Prize Talk PRV I Mon 13:00 HSZ/0002

Driven Quantum Materials: Controlling Emergent Phenomena away from Equilibrium — •Andrea Cavalleri — Max Planck Institute for the Structure and Dynamics of Matter — Laureate of the Stern-Gerlach-Medal 2026

I will discuss how coherent electromagnetic radiation, when tuned to collective modes in quantum materials, can be used to induce unexpected dynamical phenomena. The core idea is that when uncoupled normal modes are driven nonlinearly, complex correlations are created that are absent in equilibrium. Emergent dynamical orders, which include superconductivity, magnetism, ferroelectricity and other functional phenomena, are created in this way, with both fundamental and applied ramifications. I will touch on the crucial importance of modern ultrafast X-Ray Free Electron Lasers, and novel THz sources that are matched to these.

Prize Talk PRV II Tue 13:00 HSZ/0002

Polymers / Soft Matter as Model Systems for Physics — •Kurt Kremer — MPI für Polymerforschung, Mainz, Deutschland — Laureate of the Max-Planck-Medal 2026

Polymers, long chain molecules, comprise important materials of our daily life, being it simple commodities with all their advantages and disadvantages or high-tech materials in electronics or medicine, etc. Furthermore, bio-polymers such as cellulose or DNA are central constituents of living organisms. Thus, polymers have been subject of applied physics since their discovery. That, however, changed with de Gennes' n->0 theorem, showing that the inverse chain length 1/N can be mapped onto the distance |T-Tc|/Tc from the critical point in a n-vector spin model. At about the same time computer simulations became powerful tools to study critical phenomena, complemented by experiment, most notably neutron scattering for polymers. All this marked the start of polymers becoming versatile systems to study critical phenomena.

Polymers/Soft Matter are susceptible to small molecular stimuli. Thus, minute shifts in local interactions easily turn into macroscopic property changes. Here generic physical concepts meet chemical details, making polymers so versatile. The talk will review a few examples, where such effects lead to physically interesting phenomena (active systems, glass transition, nanoporous materials). Finally, new challenges imposed by soft matter will shortly be discussed.

Prize Talk PRV III Tue 13:00 HSZ/0004

Optics of single molecules explored with sub-nm precision — •Anna Rosławska — Max Planck Institute for Solid State Research, Heisenbergstr. 1, 70569 Stuttgart, Germany — Laureate of the Gaede-Prize 2026

Light-matter interaction is essential for mechanisms such as luminescence, photosynthesis, and energy harvesting, defining the emission characteristics of molecular systems and governing the conversion of energy between photons and electrons. While these processes are intensively studied and employed, little is known about their dependence on atomic-scale properties since reaching such precision in optics is extremely demanding. This challenge is nowadays overcome thanks to the combination of optical spectroscopy approaches with scanning probe microscopy, which profit from the extreme field enhancement provided by the tip that enables atomic-scale optics [1]. In my talk, I will discuss how this approach can be applied to gate fluorescence by individual charges [2], used to induce photochemical reactions with sub-nm precision [3], and enables probing optical properties of individual biological pigments.

[1] A. Rosławska, T. Neuman, B. Doppagne, A. Borisov, M. Romeo, F. Scheurer, J. Aizpurua, G. Schull, Phys. Rev. X, 12, 011012, 2022.

[2] K. Kaiser, S. Jiang, M. Romeo, F. Scheurer, G. Schull, A. Rosławska, Phys. Rev. Lett. 133, 156902, 2024.

[3] A. Rosławska, K. Kaiser, M. Romeo, E. Devaux, F. Scheurer, S. Berciaud, T. Neuman, G. Schull, Nat. Nanotechnol., 19, 738-743, 2024.

Prize Talk PRV IV Wed 13:00 HSZ/0003

Fractionalisation, fractals and strong coupling QED in spin liquids — •Roderich Moessner — MPI-PKS Dresden — Laureate of the Max-Born-Prize 2026

After a long and sustained research effort, the quest for an experimental realisation of a quantum spin liquid shows encouraging signs of nearing conclusion. This talk recalls some basic background on the nature of spin liquids and their place in what has become known as topological condensed matter physics. It then covers particularly notable properties which have been experimentally discovered in the magnetisation dynamics, namely the existence of a dynamical fractal and of disorder-free subdiffusion in three dimensions. It concludes with a discussion of the promise of realising an experimental platform for strong coupling quantum electrodynamics in the present work on pyrochlore materials.

Prize Talk PRV V Thu 13:00 HSZ/0002

Observation of Floquet states in graphene — •Marcel Reutzel — Philipps-Universität Marburg, Fachbereich Physik and mar.quest, Germany — Georg-August-Universität Göttingen, I. Physikalisches Institut, Germany — Laureate of the Walter-Schottky-Prize 2026

Material phases are traditionally controlled by parameters such as temperature or doping. Newer efforts employ ultrashort light pulses and correlated - but incoherent - interactions of the electron-lattice-spin systems to create non-thermal phases. While such on-demand material engineering has been established in the last years, more recent efforts strive for the coherent counterpart: By using time-periodic light fields (a.k.a Floquet engineering), new electronic band structures and correlated or even topological phases can be created. Importantly, these phases can then be coherently controlled by the properties of the light field. Therefore, fundamental research on Floquet engineering promises the realization of emergent material phases without any counterpart in thermal equilibrium.

Here, we will outline how the development of time-resolved momentum microscopy - a new variant of time- and angle-resolved photoelectron spectroscopy - has enabled the direct observation of Floquet states in monolayer graphene [1]. These proof-of-principle experiments on semi-metallic graphene open up a new pathway for testing the many theoretical proposals of light-induced phase transitions that have so far remained elusive.

[1] Merboldt *et al.*, Nature Physics 21, 1093 (2025).

Prize Talk PRV VI Thu 13:00 HSZ/0003

Knots and Links in Magnetism — •Maria Azhar — Faculty of Physics and Center for Nanointegration Duisburg-Essen (CENIDE), University of Duisburg-Essen, 47057 Duisburg, Germany — Laureate of the Hertha-Sponer-Prize 2026

Magnetic materials can host remarkably stable, intertwined structures that behave like knots, links, and braids; discrete objects that can be counted and, in principle, used to store information. This talk explains why such complex patterns can exist, ranging from magnetic whirls (Skyrmions) to knots and links (Hopfions), and three-dimensional objects that have only recently been observed, such as screw dislocations of spiral magnetic order.

In some magnets, the far-field is non-uniform, which fundamentally changes which knots or links are possible. Stability is then no longer described by a single number: new states emerge with fractional character, smoothly connecting configurations that would otherwise appear distinct.

At a deeper level, these phenomena follow a simple yet profound geometric idea: magnetic configurations map one sphere onto another, and their winding determines stability. Understanding the underlying principles turns knots and links into practical building blocks for robust and controllable magnetic matter.