Universität Münster

5th Münster Symposium on Intelligent Matter

June 24th, 2026
Münster, Germany

Book of Abstracts

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Center for Soft Nanoscience

CRC 1459 INTELLIGENT MATTER

5th Münster Symposium on Intelligent Matter June 24th, 2026

PROGRAM

10:00 am	*Welcome to MüSIM 2026!*	*Bart Jan Ravoo* *CRC 1459 Spokesperson*
10:10 am	**Christoph Weder** University of Fribourg, Switzerland ***Dynamic Mechanophores: Harnessing Supramolecular Interactions for Reversible Mechanochromism***	*Chair: Walter Linke* *CRC 1459 PhD Student*
11:10 pm	**MüSIM 2026 Young Researcher Award** **David Urban** SINTEF Digital, Norway ***Directional Flows using Capillary Assembly of Photo-deformable Colloidal Particles at Water-air Interfaces***	*Chair: Christina Kriegel* *CRC 1459 Managing Director*
11:30 am	**Nadja Bigall** University of Hamburg, Germany ***Nanocrystal-based Aerogels***	*Chair: Alisa Kondrateva* *CRC 1459 PhD Student*
12:30 pm	Business Lunch	
1:30 pm	*Poster Sessions*	
3:00pm	**Giovanni Volpe** University of Gothenburg, Sweden ***Smart Machines and Optical Manipulation at the Microscale***	*Chair: Jesco Schönfelder* *CRC 1459 PhD Student*
4:00 pm	**Ben Feringa** University of Groningen, The Netherlands ***The Art of Building Small: From Molecular Switches to Motors***	*Chair: Julia Terlau* *CRC 1459 PhD Student*
5:00 pm	*Poster Prizes* Closing Remarks	*Nikos Doltsinis* *CRC 1459 Co-Spokesperson*
5:30 pm	MüSIM 2026 Networking Event	

MüSIM2026 Speakers

Prof. Dr. Nadja Bigall

Department of Chemistry
Institute of Physical Chemistry
University of Hamburg
Hamburg, Germany

Nadja C. Bigall is a full professor for Physical Chemistry and Dynamics of Nanoscopic Systems at the University of Hamburg. She graduated in Physics at LMU Munich, followed by a doctorate in Physical Chemistry 2009 at TU Dresden. After two postdoctoral research stays at IIT Genoa and University of Marburg, she started a BMBF NanoMatFutur and later ERC Starting Grant funded research group at Leibniz Universität Hannover. In 2017 she became an associate professor and in 2018 a full professor. Since 2023 she continued her research at Universität Hamburg, where her research focuses on nanoparticle synthesis, assembly and structure-property correlation.

Nanocrystal-based Aerogels

Nadja C. Bigall, Universität Hamburg, Germany

In recent past, we have demonstrated that lyogels and aerogels of assembled colloidal nanocrystals can exhibit emerging properties dependent on their nano-, micro-, and macrostructure.
As an example, gels from metal and semiconductors or from various semiconductors etc. benefit from controlling their network architecture, which strongly influences the physicochemical properties,[1] which leads to a plethora of possible future applications e.g. in electrocatalysis and photocatalysis as well as in sensing, amongst others.[2]
In the present work, we present our recent advances in structure-property-correlation as well as on synthetic approaches regarding nano, micro- and macrostructuring of nanocrystal-based gels.[3]

[1] Revealing the Effect of Nanoscopic Design on the Charge Carrier Separation Processes in Semiconductor-Metal Nanoparticle Gel Networks, Jakob Schlenkrich, Dániel Zámbó, Anja Schlosser, Pascal Rusch, Nadja C. Bigall,
Advanced Optical Materials 10, 2101712 (2022)

[2] Investigation of the Photocatalytic Hydrogen Production of Semiconductor Nanocrystal-Based Hydrogels, Jakob Schlenkrich, Franziska Lübkemann-Warwas, Rebecca T. Graf, Christoph Wesemann, Larissa Schoske, Marina Rosebrock, Karen D. J. Hindricks, Peter Behrens, Detlef W. Bahnemann, Dirk Dorfs, Nadja C. Bigall,
Small 19, 2208108 (12 pp) (2023)

[3] Control over Structure and Properties in Nanocrystal Aerogels at the Nano-, Micro-, and Macroscale, Pascal Rusch, Dániel Zámbó, Nadja C. Bigall, Acc. Chem. Res. 2020, 53, 10, 2414–2424, https://doi.org/10.1021/acs.accounts.0c00463

MüSIM2026 Speakers

Prof. Dr. Ben Feringa

Faculty of Science and Engineering
Stratingh Institute for Chemistry
University of Groningen
Groningen, The Netherlands

Ben L. Feringa obtained his PhD degree at the University of Groningen in the Netherlands. After working as a research scientist at Shell in the Netherlands and the UK, he was appointed lecturer and in 1988 full professor at the University of Groningen and named the Jacobus H. van 't Hoff Distinguished Professor of Molecular Sciences in 2004. He is a member of the Royal Netherlands Academy of Sciences. In 2008 he was appointed Academy Professor and he was knighted by Her Majesty the Queen of the Netherlands.

Feringa's research has been recognized with numerous awards including the 2016 Nobel prize in Chemistry, the Tetrahedron Prize (2017) and the European Chemistry Gold Medal (2018). In 2019 he was elected as member of the European Research Council and Foreign Member of the US National Academy, USA, and in 2020 as a Foreign Member Royal Society (London) UK.
Feringa's research interest includes stereochemistry, organic synthesis, asymmetric catalysis, molecular switches and motors, self-assembly, molecular nanosystems and photo pharmacology.

The Art of Building Small
from Molecular Switches to Motors

Ben Feringa, University of Groningen, The Netherlands

The fascinating molecular motors and machines that sustain life offer a great source of inspiration to the molecular explorer at the nanoscale. Among the major challenges ahead in the design of complex artificial molecular systems and is the control over dynamic properties and responsive far-from-equilibrium behavior. Chemical systems and adaptive materials ultimately require integration of structure, organization and function of multi-component dynamic molecular assemblies at different hierarchical levels. A major goal is to achieve and exploit translational and rotary motion.

In this presentation the focus is on the dynamics of functional molecular systems and smart materials as well as triggering and assembly processes. We design switches and motors in which molecular motion is coupled to specific functions. Responsive behavior will also be illustrated in self-assembly and responsive materials with a focus on cooperative action, amplification along multiple length scales and 2D and 3D organized systems. The design, synthesis and functioning of rotary molecular motors and machines will be presented with a prospect toward future dynamic molecular systems and materials.

Information on http://www.benferinga.com
- Molecular Machines: Nature, September 2015
- Molecular Switches: Chemistry World, June 2016
- Vision statement "Materials in Motion": Adv. Mater. 2020

MüSIM2026 Speakers

Prof. Dr. Giovanni Volpe

Department of Physics
Soft Matter Lab
University of Gothenburg
Gothenburg, Sweden

Giovanni Volpe is a physicist working at the interface of soft matter, active matter, biophysics, and artificial intelligence. His research focuses on how microscale interactions and nonequilibrium dynamics can generate emergent behaviors and functional micromechanics, with applications ranging from responsive materials to bio-inspired micromachines. He develops both experimental and computational approaches, including advanced microscopy, data-driven modeling, and machine learning for quantitative analysis of complex dynamical systems. He is the author of Deep Learning Crash Course (No Starch Press, 2026) and co-founder of startups working on AI-driven solutions for imaging and advanced applications (IFLAI AB). His work aims to connect fundamental physical principles with scalable methods for design, control, and discovery in intelligent matter.

Smart Machines and Optical Manipulation at the Microscale

Giovanni Volpe, University of Gothenburg, Sweden

Microscale systems offer a unique opportunity to engineer machines whose function emerges from the interplay of geometry, interactions, and fluctuations. In this talk, I will present our work on smart machines at the microscale, combining nanofabrication, programmable interactions, and advanced optical methods to design and control colloidal micromechanisms and metamaterials.

I will first introduce how nanotechnology enables the realization of colloidal metamachines and microscopic mechanisms, where shape and mechanical constraints are engineered to produce targeted motion and response in fluid environments. I will then show how smart microscopy and optical manipulation—including high-resolution imaging, automated tracking, and light-based control—allow us to probe these machines in real time and quantify their dynamics. This approach enables precision measurements of effective interaction landscapes, including critical Casimir forces and their relation to fluctuation-induced forces known from QED Casimir physics.

MüSIM2026 Speakers

Prof. Dr. Christoph Weder

Adolphe Merkle Institute (AMI)
University of Fribourg
Fribourg, Switzerland

Christoph (Chris) Weder is Professor of Polymer Chemistry and Materials at the Adolphe Merkle Institute (AMI), University of Fribourg, Switzerland, where he has worked since 2009 and served as Director from 2010–2022. He was also the founding director of the Swiss National Center of Competence in Research Bio-Inspired Materials (2014–2020). Before joining AMI, Chris was an endowed Full Professor at Case Western Reserve University (USA). Trained as a chemist and materials scientist, his research focuses on functional polymer systems, including supramolecular and stimuli-responsive polymers, bio-inspired materials, and nanocomposites. Weder has published ~360 papers and co-invented ~25 patent families. He is an associate editor of ACS Applied Polymer Materials, a former associate editor of ACS Macro Letters, and has held advisory roles with numerous journals and research centers. Honors include membership in the Swiss Academy of Engineering Sciences, ACS Polymer Chemistry Fellowship, an ERC Advanced Grant, and the ACS Anselme Payen Award. He has mentored ~85 graduate students and ~60 postdocs.

Dynamic Mechanophores: Harnessing Supramolecular Interactions for Reversible Mechanochromism

Christoph Weder, University of Fribourg, Switzerland

Beyond simply deforming materials or breaking bonds, mechanical stress can initiate productive molecular changes in polymers. In synthetic polymers, such mechanotransduction processes are enabled by mechanophores, molecular units that convert mechanical forces into chemical or structural changes. These transformations often manifest as striking optical responses, such as changes in absorption or fluorescence. While most mechanophores rely on breaking weak covalent bonds and thus display irreversible responses, an exciting alternative leverages dynamic, non-covalent interactions.

Supramolecular motifs can promote instant and reversible mechanochromic behavior, allowing polymers to respond to force in a controlled and repeatable way. This presentation explores several supramolecular mechanophores, including rotaxanes, cyclophanes, and loop-forming architectures featuring pairs of optically active moieties. We will examine the principles that govern their operation, such as excimer and charge-transfer formation, as well as fluorescence quenching. We will connect these molecular mechanisms to macroscopic responses in different polymers and highlight correlations between mechanophore structure, polymer architecture, and mechanoresponsive performance.

MüSIM2026 Young Researcher Awardee

Dr. David Urban

MiNaLab
SINTEF Digital
Oslo, Norway

For his contribution:

Directional Flows using Capillary Assembly of Photo-deformable Colloidal Particles at Water-air Interfaces

David Urban, Marcel Rey, Antonio Ciarlo, Marie Friederike Schulte, Emiliano Descrovi, and Giovanni Volpe

Nat Commun **17**, 1004 (2026)

Colloidal particles at liquid interfaces experience long-ranged capillary interactions, whose magnitude and directionality depend on the particle shapes.
When particle shapes are determined by fabrication or synthesis, the resulting shape-mediated interactions are predefined and often lead to the formation of persistent interfacial structures. Here, we introduce polymer particles at water-air interfaces whose shape and, therefore, interactions can be altered by illumination with polarized light. Specifically, we selectively trigger capillary self-assembly by anisotropically deforming the particles at the interface. Intriguingly, further deformation of already assembled particles induces sustained interfacial flows with velocities of up to 90 μm/s. Benefitting from polarization-defined deformation directions, we create flow-patterns that do not simply follow the illumination intensity pattern, such as shear flows along a single rectangular illumination stripe. We anticipate that this interplay between photo-deformation and capillary interactions of particles will enable various forms of mixing, manipulation, and assembly of soft matter at liquid interfaces.

MüSIM2026 Poster Contributions

(alphabetical order, first author´s surname)

01. **Sulfonic Acid Driven Supramolecular Polymerization**
Sebastian Baumert, Walter Robert Linke, Antonia Albers, Constantin G. Daniliuc, Michael Ryan Hansen, and Gustavo Fernández
University of Münster

02. **Fabrication of Dispersion-tunable Spin-wave Waveguides for Large Magnonic Networks**
Jannis Bensmann[1], Kirill O. Nikolaev[1], Dmitrii Raskhodchikov[1], Robert Schmidt[1], Shraddha Choudhary[1], Richa Bhardwaj[1], Shabnam Taheriniya[1,2], Akhil Varri[1], Sven Niehues[1], Ahmad El Kadri[1], Johannes Kern[1], Wolfram H. P. Pernice[1,2], Sergej O. Demokritov[1], Vladislav E. Demidov[1], Steffen Michaelis de Vasconcellos[1], and Rudolf Bratschitsch[1]
[1]University of Münster, [2]Heidelberg University

03. **Combination of an Integrated Photonic Processor and Dopant Network Processing Units for In-Sensor Computing**
Ivonne Bente[1], Reinier J.C. Cool[1,2], Jan Brandes[3], Falk Ebert[3], Lorenzo Cassola[2], Wilfred G. van der Wiel[1,2], and Wolfram H.P. Pernice[1,3]
[1]University of Münster, [2]University of Twente, [3]Heidelberg University

04. **Self-regulating Soft Materials: Feedback Mechanisms for Coupling Photochemical Reactivity and Thermoresponsive Properties**
Zugeng Cong, Florian Friedmann, Kai Zeng, Michael Hardt, Björn Braunschweig, and Line Næsborg
University of Münster

05. **Ultrasound-controlled Disassembly Pathways of Self-assembled Polymer-decorated PdnL2n Supramolecular Architectures**
Tim David, Regina Lennarz, Jan Alexander Meissner, Anne Germann, Jan Meisner, and Bernd Martin Schmidt
Heinrich Heine University Düsseldorf

06. **Light-based Bacterial Cell-Cell Communication**
Tarek S. Elsayed, Matthew E. Allen, Xiaoran Zheng, and Seraphine V. Wegner
University of Münster

07. **Photonic Quantum Networks Bridging Quantum Optics & Quantum Information Science Platforms**
Umer Farooq[1], Daniel A. Vajner[2], Lucas Rickert[2], Koray Kaymazlar[2], Robert Behrends[2], Mareike Lach[2], Nils Kewitz[2], Timm Gao[2], Martin von Helversen[2], Anastasios Fasoulakis[2], Pratim K. Saha[2], and Tobias Heindel[1]
[1]University of Münster, [2]Technical University of Berlin

08. **Photoresponsive Hybrid Materials for Adaptive Soft Actuation**
Taís França[1,2], Leonard Cleve[1], Kevin Chhen[1], Christian A. Nijhuis[1,2], and Bart Jan Ravoo[1,2]
[1]University of Twente, [2]University of Münster

MüSIM2026 Poster Contributions

(alphabetical order, first author´s surname)

09. **Radical Recombination as a Dynamic Covalent Tool for Tuneable Responsive Porous Organic Cages**
Yannic Hartmann[1], Robert Oestreich[1], Yuki Wada[2], Philippe de Bary[1], Masaki Kawano[2], Christoph Janiak[1], and Bernd M. Schmidt[1]
[1]Heinrich Heine University Düsseldorf, [2]Institute of Science Tokyo

10. **Dynamic Redox Switching in Molecular Junctions: Intelligent Interfaces for Neuromorphic Computing**
Rohel Hoque[1], Elias David Mende[1], Aswin Sivankutty[1,2], Frank Glorius[1], Christian Nijhuis[1,2], and Robert Hein[1]
[1]University of Münster, [2]University of Twente

11. **SmartMatters4You: Giving Students Insight into the Research of CRC 1459 Intelligent Matter**
Marina H. Janczak
University of Münster

12. **From Responsive Molecular Photoswitches to Tunable Excited-state Processes: A Computational Study**
Sabine Käfer and Johannes Neugebauer
University of Münster

13. **Intelligent Light-propelled Microsystems**
Ivan Kalthoff[1], Jesco Schönfelder[2], Markus Thomas Kuhnert[2], Gan Wang[3], Giuseppe Pesce[4], Giovanni Volpe[3], Jörg Imbrock[2], Marcel Rey[2], and Raphael Wittkowski[1]
[1]RWTH Aachen University, [2]University of Münster, [3]University of Gothenburg, [4]University of Naples

14. **Multi-state and Multi-stimuli-responsive Rotaxanes**
Lisa Kamecke[1], Max Fellert[2], Eric Sidler[2], Massimiliano Curcio[3], Stefano Corra[3], Alberto Credi[3], Ben L. Feringa[2], and Robert Hein[1]
[1]University of Münster, [2]University of Groningen, [3]Università di Bologna

15. **Green-synthesized Single-benzene Fluorophores Exhibiting Room-temperature Phosphorescence and Solid-state Fluorescence for Biological and Optical Applications**
Maximilian Kramp, Durga Prasad Karothu, Juan Camilo Zschommler, Patrick Commins, Thomas Prestel, Verena Ibl, Panče Naumov, Carolin Müller, and Stefan Schramm
University of Applied Sciences Dresden

MüSIM2026 Poster Contributions

(alphabetical order, first author´s surname)

16. **Adaptive Molecular Systems in Optical Neural Networks**
    Peter Lazarowicz, Jonas Konrad, Benjamin Risse, and Carsten Schuck
    University of Münster

17. **Self-Assembly of Hybrid Nanostructures for Brain-Inspired Electronics**
    Dominik Mählmann[1], Marc Beuel[1,2], Jonas Mensing[1], Andreas Heuer[1], Bart Jan Ravoo[1,2], and Wilfred G. van der Wiel[1,2]
    [1]University of Münster, [2]University of Twente

18. **Responsive Coatings for On-demand Active Delamination**
    Soumabrata Majumdar and Michael M. Lerch
    University of Groningen

19. **Synthesis of Functionalized Alternating Polymers and Their Application in Materials Science**
    Kirill Markelov, Maximilian Bagus, and Armido Studer
    University of Münster

20. **Chirality-induced Spin Selectivity: Dependence on Molecular, Substrate and Layer Properties**
    Paul Möllers[1], Adrian Joe Urban[2,3], Bianca Catalina Baciu[4], Rafael Rodriguez[5], Takuro Sato[2], Albert Guijarro[4], Jeanne Crassous[5], Steven De Feyter[3], Hiroshi Yamamoto[2], and Helmut Zacharias[1]
    [1]University of Münster, [2]National Institutes of Natural Sciences Japan, [3]Katholieke Universiteit Leuven, [4]University of Alicante, [5]University of Rennes

21. **First Steps towards van der Waals Material-based Tunnel Junctions**
    Dennis Mors[1,2], Sruthi Sudhakaran[1,2], Christian A. Nijhuis[1,2], and Iris Niehues[1]
    [1]University of Münster, [2]University of Twente

22. **Dynamic Self-organization of Colloidal Self-propelled Rods**
    Anpuj Nair S, Yogesh Shelke, and Hanumantha Rao Vutukuri
    University of Twente

23. **Developing Tunable Triplet Emitters towards Adaptive Electroluminescent Materials**
    Alex Oster, Thaison Nguyen, Carl L. Giard, Dominik Schwab, Nikos L. Doltsinis, Cristian A. Strassert
    University of Münster

24. **Photoresponsive Interfacial Behavior of Hybrid Photosensitizer Surfactant Mixtures**
    Phat T. Pham, H.Gökberk Özcelik, Julius Gemen, Frank Glorius, Andreas Heuer, and Björn Braunschweig
    University of Münster

MüSIM2026 Poster Contributions

(alphabetical order, first author´s surname)

25. **Modular Synthesis of Highly Tuneable Dynamic Redox Switches**
    Bünyamin Sikora, Daniel Aßenmacher, Constantin G. Daniliuc, and Robert Hein
    University of Münster

26. **Supramolecular Light-switchable Triazole-hosts for Photoadaptive Anion Binding**
    Yannik Steinberg, Alisa Kondrateva, Monika Schönhoff, and Olga García Mancheño
    University of Münster

27. **New Photoswitches for Integration in Adaptive Nanosystems**
    Bastian Stövesand, Arne Nalop, Bart Jan Ravoo, and Frank Glorius
    University of Münster

28. **Controlling Liquid Crystal Phase Transitions via the Photostationary State of Arylazopyrazoles**
    Tobias Thiele, Kristina Hrybenko, Christoph Wölper, and Michael Giese
    University of Duisburg-Essen

29. **Towards Electro-optical In-memory Computing with Phase Change Materials**
    Niklas Vollmar[1], Daniel Wendland[1], Akhil Varri[1], Anna Ovvyan[2], Sebastian Walfort[1], Zhongyu Tang[2], Wolfram H.P. Pernice[2], and Martin Salinga[1]
    [1]University of Münster, [2]Heidelberg University

Photographs and images obtained from:

Nadja Bigall, Ben Feringa, Givanni Volpe, Christoph Weder, and David Urban