

# Wigner 121 Scientific Symposium

Wigner Research Centre for Physics  
Institute for Particle and Nuclear Physics  
Dept. Of Materials Science by Nuclear Methods  
Functional Nanostructures Research Group

Daniel G. Merkel, L. Deák, S. Sajti, A. Lengyel, G. Hegedűs

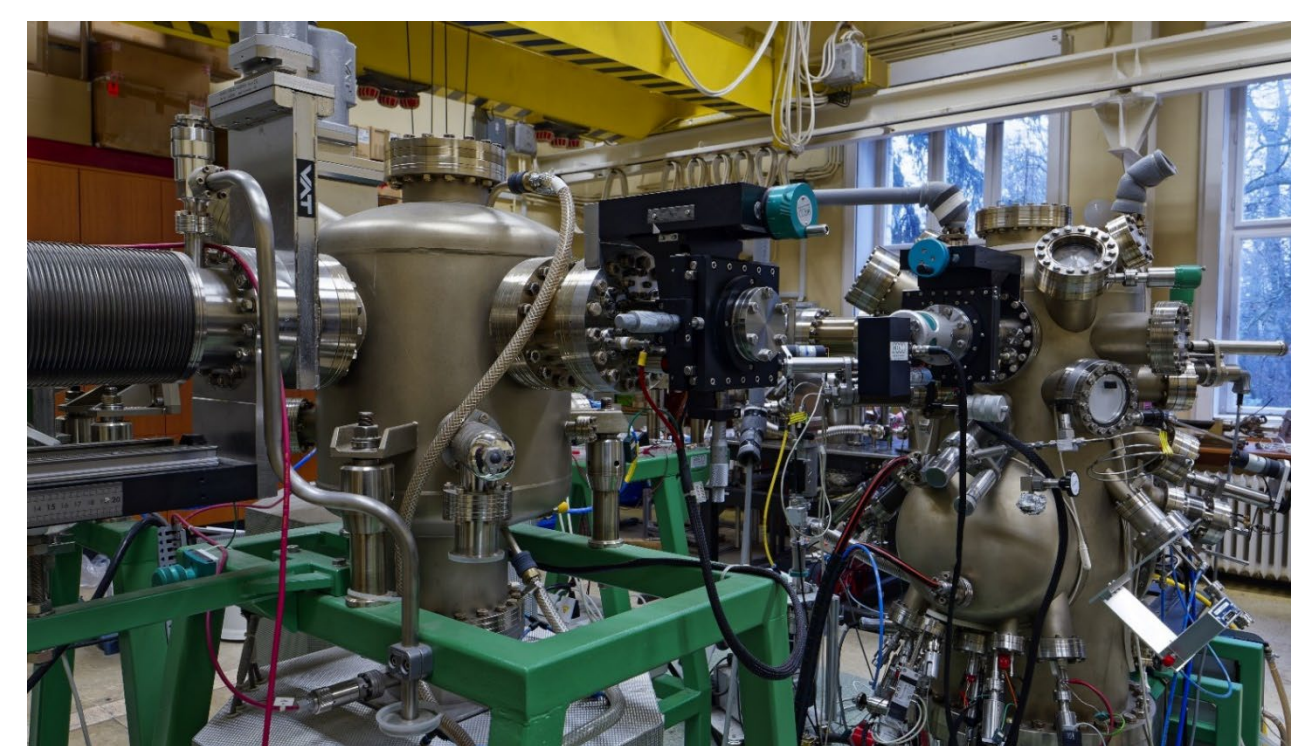
## Introduction

The Functional Nanostructures Research Group focuses on fundamental research in the field of multiferroic materials, neutron supermirrors, biological membranes, basic physical phenomena, and methodological and theoretical questions within the framework of diverse international collaborations.

In addition to research activities, our group plays a significant role in numerous domestic and international scientific committees. We organize university courses, conduct student laboratories, supervise diploma and PhD topics, deliver educational talks, and participate as lecturers and practical instructors at international schools.

The research group oversees the Molecular Beam Epitaxy (MBE) equipment at the NKFIH TOP 50 Functional Materials Laboratory (FunMatLab). We have direct access to the GINA neutron reflectometer and actively participate in the operation and development of the Mössbauer laboratory.

## Research Infrastructures



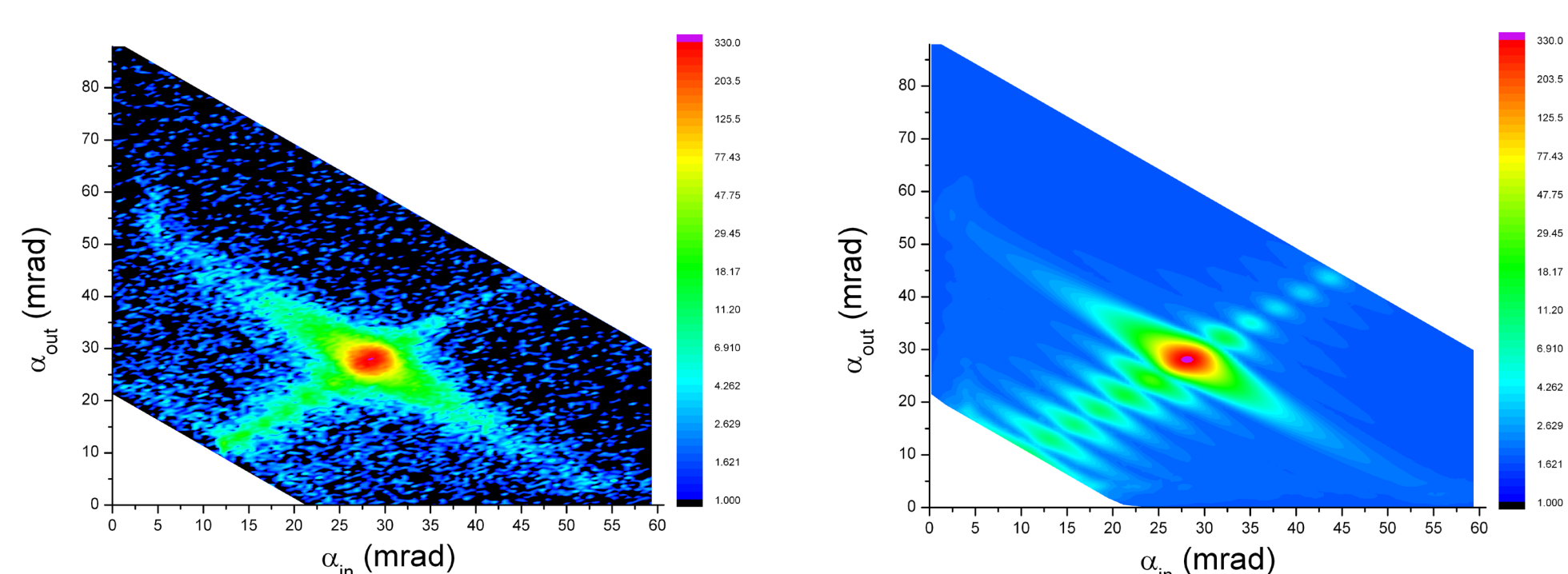
Molecular Beam Epitaxy



GINA polarized neutron reflectometer

## Research Highlights

### Domain-domain correlation functions used in off-specular scattering

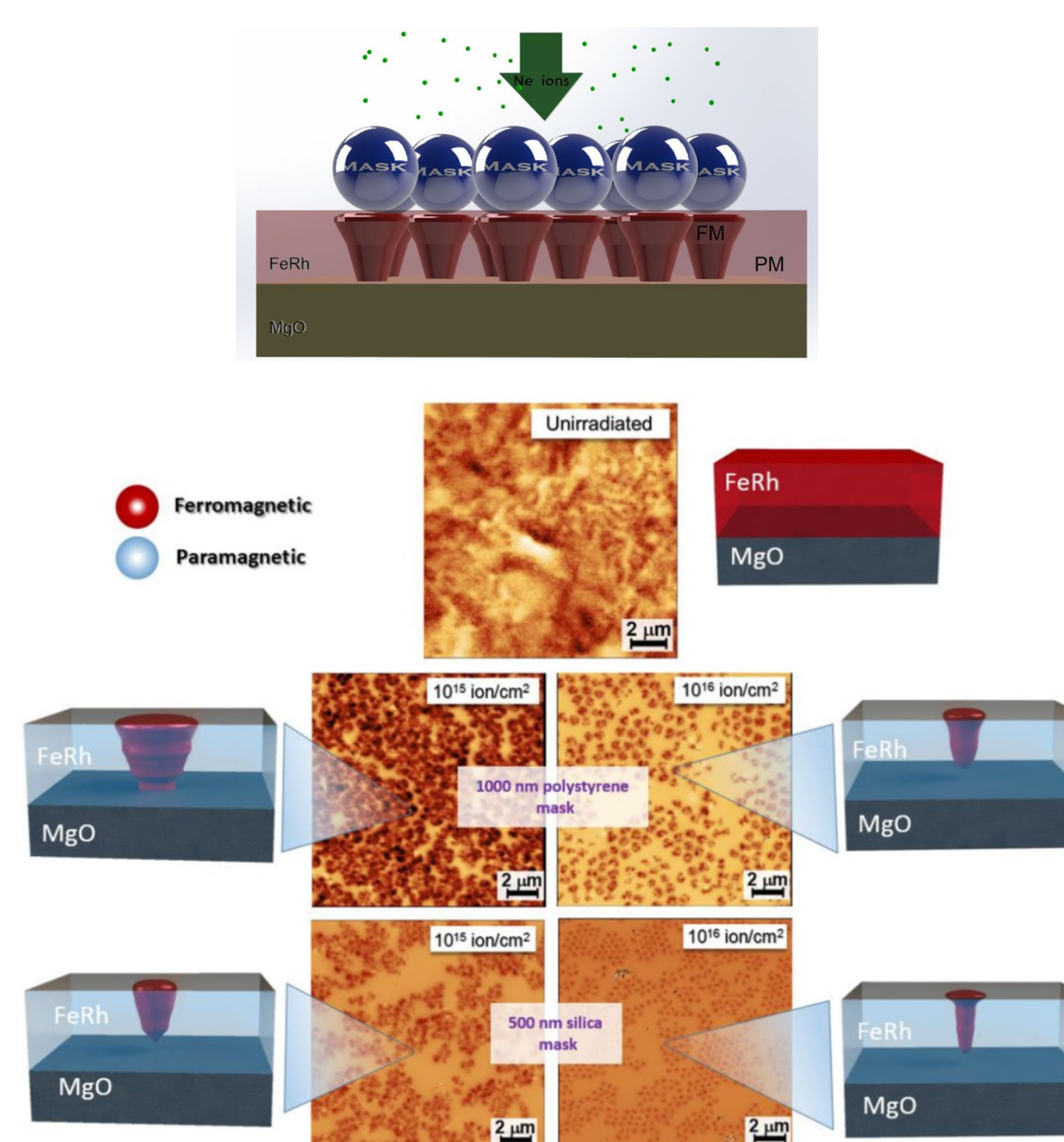


$$\mathcal{E}_{ii}^{\mu\nu}(\mathbf{R}_i) = \eta_i^\mu (\delta_{\mu\nu} - \eta_i^\nu) \psi_i(\mathbf{R}_i) \quad \text{and} \quad \psi_i(\mathbf{R}_i) = G_i(-1, \mathbf{R}_i)$$

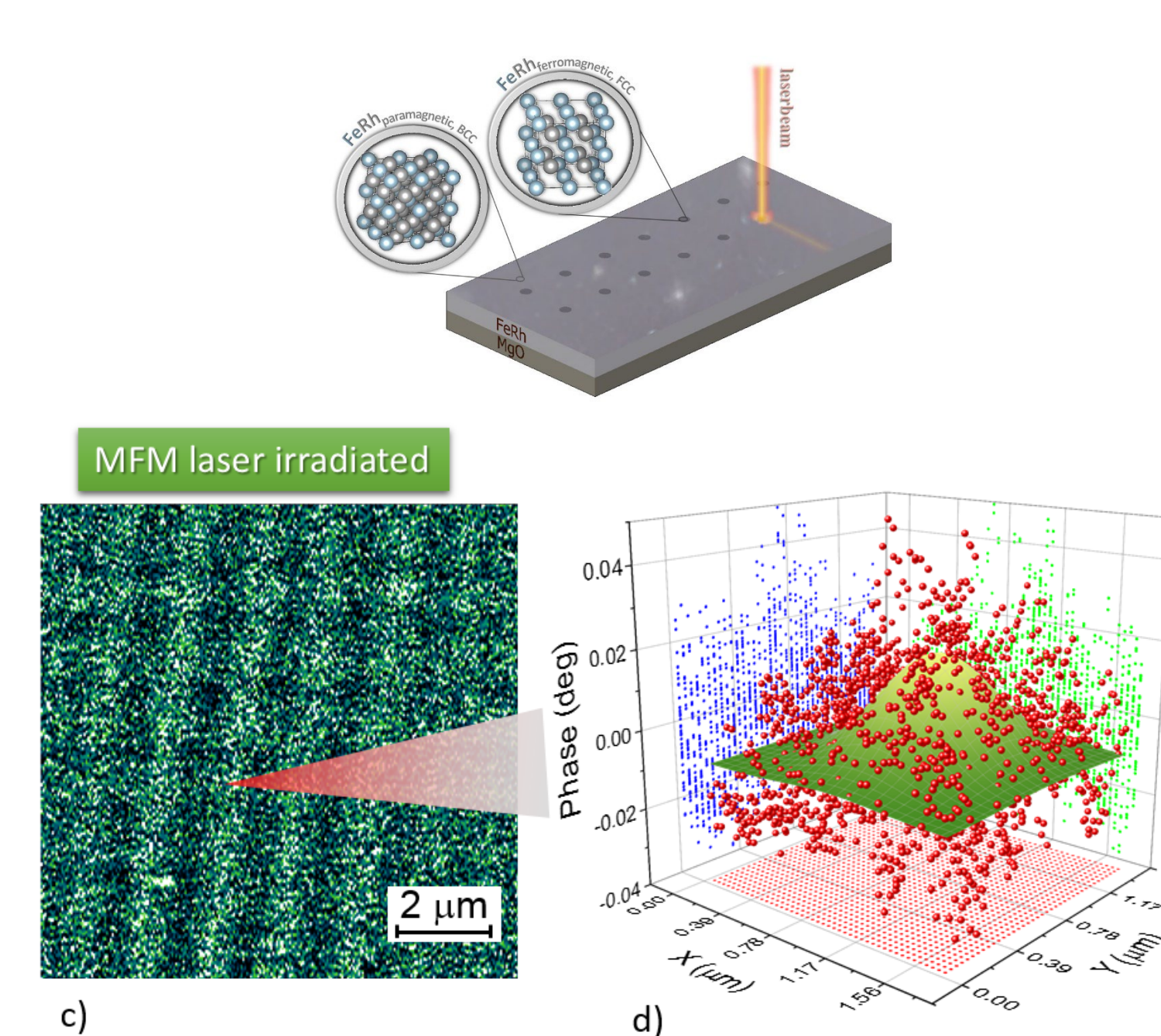
The open questions in the domain-domain correlation functions - describing lateral inhomogeneities in single and multilayer systems - were elucidated.

### Magnetic Nanopattern Formation in FeRh Thin

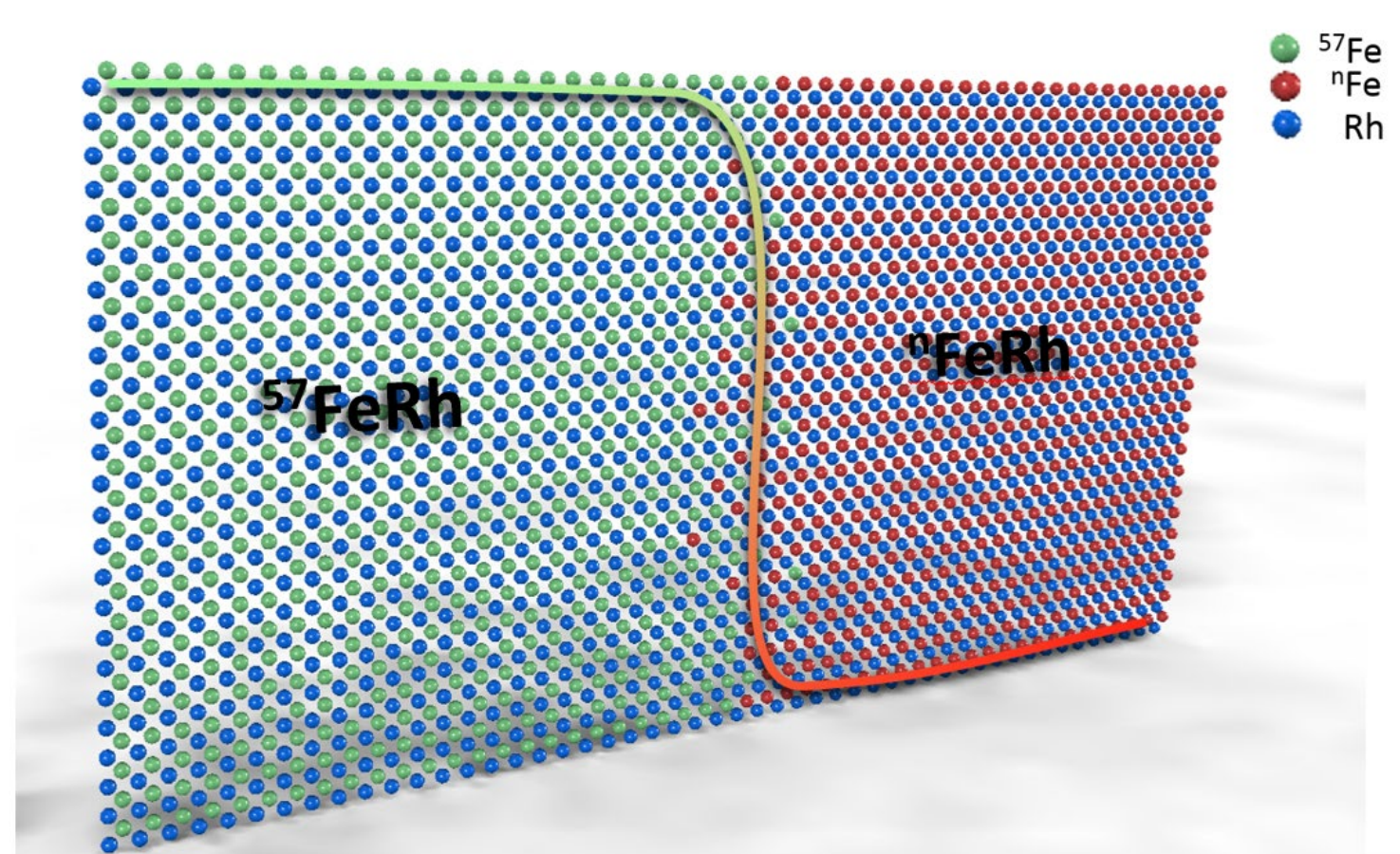
Irradiation induced



Laser induced

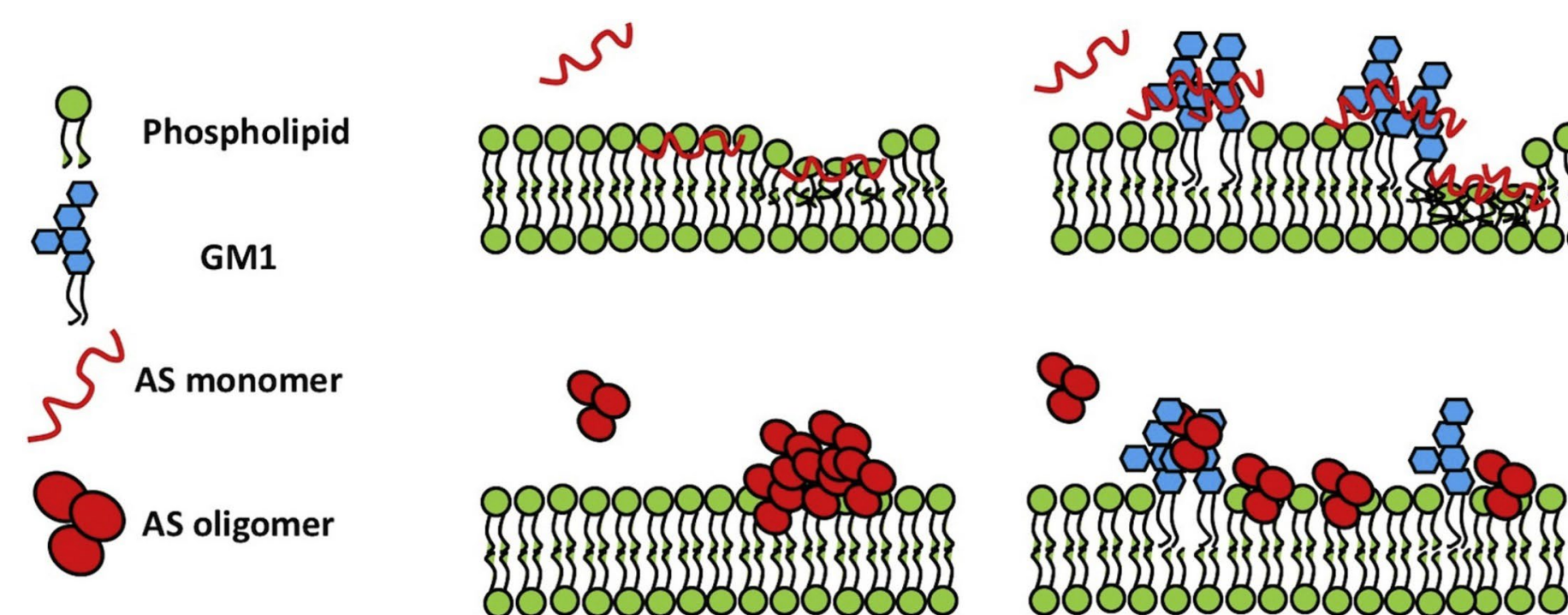


### Iron self-diffusion in B2-FeRh thin film



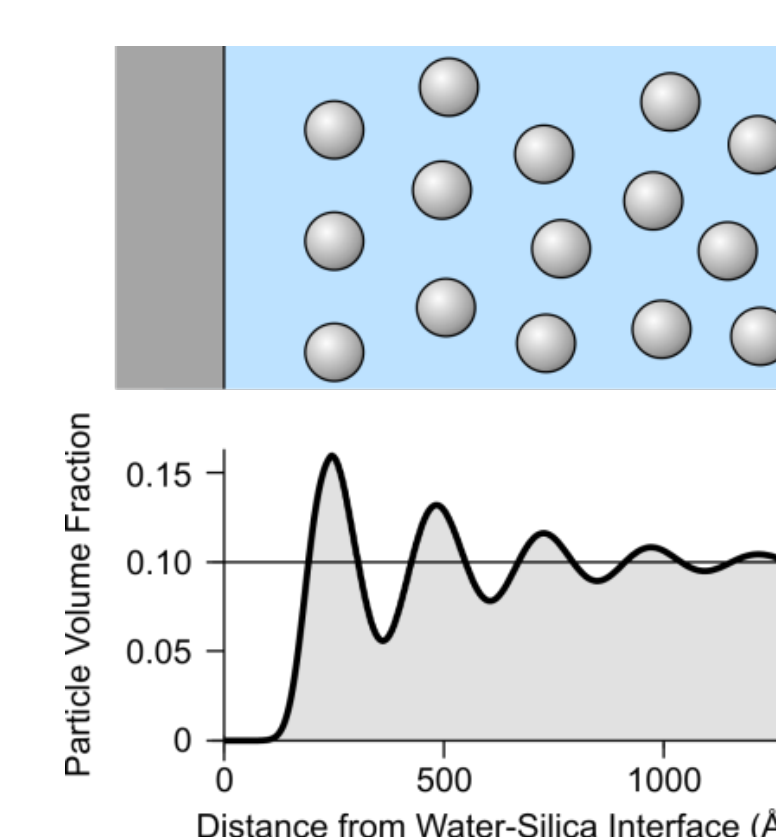
Self-diffusion coefficients were determined by neutron reflectivity technique in a MBE prepared FeRh thin film.

### GM1 Ganglioside role in the interaction of Alpha-synuclein with lipid membranes: Morphology and structure



The monomer- and oligomer-interactions are both limited to the external membrane leaflet and that the presence of ganglioside leads to a stronger interaction of the membranes and Alpha-Synuclein in its monomeric and oligomeric forms with a stronger aggressiveness in the latter.

### Structuring of colloidal silica nanoparticle suspensions near water-silica interfaces



Oscillatory concentration profile of the silica nanoparticles in the normal direction to the interface determined by neutron reflectometry.

## Publications of the group

- Merkel, D.G.; Sájerman, K.; Vácz, T.; Lenk, S.; Hegedűs, G.; Sajti, S.; Németh, A.; Gracheva, M.A.; Petrik, P.; Mukherjee, D. et al. MATERIALS RESEARCH EXPRESS 10 : 7 Paper: 076101 , 7 p. (2023)
- Sajti, S. PHYSICA A - STATISTICAL MECHANICS AND ITS APPLICATIONS 623 Paper: 128853 , 12 (2023)
- Lengyel, A.; Bazsó, G.; Chumakov, A.I.; Nagy, D.L.; Hegedűs, G.; Bessas, D.; Horváth, Z.E.; Nemes, N.M.; Gracheva, M.A.; Szilágyi, E. et al. MATERIALS SCIENCE AND ENGINEERING B - SOLID STATE MATERIALS FOR ADVANCED TECHNOLOGY 285 Paper: 115939 , 8 p. (2022)
- Merkel, D.G.; Hegedűs, G.; Gracheva, M.; Deák, A.; Illés, L.; Németh, A.; Maccari, F.; Radulov, I.; Major, M.; Chumakov, A.I. et al. ACS APPLIED NANO MATERIALS 5 : 4 pp. 5516-5526 , 11 p. (2022)
- Stankov, S.; Merkel, D.G.; Kalt, J.; Gottlicher, J.; Lazewski, J.; Sternik, M.; Jochym, P.T.; Piekarczyk, P.; Baumbach, T.; Chumakov, A.I. et al. NANOSCALE ADVANCES 4:1, 19 , (2022)
- Perissinotto, F.; Rondelli, V.; Senigaglia, B.; Brocca, P.; Almasy, L.; Bottyan, L.; Merkel, D.G.; Amenitsch, H.; Sartori, B.; Pachler, K. et al. NANOSCALE 13 : 30 13158, 1 (2021)
- Balogh, J.; Hegedűs, L.G.; Kaptás, D.; Merkel, D.G.; Nakanishi, A.; Nagy, D.L. THIN SOLID FILMS 721 Paper: 138551, 19 (2021)
- Merkel, D.G.; Lengyel, A.; Nagy, D.L.; Németh, A.; Horváth, Z.E.; Bogdán, Cs.; Gracheva, M.A.; Hegedűs, G.; Sajti, Sz.; Radnóczy, GyZ et al. SCIENTIFIC REPORTS 10 : 1 13923 , 11 p. (2020)
- Maroni, P.; Gvaramia, M.; Kosior, D.; Kubiak, K.; Scarratt, L.; Smith, A.M.; Merkel, D.G.; Bottyan, L.; Borkovec, M. PHYSICAL CHEMISTRY CHEMICAL PHYSICS 22 : 11 pp. 6449-6456 , 8 p. (2020)
- Sajti, Sz.; Bottyan, L.; Moulin, J.-F.; Paul, A. JOURNAL OF SURFACE INVESTIGATION: X-RAY SYNCHROTRON AND NEUTRON TECHNIQUES 14 pp. S1-S4 , 4 p. (2020)

