the 19th annual

Nanosymposium

At the interface of physics and chemistry

06-07-2022

Day Chair:
Prof. dr. Maxim S. Pchenitchnikov

Speakers:
prof. dr. Joost Frenken
and Nanoscience Students

This booklet is for print use for the 2022 edition of the annual Nanosymposium, organised by the Top Master Nanoscience Programme under the Zernike Institute for Advanced Materials (ZIAM) at the University of Groningen.
More information can be found at:
`https://nanosymposium.nl/`

Contents

About

Preface

Welcome to the Nanoscience Symposium 2022! In this nineteenth annual edition, we will examine recent advancements “at the interface of physics and chemistry”. In this symposium, the 13 first-year students of the Nanoscience Topmaster programme will present their short research projects conducted at several different research units in the Zernike Institute of Advanced Materials (ZIAM) and Engineering and Technology institute Groningen (ENTEG). The topics that will be discussed today are incredibly varied and range from the development of biomedical adhesives to investigation into transport properties in colloidal quantum dot superlattices. There’s something interesting here for everyone! In addition to these talks, we are very happy to announce that Prof. Joost Frenken, the new dean of the faculty of science and engineering, will be discussing the road from science to application in a talk titled ‘Nanoscience to Nanotechnology’.

I am very thankful to the hard work of all committee members, without whom the organization of event would not have been possible. I’d also like to thank Prof. Maxim Pshenchnikov for chairing the symposium, and Prof. Caspar van der Wal and Prof. Thomas la Cour Jansen for their continuous support during the organization process. Additionally, we like to thank our PIs and daily supervisors for providing us with support and excellent research opportunities. We are very excited for this symposium, and we hope that you will have a nice and insightful day!

On behalf of the entire committee,

Rixt Bosma, Chair

Organising committee

The symposium is fully organised by the students of the Top Master in Nanoscience (Cohort 2021-2023) at the University of Groningen. The members of this year's committee are

Aishwairya De
Gustavo Chávez Ponce de León
Krishnaraajan Sundararajan
Pim Witte
Rixt Bosma
Fatemeh Sarmasti Emami
Sietse Dijt
Bibek Bhujel
Ishitro Bhaduri
Muhammad Zohaib
Qianshan Feng
José Roberto Andrade Aguirre
Tsedenia Alemu Zewdie

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university of groningen / faculty of science and engineering / zernike institute for advanced materials

ZIAM Research Groups	
Research Group	Principal Investigators
Bio-inspired Circuits and Systems	Elisabetta Chicca
Device Physics of Complex Materials	Justin Ye
Macromolecular Chemistry and New Polymeric Materials	Katja Loos and Giuseppe Portale
Materials Chemistry	Moniek Tromp and Loredana Protesescu
Micromechanics	Erik van der Giessen and Patrick Onck
Molecular Biophysics	Wouter Roos and Rifka Vlijm
Nanostructured Materials and Interfaces	Bart Kooi and George Palasantzas
Nanostructures of Functional Oxides	Beatriz Noheda
Optical Condensed Matter Physics	Maxim Pchenitchnikov
Optical Spectroscopy of Functional Nanosystems	Richard Hildner
Photophysics and OptoElectronics	María Loi and Jan Anton Koster
Polymer Chemistry and Bioengineering	Andreas Herrmann and Ton Loontjens
Physics of Nanodevices	Bart Van Wees, Casper Van der Wal, and Marcos Guimarães
Polymer Science	Marleen Kamperman
Quantum Interactions and Structural Dynamics	Ronnie Hoekstra and Thomas Schlathölter
Solid State Materials for Electronics	Graeme Blake
Solid State Nuclear Magnetic Resonance	Patrick van der Wel
Spintronics of Functional Materials	Tamalika Banerjee
Surfaces and Thin Films	Petra Rudolf, Maike Stöhr
Theoretical Chemistry	Shirin Faraji, Ria Broer
Theory of Condensed Matter	Jasper Knoester, Maxim Mostovoy Thomas Jansen and Jagoda Slawinska

More information and details available at
`https://www.rug.nl/research/zernike/research/labs`

Chair of the Day

Prof. Maxim S. Pchenitchnikov

Maxim S. Pchenitchnikov obtained his PhD from Moscow State University in 1987. In 1992, he moved to the University of Groningen, the Netherlands, as a postdoctoral fellow, to join the staff in 1996, first at the department of chemistry, and since 2006 at the department of physics. In the early 90s, he began to design experiments and theoretical description of femtosecond spectroscopy on liquid state dynamics. He with co-workers was the first to report time-gated and heterodyne-detected photon echoes from solutions. The technical aspects of this work culminated in 1998 with the Guinness Book of World Records certificate awarded for "*The shortest flashes of light produced and measured*, *lasted for 4.5 femtosecond*". In the 2000s, his research was mainly focused on hydrogen-bond dynamics in liquids and at (bio)interfaces. He was amongst the first to report infrared photon echoes from liquid and nanoconfined water. His current research interests cover a wide range of ultrafast phenomena in organic materials at nanoscopic lengths and femtosecond time scales.

"We use optical spectroscopy to study a wide range of ultrafast phenomena in organic materials at nanoscopic lengths and femtosecond (0.000000000000001 s) time scale, with the main focus on exciton and charge dynamics in energy-related and bio-inspired materials."

List of Abstracts – Talks

Student Talks

Developing Biomedical Adhesives for Skin Transplants

José Roberto Andrade Aguirre

Supervisor: Prof. Marleen Kamperman
Group: Polymer Science

One of the limitations of current mesh graft techniques is the use of toxic glues applied to fasten the skin grafts to the wound bed. From the study of species such as the mussel and sandcastle worms, quite a lot is known about releasing biocompatible wet adhesion, but the highly modified polypeptides they employ are neither easy to make nor very practical for human use. This project focuses on the development of underwater biocompatible glue, using the design principle of polypeptide complex coacervate, with Hyaluronic acid (HA) and Chitosan (CH) as the anionic and cationic polymers respectively. The yield and properties of this complex coacervate are strongly dependent of parameters such as pH, polymer ratio, polymer concentration, and salt concentration. Using UV-Vis spectroscopy and Zeta potential, we studied the effect of the charge ratio for different pH. Finally, several experiments to optimize the skin transplant process were developed, including the implementation of freeze dried coacervate.

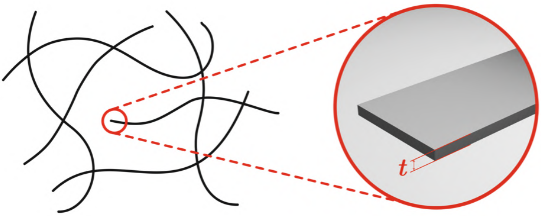
Structural Insight on Amino-acid-based Hydrogel Using Small-angle X-ray Scattering (SAXS) Technique

Bibek Bhujel

Supervisor: Prof. Giuseppe Portale
Group: Macromolecular Chemistry and New Polymeric Materials

Hydrogels are highly absorbent insoluble three-dimensional (3D) networks of polymers. They maintain a very well-defined structure due to physical or chemical cross-linking of individual polymer chains. Hydrogels have existed for almost a century, and nowadays, they have a huge number of applications in numerous processes ranging from biological to industrial.

In this project, we studied the solvent-triggered formation of hydrogels based on a low molecular weight gelator (LMWG) called Fmoc-k(Fmoc) [Fmoc: fluorenylmethoxy-carbonyl, k: L-lysine] using the small-angle x-ray scattering technique (SAXS). A Fmoc-k(Fmoc) molecule consists of aromatic moieties and multiple hydrogen bond donors and acceptors. It is particularly interesting because hydrogels based on it possess several advantages and properties like low minimum gelation concentration (MGC), high mechanical strength, high thermal stability, and thixotropic property. Furthermore, they are also biocompatible and biodegradable, which make them ideal for drug delivery. SAXS is employed because it gives us the structural information at the nanoscale and sub-microscale. From these information, we can understand the supramolecular structure and design new architectures tailored to specific needs depending on biological or non-biological applications. Futhermore, methyl red was used as a model for drug in order to study the kinetics of drug release using UV-Vis spectroscopy.



Transport Properties of PbSe Colloidal Quantum Dot Superlattices

Muhammad Zohaib

Supervisor: Prof. Maria Antonietta Loi
Group: Photophysics & Optoelectronics

For the miniaturization and efficiency improvement of semiconductor devices, the exploitation of electrical properties of new classes of nanomaterials namely quantum dots (QDs) is quite important. The careful control of the self-assembly of these QDs in the solution phase can create their superlattices. These superlattices of QDs show very promising device performance in the field-effect configuration. In this work, we deposited the superlattices of Lead Selenide (PbSe) QDs as an active channel layer of field-effect transistors to study the transport properties in these structures. By characterizing the crystal structure we examined the ordering of nanocrystals in superlattices. Furthermore, we performed low-temperature measurements in order to understand the behavior of these superstructures towards the transport of charges.

Quantification of the Ordering of PbSe Quantum-Dot Super-Lattices (QD-SLs) using Advanced X-Ray Techniques

Krishnaraajan Sundararajan

Supervisor: Prof. Giuseppe Portale
Group: Macromolecular Chemistry and New Polymeric Materials

Colloidal QDs can self-assemble and can result in the formation of periodic superstructures (2D/3D). This periodic arrangement of QDs is known as a superlattice (SL) and similar to atomic lattices, these SLs also diffract light with a wavelength comparable to that of the periodicity of their arrangement. The orientation of the QDs on both the atomic level and super-structure level influences the transport properties of devices fabricated using such structures. Poor orientation of such SLs is an obstacle to improving the transport properties of such arrays. The development of experimental techniques to quantify such orientations at both atomic and the super-structure length scale is crucial to circumvent this hurdle. My project focuses on studying both the orientations: namely the orientation of the PbSe atomic lattice (AL) and that of the SL formed with respect to the substrate using X-Ray characterization techniques such as Small Angle X-Ray Scattering and Wide Angle X-Ray Scattering (SAXS/WAXS). It also focuses on quantifying the orientations of the formed QD-SLs.

Structure and Thermoelectric Performance of Copper-rich $Cu_{2+x}Se$ Doped With Rare-earth Elements

Aishwairya De

Supervisor: Prof. Graeme Blake
Group: Solid-State Materials for Electronics

Sustainability is vital for the new century, and thermoelectric (TE) materials, which convert heat and electricity into one another, are the area of tremendous interest as a source of clean and sustainable energy. With the recent development of phonon-liquid electron crystals (PLECs), the most prevalent of which are copper chalcogenides, considerable breakthroughs have been made in the field of thermoelectric materials. Because of the liquid-like features of highly mobile copper ions in these materials, heat-carrying phonons are effectively scattered, and PLECs have a high thermoelectric figure of merit ZT. This project focuses on studying the effect of doping copper-rich $Cu_{2+x}Se$ with rare earth elements.

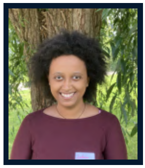
Robust Photoactuating Artificial Muscles from Amino Acid Modified Molecular Motor Amphiphiles.

Pim Witte

Supervisor: Prof. Ben Feringa
Group: Synthetic Organic Chemistry

As technology progresses, engineering on the molecular scale to create stimuli-responsive functional materials becomes increasingly important. Taking inspiration from nature for the development of such stimuli-responsive materials capable of converting molecular motion into macroscopic movement, it is of paramount importance to be able to precisely control molecular organization to allow for the amplification of motion by many orders of magnitude. By modifying light-driven molecular motors, versatile responsive molecular systems can be synthesized through self-assembly. One such system was presented by the Feringa group, where an artificial muscle with actuation functions was fabricated from photoresponsive amphiphilic molecular motors. The artificial motor introduced in this work does suffer from drying effects that result in the loss of actuation, and the strings are relatively weak. In our work, we address these issues by modifying the motor by introducing amino acid groups and investigating the effect on the self-assembly and photoactuation of the system.

Synthesis and Characterization of Chiral Polyoxometalates and their Catalysis Applications



Tsedenia Alemu Zewdie

Supervisor: Prof. Paolo Pescarmona
Group: Sustainable Chemical Products and Catalysis

Polyoxometalates (POMs) are metal-oxygen clusters of early transition metals in high oxidation states (W^{6+}, Mo^{6+}, V^{5+}, Nb^{5+}, and Ta^{5+}). The structural diversity of POMs leads to equally diverse properties and applications in catalysis, magnetochemistry, and medicine. The objective of this project is to synthesize and characterize new enantiomerically pure chiral polyoxometalates. There are several ways to synthesize chiral POMs including chiral POMs with achiral linkers, achiral POMs with chiral organic ligands, and self-assembly of achiral units yielding chiral helical structure (not enantiomerically pure), and self-assembling units resulting in other structures. The questions to answer with this project are: 1) Can we make a new class of chiral POMs? 2) Can we use them for catalysis? 3) Can we measure their circular dichroism (CD) spectra? [4) Can we spin coat them for electronics applications?]

3D Printing of Drug Delivery Scaffolds

Gustavo Chávez Ponce de León

Supervisor: Prof. Marleen Kamperman
Group: Polymer Science

Musculoskeletal tissues are prone to injuries as they make up the region where stress concentration occurs. These injuries are the leading contributor to disability around the world due to their poor healing process. To overcome this problem, 3D-printed scaffolds, commonly used in tissue engineering, are essential elements in the treatment of these conditions as they provide a suitable microenvironment for cells to proliferate and differentiate. To further boost cell differentiation and/or add antibacterial properties, drug-delivery systems can be introduced. These, however, usually present a burst release of the drug in the first few hours. In our project, a new approach was evaluated, including drug nanocarriers. We have produced and characterized poly(lactic-co-glycolic acid) (PLGA) nanoparticles (NPs) loaded with hydrophilic drugs. Next, we mixed the drug-loaded PLGA NPs with polycaprolactone (PCL) microparticles before melting and studied the printability using Melt Electrowriting. We aim to control the drug release by producing 3D scaffolds with encapsulated PLGA nanoparticles in the PCL matrix.

Stability Analysis of $CsSnI_3$ Perovskite Nanocrystals Embedded in Polymer Matrices

Rixt Bosma

Supervisor: Prof. Loredana Protesescu
Group: Nanomaterials Chemistry

Metal halides perovskites with nanoscale geometries have revolutionised the field of solution-processed photovoltaics and light-emitting devices due to their strong absorption and exceptional photoluminescence properties combined with a remarkable tolerance to structural defects. However, the further development of these materials to practical commercialization is hindered by their toxic components like lead, and by their inherent structural lability. Tin-based perovskites have shown promise as a non-toxic alternative to their lead counterparts, but these tin structures still underperform their lead analogs in both performance and stability. $CsSnI_3$ nanocrystals, specifically, cannot yet survive for an hour when kept in the ambient. This project aims to stabilise $CsSnI_3$ nanocrystals in polymer matrices. To achieve this, a broad survey is performed on the effect of a wide range of polymers on the optical properties of $CsSnI_3$.

Optical Spectroscopy of (Individual) Tin-Based Perovskite Nanocrystals

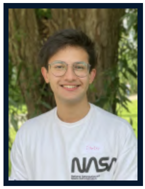
Fatemeh Sarmasti Emami

Supervisor: Prof. Richard Hildner
Group: Optical Spectroscopy of Functional Nanosystems

Inorganic perovskite $CsPbX_3$ nanocrystals (NCs) possess advantageous photoluminescence (PL) characteristics including higher quantum yield, narrower emission linewidth, as well as negligible influence of self-absorption and Förster resonance energy transfer. Unfortunately, due to their inherent ionic nature, the fully-inorganic trihalide perovskite NCs can be degraded in polar solvents such as water. They also tend to degrade under exposure to high temperature or high-energy electron beams. The goals of the experiments are measuring the absorption and PL and blinking patterns of these perovskite NCs in different concentration to get single photon quantum dot. The results of the experiments provide unique insight into the charge accumulation and migration and thus is of crucial importance for device design and improvement.

Polarization-resolved Excitation Spectroscopy on C8S3 Nanotubes

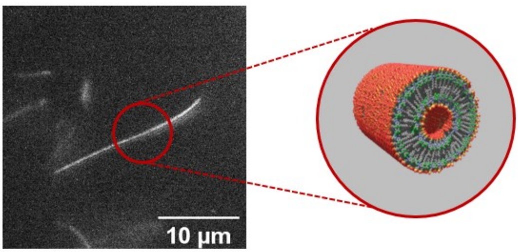
Ishitro Bhaduri



Supervisor: Prof. Maxim Pchenitchikov and Prof. Richard Hildner
Group: Optical Condensed Matter Physics
and Optical Spectroscopy of Functional Nanosystems

Making effective use of solar energy is an issue that is becoming increasing prevalent in today's world. Natural photosynthetic systems like plants and algae contain hierarchically arranged structures called natural light-harvesting complexes which allow for extremely efficient conversion of solar energy to chemical energy. However, due to their inherent heterogeneity, it is difficult to study these natural complexes in a controllable manner in the lab. Artificial light-harvesting complexes like C8S3 molecules provide an effective base for investigating the energy transport mechanisms in natural light-harvesting complexes via self-assembled supramolecular structures. C8S3 molecules self-assemble into double-walled cylindrical nanotubes reminiscent of the photosynthetic structures found in green sulfur bacteria. The higher-lying excitonic transitions of these C8S3 nanotubes are particularly interesting in elucidating their supramolecular structure. Studying these transitions experimentally can also corroborate existing theoretical models. However, these transitions are obscured in bulk solution due to ensemble averaging, necessitating the optical investigation of individual nanotubes. Probing individual tubes also allows us to study polarisation-resolved transitions due to the inherent anisotropy of the tubes.

My work revolved around obtaining polarisation-resolved excitation spectra of individual nanotubes to study the higher-lying transitions. An additional aim was also to compare the isotropic excitation spectra of individual tubes to the absorption of the bulk solution.



Non-linear Hall Effect in $MoTe_2$.

Qianshan Feng

Supervisor: Prof. Marcos Guimarães
Group: Opto-Spintronics of Nanostructures

Second harmonic Hall-voltage is observed in a symmetry-broken system to show the direct measurement of Berry-curvature dipole. The experiment material is $MoTe_2$ with 1T' phase, whose 2D nature facilities the observation of Hall voltage and the symmetry broken in such a way to allow a large and quadratic transversal voltage response to current. The measurements are operated on a device with dimensions of micrometers in-plane and nanometers between layers, and the geometry of a Hall bar.
The fabrication procedure is carried out in Physics-of-NanodevicesFNDlabs. In FND labs, the mesoscopic behavior of electrons, in terms of transport and interaction with electric or magnetic fields, is studied on devices with dimensions of micrometers and nanometers. Quantum effects are discovered and proved through the delicate design of the geometry of devices and crystals with specific crystal structures and magnetic orders.

Assessing Long-term Phototoxicity in Live-cell STED Microscopy

Sietse Dijt

Supervisor: Prof. Rifka Vlijm
Group: Molecular Biophysics

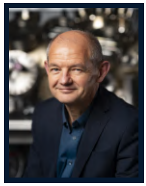
Stimulated Emission Depletion (STED) microscopy is one of the super-resolution techniques that overcome the diffraction limit of light. The high spatial and temporal resolutions of STED make this a suitable technique for imaging the cellular processes in living cells. However, the resolution of STED microscopy is dependent on the power of the STED laser, which is speculated to cause photodamage at high intensity. In this project, a framework is developed to determine the potential phototoxicity of STED. This framework includes control of the microscope through home-written python code. We evaluate not only whether instant cell death occurs (the common method) but also monitor the long-term effect on cell division. Cells only divide when they are in good condition, making them an excellent marker for detecting even small amounts of phototoxicity. We found similar rates of cell division for cells imaged with and without STED, showing that STED microscopy with low phototoxicity is possible.

Invited Speakers

From Nanoscience to Nanotechnology

Prof. Joost Frenken

Dean of Faculty of Science and Engineering
University of Groningen



The leap from basic science to the technology of consumer products is sometimes bridged much more quickly than you might think. In this talk, I would like to highlight the most advanced technology that is being used today in the semiconductor industry to produce the latest generations of processor and memory chips. This technology is rooted in optical lithography with extreme ultraviolet light and is the domain of the Dutch company ASML. Intimately linked to this rapidly evolving technology is the basic physics and chemistry research that is conducted at the Advanced Research Center for Nanolithography (ARCNL) in Amsterdam, where I had the pleasure of working until a week before this symposium. I will provide a concise overview of this wonderful field in which nanoscience and nanotechnology go truly hand in hand, and illustrate this with a few examples.

Joost Frenken is the Dean of the Faculty of Science and Engineering and a professor of Physics at the University of Groningen. Until recently, he was the director of the Advanced Research Center for Nanolithography (ARCNL) in Amsterdam and a professor of Physics at both universities in Amsterdam (UvA and VU). Before the start of ARCNL, Frenken was a professor of Physics at the Kamerlingh Onnes Laboratory of Leiden University.
Frenken's scientific expertise is in the atomic-scale structure, diffusion, chemical reactions, phase transitions and friction phenomena at surfaces and interfaces, investigated with advanced instruments, many of which were developed under his supervision. His achievements have been recognized in several research awards and a membership of the KNAW, The Royal Netherlands Academy of Arts and Sciences.
Frenken has (co)-initiated two companies, Leiden Probe Microscopy BV and Applied Nanolayers BV.

Photo of Prof. Joost Frenken is taken by Ivar Pen.

Useful Information

MSc Nanoscience (Top Master)
Nanoscience is an interdisciplinary field at the border between physics, chemistry, materials science and biochemistry. The manipulation of matter on the nanoscale offers new opportunities to solve scientific challenges in the modern world. The Top Master's degree programme in Nanoscience is closely linked to the Zernike Institute for Advanced Materials, a leading international research centre, ranked amongst the top 20 of the world.
More information can be found at `www.rug.nl/masters/nanoscience/`

Zernike Institute for Advanced Materials
Zernike Institute for Advanced Materials (ZIAM) at the University of Groningen is a research facility at which physicists, chemists, and increasingly biologists, theoreticians and experimentalists work closely together, giving the Institute a breadth rarely found elsewhere. In our efforts we involve the whole chain of knowledge; modelling, design, synthesis, characterization, physical properties, theory and device functionality. The Institute is formed by a team of 35 Principal Investigators, organised in 20 Research Groups, creating a multidisciplinary research environment without borders.

Nanosymposium
The *Nanoscience Symposium* is an annual gathering fully organized by first year nanoscience master students. In the event the students present their small project research, covering a wide spectrum of topics, ranging from photoresponsive hydrogels to photovoltaic devices, advanced imaging techniques and many more. National and International guest speakers are invited as well, bringing together both passionate young scientist and experienced top level researchers. Information on current and past symposiums can be found at `www.nanosymposium.nl`

Nanosymposium
At the interface of physics and chemistry

Partners and Sponsors

The organising committee of the 2022 Nanosymposium would like to express their enormous gratitude to our sponsors, without which the event would have been impossible!

CogniGron: Founded to Make a Difference

Ambition and Mission

CogniGron was founded in 2018 to create the fundamental building blocks for a new type of computing, that is *cognitive computing* or *computing inspired by the brain*. These building blocks consist of self-learning materials that can perform the tasks that are currently assigned to thousands of transistors and complex algorithms in a more efficient and straightforward manner. Hence, these building blocks form the basis for a new generation of computer platforms for cognitive applications, such as pattern recognition and analysis of complex data. Towards this ambition, CogniGron aims to create the conditions for researchers from materials science (physics and chemistry), computer science, artificial intelligence and mathematics to work closely together with a common mission: *to develop cognitive computing at all levels: from materials that can learn to devices, circuits and algorithms*.
To the best of our knowledge, CogniGron is the first collaborative initiative of its kind.

Need for a Paradigm Change

Our modern society is shaped by technological advances and thrives on developments in information and communication technology (ICT). The emergence of the internet in the mid-1990s has ultimately shaped a new era. Digitized or digital information can easily be shared worldwide at the touch of a button, with the internet providing automated access to huge collections of data. The rapid increase in the use of sensors and the rise of the Internet of Things have triggered an explosion in streaming data volumes, opening a wealth of new application perspectives. When properly processed, this amount of data can generate an unprecedented level of knowledge. Thus, large-scale data processing has an enormous transformative potential, enabling for instance rapid disease diagnosis, personalized medical treatments, increased national security and forecasting of natural disasters. To realize this potential, we need computers that can classify, prioritize, combine and analyse data, as well as generate new suggestions – systems that can learn and become better by doing. Deep learning offers a solution by detecting, classifying and predicting patterns in data, for example for facial recognition in video surveillance, recognition of traffic patterns by self-driving cars or predicting epidemics based on Google search requests.

Currently, successful methods from the field of artificial intelligence rely on neural networks or other brain-inspired algorithms and software. These are then implemented on traditional hardware (a computer) that is not optimized for neural functionality and also lacks plasticity, that is, the ability to learn. This results in a very high energy demand for the efficient handling of data and has led to the ICT field consuming 10% of the world's electricity consumption. This is expected to exceed 20% by 2030 [Nature.561, 163 (2018)].

In contrast, our brain has the ability to learn at a fraction of the energy consumption required by a supercomputer: with around 9×10^{10} neurons and 1.5×10^{14} connections (synapses), it consumes only 20 W, which is less energy than a light bulb. A man-made system that can approach the cognitive functioning of the human brain consumes 80 kW, both for computing and communication functions.

This means that the energy usage of information processing can be reduced by several orders of magnitude if we embrace the principles of neuromorphic computing. A paradigm change in how we process information is all the more urgent as the era of Moore's law, which describes that the processing power of 'conventional' computers doubles every two years, has come to an end. In other words, we are reaching the physical limits of what can be achieved with the current technology. It is obvious that significant investments in science and technology are needed to address the future demands of cognitive computing.

CogniGron is working on the necessary fundamental breakthroughs and technological advances to develop novel architectures for neuromorphic or cognitive computing that promise energy efficiencies orders of magnitude better than current computers. Creating such architectures requires a holistic approach that joins efforts in materials science, physics, mathematics, computer science and artificial intelligence.

Timetable

S: Student Speaker, IS: Invited Speaker.

09:30-09:50	**Opening**		
09:50–10:10	S	**José Roberto Andrade Aguirre**	Developing Biomedical Adhesives for Skin Transplants
10:10–10:30	S	**Bibek Bhujel**	Structural Insight on Amino-acid-based Hydrogel Using Small-angle X-ray Scattering (SAXS) Technique
10:30–10:50	**Coffee Break**		
10:50–11:10	S	**Muhammad Zohaib**	Transport Properties of PbSe Colloidal Quantum Dot Superlattices
11:10–11:30	S	**Krishnaraajan Sundararajan**	Quantification of the ordering of PbSe Quantum-Dot Super-Lattices (QD-SLs) using Advanced X-Ray Techniques
11:30–11:50	S	**Aishwairya De**	Structure and Thermoelectric Performance of Copper-rich Cu_{2+x}Se Doped with Rare-earth Elements
11:50–12:40	**Lunch Break**		
12:40–13:20	IS	**Prof. Joost Frenken** Dean of FSE, University of Groningen	From Nanoscience to Nanotechnology
13:20–13:40	S	**Pim Witte**	Robust Photoactuating Artificial Muscles from Amino Acid Modified Molecular Motor Amphiphiles
13:40–14:00	S	**Tsedenia Alemu Zewdie**	Synthesis and Characterization of Chiral Polyoxometalates and Their Catalysis Applications
14:00–14:20	**Coffee Break**		
14:20–14:40	S	**Gustavo Chávez Ponce de León**	3D Printing of Drug Delivery Scaffolds
14:40–15:00	S	**Rixt Bosma**	Stability Analysis of CsSnI3 Perovskite Nanocrystals Embedded in Polymer Matrices
15:00–15:20	S	**Fatemeh Sarmasti Emami**	Optical Spectroscopy of (Individual) Tin-Based Perovskite Nanocrystals
15:20–15:40	**Coffee Break**		
15:40–16:00	S	**Ishitro Bhaduri**	Polarization-resolved Excitation Spectroscopy on C8S3 Nanotubes
16:00–16:20	S	**Qianshan Feng**	Non-linear Hall Effect in MoTe2
16:20–16:40	S	**Sietse Dijt**	Assessing Long-term Phototoxicity in Live-cell STED Microscopy
16:30–16:45	**Teacher of the Year Ceremony**		
16:45–17:00	**Closing**		

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