogniGron and NanolabNL to work together and make sure the facilities are up-to-date with the newest technological advances. Since the goal of CogniGron is closely related to developing novel electronic devices, for which the nanolithography and fabrication facilities provided by NanoLabNL are crucial, CogniGron has reserved funds to support NanoLabNL in the form of a new electron beam evaporator as well as a technician to support the new PhD students and staff who will be using the NanoLabNL facilities in Groningen. We are aware that more support is needed to maintain the NanoLabNL facilities in Groningen at international standards, and we are constantly working with the NanoLabNL management team to find solutions. Therefore, CogniGron has reserved a yearly budget for the running costs of NanoLabNL Groningen from 2021 until 2025 and CogniGron researchers can make use of the clean-room facilities at no cost. CogniGron counts with Arjun Joshua to support the NanoLab activities of CogniGron staff.

PUBLICATIONS

PEER-REVIEWED PUBLICATIONS

Akbari, M., Covi, E., Khateb, F., & Tang, K.-T. (2026). A 0.3-V Current-Mode Asynchronous Delta-Sigma Modulator for Wireless Sensor Nodes. **IEEE Transactions on Circuits and Systems I: Regular Papers**, **73**(4), 2332–2344.
<https://doi.org/10.1109/TCSI.2025.3614591>

Balister, P., Donderwinkel, S., Groenland, C., Johnston, T., & Scott, A. (2025). Counting graphic sequences via integrated random walks. **Transactions of the American Mathematical Society**, **378**(7), 4627–4669.
<https://doi.org/10.1090/tran/9403>

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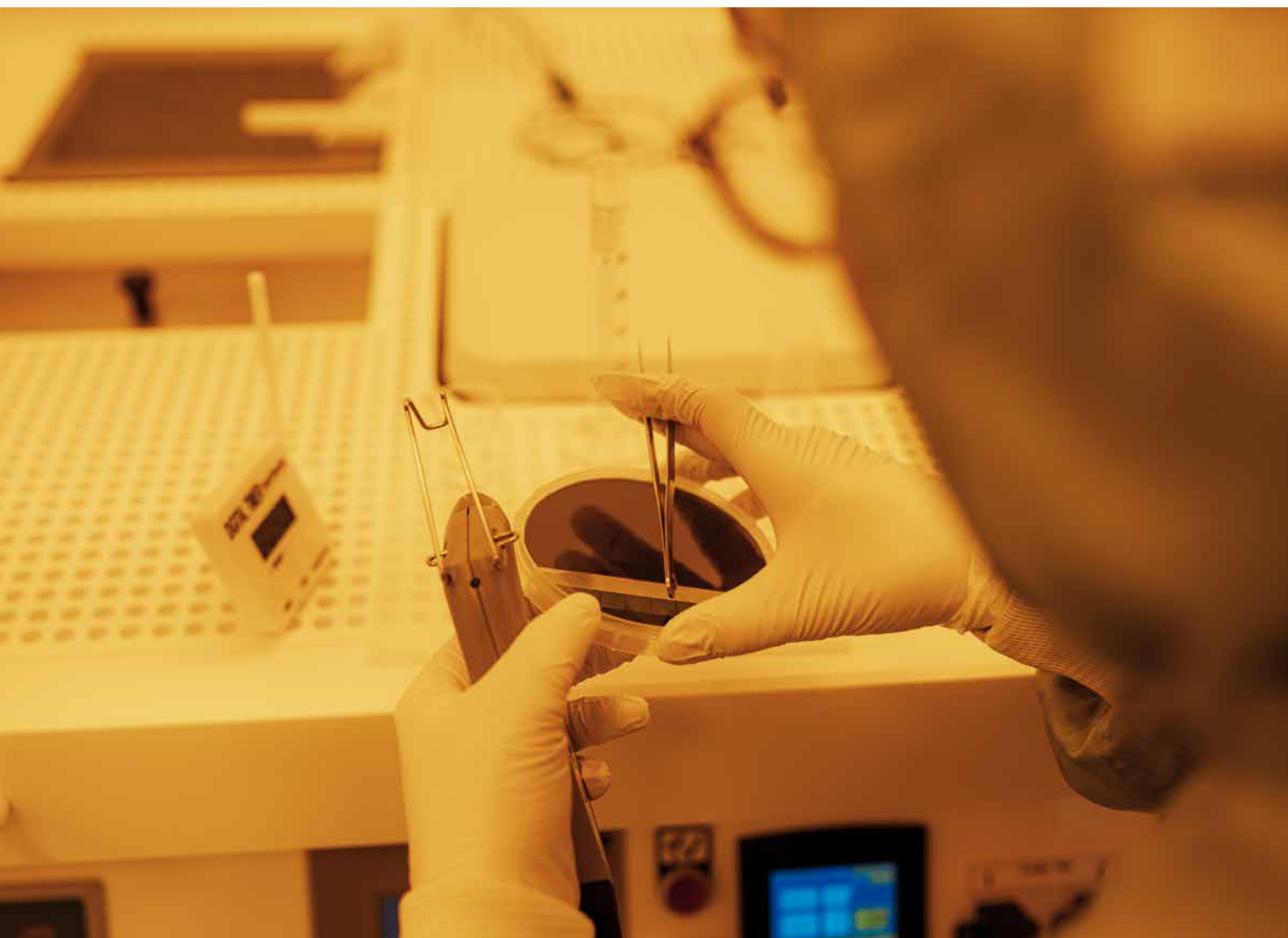
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COGNIGRON ACTIVITIES

Strengthening communities, building connections

In 2025, CogniGron actively contributed to community building at both local and national levels. Through strategic meetings, academic gatherings and international events, we strengthened internal collaboration and helped shape the growing neuromorphic computing ecosystem.

INTERNAL COGNIGRON EVENTS AND ACTIVITIES

Cognigron@work sessions

In these weekly meetings, researchers from CogniGron (PhD students, postdoctoral fellows, PIs) present their work in a 15-minute talk, taking care to explain the work to a broad interdisciplinary audience from the different disciplines within CogniGron. These sessions also provide opportunity for questions and discussion.

CogniGron Science story sessions

These sessions were newly installed in 2025 and are aimed at promoting in-depth discussion about specific topics or themes within the community of CogniGron PIs. Considering the wide breadth of research areas within CogniGron, with these sessions we aim to further common understanding by sharing views from each respective discipline on a certain topic. Although it is primarily targeted to PIs, CogniGron postdocs and PhD students are welcome to attend as well. These discussions contribute to developing a shared vision of neuromorphic computing research and technology development and the key challenges therein. Topics that were covered during these sessions in 2025 include Real-world applications for neuromorphic computing; Materials and devices for demonstrators; Robustness in the context of neuromorphic computing, and TinyML in the context of neuromorphic applications.

CTN introductory lectures

In these sessions organized by the CogniGron Talent Network (CTN), young CogniGron researchers (PhD students and postdocs) select scientific topics and explain these to their peers. These sessions are aimed to promote mutual understanding of the research approaches and methodology used within the different disciplines within CogniGron and to explain the terminology used to each other. These sessions are particularly helpful to freshly started CogniGron researchers in order to understand the research presented in the Cognigron@work sessions more easily.

CogniGron Research Away Day

Every year, the entire CogniGron research community is invited to participate in a full day of brainstorming, discussions, workshops and interactions away from the University's buildings. The aim of this event is to generate new ideas, align strategies and priorities, and to promote internal cohesion.

Workshop on Sustainability in Distributed and Networked Systems

CogniGron and the Distributed Systems Research Groups of TU Ilmenau and University of Groningen organized a workshop to discuss research findings, initiatives and challenges for Sustainability in Distributed and Networked Systems.

Networking event MELON SEEDS 2025



[Photo by Luisella Kraak from phone Igor Lukyanchuk]

On 27 and 28 February CogniGron hosted MELON SEEDS 2025, the final networking meeting of the [MSCA-RISE MELON project](#), organized by Beatriz Noheda, Andrey Ragulya, and Igor Lukyanchuk. The objective of the RISE action "MELON" was to develop an innovative materials platform for the realization of emergent computing circuits that consistently maintain more than binary states and emulate the plasticity and self-organization of neuronal connections.

NL-ECO Consortium Meeting 2025

CogniGron participated in the NL-ECO Consortium Meeting 2025 brought together researchers, PhD students, and junior scientists working on the three core work packages of NL-ECO: CONCEPT, MATTER, and INTEGRATE.

Neuromorphic Now 2025: From Vision to Impact



The Neuromorphic Now conference returned for its second edition on 13 June 2025, bringing together 110 researchers, innovators, and policymakers in Delft. Organised by TNO, CWI, TU Delft, and CogniGron, the event aimed to accelerate the neuro-morphic computing innovation agenda

Research Away Day 2025



On 19 June, the CogniGron community came together for the second edition of the Research Away Day, full of inspiring brainstorming sessions, workshops, poster presentations, and keynote from Kees Eijkel on creating real-world impact.

Neuromorphic Now!



The Neuromorphic Now conference returned for its second edition on 13 June 2025, bringing together 110 researchers, innovators, and policymakers in Delft. The event was organized by TNO, CWI, TU Delft and CogniGron, to accelerate the neuromorphic computing innovation agenda. Building on the success of the inaugural 2024 meeting (co-organized by IMEC), this year's event focused on uniting academia and industry, strengthening networks at Dutch, European, and global level, and laying ground-work for government and top sector involvement.

Guided visit to the Dutch police together with the University of Twente

CogniGron joined the [visit of the Eenheid Landelijke Expertise en Operaties \(Politie Nederland\) to the University of Twente](#), where innovation and law enforcement came together under the umbrella of Mission10x. Discussions centred on how emerging technologies like neuromorphic computing can support the police and enhance security efforts in an increasingly data- and intelligence-driven world.

Kick-off UEF funded projects with HTRIC



In September 2025, we celebrated the kick-off of the Ubbo Emmius Foundation funded programmes, marking the start of the next phase of CogniGron.

A surprise celebration: CogniGron's leadership handover



On Monday 15 September, the CogniGron community gathered for a very special edition of CogniGron@Work. What many thought would be a regular meeting turned into a surprise celebration, marking both the official handover of leadership to Prof. Dirk Pleiter, and a heartfelt tribute to Prof. Beatriz Noheda, who has guided CogniGron with vision and dedication for the past eight years.

Online workshop with SpiNNcloud, a Technische Universität Dresden

On Tuesday 14 October, CogniGron hosted an **online workshop** with SpiNNcloud, a Technische Universität Dresden spinoff developing neuromorphic supercomputers based on the SpiNNaker2 chip — a technology that mimics the brain's architecture for extreme energy efficiency and parallel processing.

CogniGron joins Future of Compute innovation mission to the UK



CogniGron participated in the Future of Compute innovation mission to the United Kingdom: an initiative designed to strengthen connections between the Dutch and UK ecosystems in AI, integrated photonics, and neuromorphic computing.

COGNIGRON SEMINARS FOR INVITED SPEAKERS

We value the opportunity to invite experts from around the world to visit Groningen to gain a better understanding of the latest developments in this diverse and emerging field of Neuromorphic Computing. This also creates a sense of community, as well as to make CogniGron known to the international and national communities. In 2025, we had the following speakers:

- **Dr. Andreea Sburlea** (Assistant Professor in Human Centered Intelligence at University of Groningen, NL)
"Brain-Computer Interfaces - a human-centered intelligence approach." - 20 January
- **Prof. Francky Catthoor** (Professor, KU Leuven, Belgium)
"Where digital becomes almost-neural: variability phenomena at the extreme miniaturization limit of 'classical' microchips." - 12 February
- **Elena Lazovik & Edser Apperloo** (TNO innovation for life, NL)
"ERP orchestration of distributed computing: planning neuromorphic software for domain applications." - 28 April
- **Prof. Martin Ziegler** (Chair of Energy Materials and Devices at Kiel University, Germany) "Bio-inspired information pathways." - 7 May
- **Prof. Federico Corradi** (Neuromorphic Edge Computing Systems Lab, TU Eindhoven, NL)
"Neuromorphic Computing for Real-Time Signal Processing at the Edge." - 7 May
- **Prof. Sreetosh Goswami** (Centre for Nano Science and Engineering, Indian Institute of Science, Bangalore, India)
"Molecular Neuromorphic Building Blocks for Artificial Intelligence." - 2 June
- **Prof. Zdenka Kuncic** (Professor of Physics, The University of Sydney, Australia)
"Memristive Nanowire Networks: Neuromorphic Intelligence beyond Artificial Neural Networks." - 12 June
- **Dr. Kees Eijkel** (QuTech, Delft)
"Research Impact, how do ecosystems help?" - 19 June
- **Dr. Fábio Schittler Neves** (Department of HPC, Fraunhofer ITWM)
"Neuromorphic Computing at Fraunhofer ITWM: Ising Machines, automation and STANCE" - 24 September
- **Prof. David Lentink** (Professor Biomimetics, Energy and Sustainability Research Institute Groningen, NL)
"Understanding bird flight to improve flying robots." - 15 December



SCIENCE COMMUNICATION

Tamalika Banerjee Featured on In Science Podcast



Tamalika spoke with hosts Wim Brons and Hanne van Loo about her path from superconductors in India to pioneering spintronic research in the Netherlands. Tamalika also gave an interview at the IO+ platform where she talked about her work at IMChip.

Keynote Dirk Pleiter at The Hardware That Fuels the AI Revolution



Dirk delivered an inspiring keynote at the The Hardware AI Revolution event, where we explored the critical role of hardware in AI, from GPUs to HPC clusters, and when to choose desktop PCs over specialized systems

Neuromorphic Computers and AI with Niels Taatgen at the ERN



European Researchers' Night at Forum Groningen, our researcher Niels Taatgen gave a mini-lecture on Neuromorphic Computers and AI.

Zpannend Zernike



Together with ENTEG and ZIAM, we were excited to present the BicsBot: a humanoid service robot designed to explore how touch shapes connection between humans and machines, at the Zpannend Zernike event that is aimed at children and families. Children were invited to shake the robot's hand and give their impression of how this felt to them. Such feedback is valuable for CogniGron researchers in further development of robotic applications in the real-world and in promoting the acceptance of robots in daily-life usage.

CogniGron / CTN career fair hosted by Cover



The CogniGron Talent Network brought neuromorphic computing to life at the career fair hosted by Cover, the study association for AI and Computing Science at the University of Groningen.



In October 2025, CogniGron launched the first blog website section about the science happening at our research centre. Based on the weekly CogniGron@Work sessions, where our scientists share their research findings, challenges and new insights, it gives a glimpse on the developments on neuromorphic computing, intelligent materials, and unconventional architectures. Written in an accessible style, each post makes complex ideas understandable for both researchers and curious readers alike, showing how CogniGron is shaping the future of computing. In 2025, the following blog posts were published:

- **Brains, bonds, and bowling: meet CogniGron's Talent Network:** The first post of this blog series takes you inside the CogniGron Talent Network (CTN), a community launched in 2024 that brings together PhDs and postdocs from across different disciplines such as physics, AI, and materials science.
- **Tiny robots, big responsibility: A peek into the world of swarm robotics:** In our second blog post, student assistant Amalie Fedorova talks with Bahar Haghighat to explore the fascinating world of swarm robotics - small, intelligent robots work together to monitor structures like bridges and pipelines, keeping us safe in ways humans and static sensors simply can't.
- **Probabilities, P-Bits, and the post-silicon future:** As silicon technology nears its physical limits, researchers at CogniGron are exploring bold new frontiers in computing. In this blog post, PhD candidate Ishitro Bhaduri introduces probabilistic computing—an approach that swaps stable binary bits for flickering p-bits, capable of tackling uncertainty and complex optimisation problems with ease.
- **From bricks to blueprints: building the structure neuromorphic computing needs:** Neuromorphic computing is rich in innovative components, but still lacks a clear blueprint for assembling them into large, functional systems. In this blog, Dr Madison Cotteret explains why deep learning methods fall short for spiking neural networks, why higher-level mathematical structure is needed, and the role of Vector-Symbolic Architectures (VSAs) in solving this problem.

GOVERNANCE AND FUNDING

Governance

At the heart of our research centre lies a robust framework of leadership and oversight, designed to drive innovation, foster collaboration, and ensure the highest standards of performance. From the timely guidance of our supervisory board to the tireless efforts of our programme board, each facet of our management team is crafted to create an environment of efficiency and continuous improvement to realise the ambitions and goals of CogniGron.

Scientific director

The scientific director is responsible for the scientific programme and chairs the programme board. The director functions as the official representative of the centre and shapes the cutting-edge scientific programme.

The success of CogniGron is rooted in the dedication and vision of its founding scientific director, **Prof. Beatriz Noheda**. Beatriz Noheda received her PhD in Physics from the Universidad Autónoma de Madrid, Spain. In 2003, after holding various positions at Saarland University, the Clarendon Laboratory in Oxford, Brookhaven National Lab in New York and the Vrije Universiteit in Amsterdam, she was awarded a Rosalind Franklin Fellowship by the University of Groningen, where she is now Full Professor. Noheda is a Fellow of the American Physical Society and recipient of the IEEE Robert E. Newnham Ferroelectrics Award. She has served as a

member of numerous national and international committees and several editorial boards. She is the author of more than 150 publications and receives more than 10 invitations a year to speak at international conferences. Noheda's research focuses on understanding the relationship between the structure and functionality of thin films of ferroelectric and multiferroic materials, often used as memory elements. Her research, although fundamental in nature, is inspired by two main application areas that, together, she believes will enable the next technological revolution: piezoelectric energy harvesting for low-power electronics and the development of novel materials for adaptable electronics and neuromorphic computing.

In September 2025, CogniGron's Scientific Directorship transferred from Beatriz to **Prof. Dirk Pleiter**. Since October 2024, Dirk Pleiter has been chair of Innovative computer architecture

at the University of Groningen. Furthermore, since January 2021, he has been a professor of HPC at the KTH Royal Institute of Technology in Stockholm. During the first two years at KTH, he served as director of the PDC supercomputing centre. Before he had been at JSC and in parallel professor of physics at the University of Regensburg. He has also been a co-founder of the Open Edge and HPC Initiative. Since 2015 he is co-chairing the ETP4HPC's Strategic Research Agenda working group on Mathematical Models and Algorithms. Pleiter's research is focused on co-design of supercomputers as well as IT infrastructures. Co-design is aimed at understanding how computer architectures can be designed such that they are optimised for specific applications. Conversely, the research also elucidates how applications need to be adapted in order to fully benefit from upcoming new technologies such as neuromorphic computing.



Programme board

The programme board is an important driving force in CogniGron's strategic decision-making. The programme board, chaired by the scientific director, is the driving force behind CogniGron's scientific strategy and daily operations. This team allocates the budget, determines the scientific strategy, and is responsible for the daily running of the scientific programme, as well as the recruitment of new staff. In 2025, the programme board was composed of the following members:

- Prof. Tamalika Banerjee
Professor Physics of Nanodevices
- Prof. Elisabetta Chicca
Professor Bio-Inspired Circuits and Systems
- Prof. Georgi Gaydadjiev
Professor Innovative Computer Architecture
- Prof. Dirk Pleiter
Prof. Innovative Computer Architecture
- Prof. Lambert Schomaker
Professor Artificial Intelligence
- Dr. Alef Sterk
Assistant Professor Mathematics
- Prof. Niels Taatgen
Professor Artificial Intelligence and Research Director of the Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence

- Prof. Moniek Tromp
Professor Materials Chemistry
Research Director Zernike Institute for Advanced Materials
- Prof. Ton Engbersen -
Advisor to the Programme Board
Professor Data Science Engineering

In the course of 2025, the following persons joined the Programme Board:

Since May 2025:

- Prof. Ming Cao,
Full Professor, Networks and Robotics and Scientific Director, Jantina Tammes School of Digital Society, Technology and AI
- Prof. Bayu Jayawardhana,
Director of Engineering, Faculty of Science and Engineering and Scientific Director of Engineering and Technology Institute of Groningen

Since October 2025:

- Prof. Jaap Top,
Research Director of the Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence

Extended Programme Board

Every three-months the Programme Board meeting is extended with Prof. Bart Besse-link, Prof. Matthew Cook, Dr. Erika Covi, Dr. Serte Donderwinkel, Prof. Herbert Jaeger, Prof. Bart Kooi, Dr. Farhad Merchant and Prof. Fatih Turkmen.

Supervisory board

The Supervisory Board oversees the long term strategy of the research centre, and advises the scientific director on significant changes in focus and implementation of the programme. It is composed of the following persons:

- Drs. Hans Biemans
Member of the Board of the University of Groningen
- Prof. Joost Frenken
Dean of the Faculty of Science and Engineering, University of Groningen
- Dr. Esther Marije Klop
Managing director of the Faculty of Science and Engineering, University of Groningen

Coordinating office

During 2025, the CogniGron coordinating office consisted of:

- Managing director:
January - June: Annechien Pronk and Sander Baesjou (ad interim) (Realisatiekracht.nu)
From July onwards: Jesse Siegers

- Scientific Coordinator:
January - February: Freerk Reitsma (ad interim)
From February onwards:
Dr. Judith Paridaen
- Managing Assistant:
January: Annemijn Hilbolling
From January onwards:
Luisella Kraak
- Communication officer:
January - May: Femke Boekhorst, Ine Kjosås, Isabella Bazuin (ad interim)
From September onwards:
Ester van Wijhe

Strategic Advisory Board

In 2025, the former Scientific Advisory Panel was transformed into the new Strategic Advisory Board. CogniGron is proud to have an excellent team of researchers and industry representatives to form the international Strategic Advisory Board. Their expertise and vision on neuromorphic computing and relevant technologies are of great value and guidance in shaping CogniGron's research and technology agenda. The members of the SAB are:

- [Prof. Yoeri van de Burgt](#)
Assistant Professor in Microsystems group
Institute of Complex Molecular Studies (ICMS), TU Eindhoven, Netherlands
- [Prof. Regina Dittmann](#)
Director of the Institute of Electronic Materials and Professor Elektrotechnik
Forschungszentrum Jülich and RWTH Aachen, Germany

- [Prof. Chris Eliasmith](#)
Professor Philosophy and Systems Design Engineering, and cross-appointed to Computer Science and Director of the Centre for Theoretical Neuroscience
University of Waterloo, Canada
- [Prof. Julie Grollier](#)
Professor Nanodevices for Bio-Inspired Computing and Chair of the interdisciplinary research network GDR BioComp
CNRS/Thales, France
- [Prof. Giacomo Indiveri](#)
Professor Neuromorphic Cognitive Systems and Director of the Institute of Neuroinformatics
University of Zurich/ ETH Zurich, Switzerland
- [Prof. Tony Kenyon](#)
Professor of Nanoelectronic & Nanophotonic Materials
University College London, United Kingdom
- [Dr. Omar Niamut](#)
Director of Science, The Netherlands Organisation for Applied Scientific Research (TNO), the Netherlands
- [Prof. Ivan Schuller](#)
Professor Nanoscience and Director of QMEENC (Quantum Materials for Energy Efficient Neuromorphic Computing)
Department of Physics and Centre for Advanced Nanoscience, University of California, San Diego, USA
- [Prof. Abu Sebastian](#)
Professor at Kirchhoff-Institut für Physik at Universität

Heidelberg, Germany
Distinguished Research Scientist at IBM Research, Zurich, Switzerland

- [Dr. Maarten Voncken](#)
Head of Research Metrology at ASML, Eindhoven, the Netherlands
- [Prof. Wilfred van der Wiel](#)
Professor of Nano Electronics and Director of the Centre for Brain-Inspired Electronics (BRAINS)
University of Twente, Netherlands
- [Dr. Amir Zjajo](#)
Chief Scientific Officer at Innatera Nanosystems, Delft, the Netherlands

Changes to the Scientific Advisory Panel in 2025:

CogniGron is grateful to the following persons having served as members of the Scientific Advisory Board until September 2025:

- [Dr. Heike Riel](#)
IBM Fellow, Department Head Science & Technology
IBM Zurich, Switzerland
- [Prof. Susan Stepney](#)
Professor of Computer Science
University of York, United Kingdom
- [Prof. Rainer Waser](#)
Professor of Electrical Engineering and Information Technology at RWTH Aachen University, Germany, and Director of the Peter Grünberg Institute, Jülich, Germany



EXTERNAL FUNDING

We are aware of the unique position that we have and are committed to obtaining the maximum benefits by developing strategic partnerships by means of national or international consortia and taking advantage of the available matching schemes, as long as the partnerships do not compromise our focus. CogniGron is actively participating in or coordinating externally funded projects.

EU FUNDING

AWARDED IN 2025:

Self-AwaRe NEuromorphic ArChiTectures: Security, Reliability and Energy-Efficiency (REACT)

This project has received funding from the EC under the Marie Skłodowska-Curie Actions grant agreement no. 101226463 (MSCA-DN)

- CogniGron awardee: Farhad Merchant (Coordinator)
- Amount: € 915.857,28

Universality in phase transitions in random graphs (GraPhTra)

This project has received funding from the EC under the Marie Skłodowska-Curie Actions grant agreement no. 101211705

- CogniGron awardee: Serte Donderwinkel
- Amount: € 217.076,16

In-Materio Reservoir Computing Using Tailored Epitaxial Complex Oxides (RECOMPUTE)

This project has received funding from the EC under the Marie Skłodowska-Curie Actions grant agreement no. 101203197

- CogniGron awardee: Martin Sarott
- Amount: € 217.076,16

Meta-Learning of memristive devices for lifelong adaptation (MALEFICENT)

This project has received funding from the EC under the Marie Skłodowska-Curie Actions grant agreement no. 101207193

- CogniGron awardee: Fernando Quintana Velazquez
- Amount: € 217.076,16

Ferroelectric Leaky Integration for Computational Efficiency (FELICE)

This project has received funding from the European Research Council under the agreement no. 101248563

- CogniGron awardee: Erika Covi
- Amount: € 150.000

RUNNING PROJECTS:

Contracts for Control System Design (COCOS)

This project has received funding from the European Research Council under the grant agreement no. 101169999

- CogniGron awardee: Bart Besselink
- Amount: € 1 984 840,00

ARCHitectures based on unconventional accelerators for dependable/energy efficient AI Systems (ARCHYTAS)

This project has received funding from Europe Defense Funds Research actions on digital transformation 2023.

- Coordinator: IVECO Defense vehicles, Italy
- CogniGron participant: Erika Covi
- Amount: € 817.165,00

MAterials for Smarter AUTonomous sensOrs (MASAUTO)

This project has received funding from the EU Horizon Europe programme under the Marie Skłodowska-Curie grant agreement no. 101168161

- Coordinators: Prof. Luís Marques and Dr. José Silva (University of Minho, Portugal)
- CogniGron participant: Beatriz Noheda
- Amount: € 274 370,40

ERC- Synergy grant: Transforming IoT Sensory Systems for a Sustainable Future (SWIMS)

This project has received funding from the European Research Council under grant agreement no. 101119062

- Coordinator: Gerhard Fettweis (TU Dresden, Germany)
- CogniGron participant: Elisabetta Chicca
- Amount: € 2.714.222,50

Crystalline Oxides for Next Generation Computing and Emerging Photonic Technologies (CONCEPT)

This project has received funding from HORIZON Research and Innovation Actions / HORIZON-RIA under grant agreement no. 101135946

- Coordinator: Henrik Hovde Sønsteby (University of Oslo, Norway)
- CogniGron participant: Beatriz Noheda
- Amount: € 423,110.00

Reconfigurable Superconducting And Photonic Technologies Of The Future (RESPITE)

This project has received funding from the EU Horizon 2020 Pathfinder programme under grant agreement no. 101098717

- Coordinator: Delft University
- CogniGron participant: Bart Kooi
- Amount: € 395.198,75

Memristive and multiferroic materials for emergent logic units in nanoelectronics (MELON)

This project has received funding from the EU Horizon 2020 Research and Innovation Staff Exchange programme under grant agreement no. 872631

- Coordinator: Igor Lukyanchuk (University of Picardie Jules Verne, France)
- CogniGron participant: Beatriz Noheda
- Amount: € 308.200,00

Topological Solitons in Ferroics for Unconventional Computing (TOPOCOM)

This project has received funding from the EU Horizon 2020 programme under the Marie Skłodowska-Curie grant agreement no. 101119608

- Coordinators: Dennis Meier (Norwegian University of Science and Technology, Norway)
- CogniGron participant: Beatriz Noheda
- Amount: € 274.370,40

Insect-Brain Inspired Neuromorphic Nanophotonics (Insectneuronano)

This project has received funding from the EU Horizon 2020 European Innovation Council programme under grant agreement no. 101046790

- Coordinator: Anders Mikkelsen (Lund University, SE)
- CogniGron participant: Elisabetta Chicca
- Amount: € 272.990,00

NATIONAL FUNDING

AWARDED IN 2025:

EBRAINS-Neurotech: Assembly Line for Brain Reading and Writing (NWO-Large-Scale Research Infrastructure programme)

- Coordinator: Cyriel Pennartz (University of Amsterdam)
- CogniGron participant: Elisabetta Chicca, Beatriz Noheda
- Amount: € 1.518.848,29

An Autonomous Miniaturized Robot Swarm for Real-Time Infrastructure Vibration Inspection (NWO-Vidi)

- CogniGron awardee: Bahar Haghighat
- Amount: € 850.000

Brain-inspired integrated memory chips for energy-efficient computing (NWO-TakeOff Phase1)

- CogniGron awardee: Tamalika Banerjee
- Amount: € 30.000

RUNNING PROJECT:

Netherlands Initiative for Energy-Efficient Computing (NL-ECO)

This project has received funding from within the Dutch NWA-ORC scheme under grant agreement no. NWA.1389.20.140

- Coordinator: Hans Hilgenkamp (University of Twente, NL)
- CogniGron participants: Beatriz Noheda, Tamalika Banerjee, Georgi Gaydadjev, Niels Taatgen and Elisabetta Chicca.
- Amount: € 971.211,00

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OTHER INTERNATIONAL FUNDING

Memristive Time Difference Encoder (MemTDE)

This project has received funding from the German Science Foundation (DFG) under individual research grant agreement no. 441959088

- Applicant: Elisabetta Chicca
- CogniGron participant: Elisabetta Chicca
- Amount: € 278.750,00



CONTACT INFORMATION

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