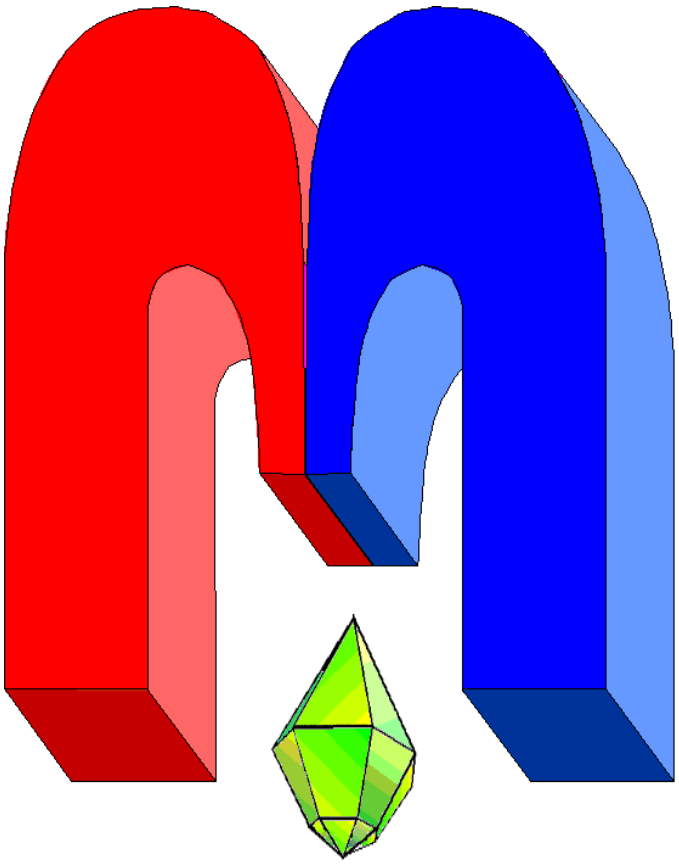
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† In Kazan University the Electron Paramagnetic Resonance (EPR) was discovered by Zavoisky E.K. in 1944.

Magnetic Resonance in Solids, 2025. Editor's Letter

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This letter provides a brief overview of scientific articles published in the *Magnetic Resonance in Solids. Electronic Journal (MRSej)* during 2025 (Volume 27, Issues 1-3). Fifteen research papers appeared in the volume, distributed over three issues and covering electron paramagnetic resonance of point defects in low-dimensional solids, spectroscopy and crystal-field theory of rare-earth ions, the magnetism of complex and high-entropy oxides, nuclear magnetic resonance of porous media, and the computational and instrumental underpinnings of magnetic resonance. Rather than cataloguing individual results, the present letter attempts to trace the internal coherence of the volume and to indicate the directions in which the journal's traditional themes have developed over the past year.

Keywords: magnetic resonance; EPR; NMR; crystal field; point defects; magnetic oxides; porous media; high-entropy oxides; hexagonal boron nitride

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1. Overview of the volume

Volume 27 of *Magnetic Resonance in Solids* comprises fifteen research articles, published in three issues. The first issue is the shortest, containing two contributions [1, 2]; the second issue adds three further papers [3–5], while the third issue, with ten articles [6–15], forms the substantive core of the year. This distribution is not merely a matter of editorial scheduling: it reflects the rhythm of a journal whose submissions arrive in waves, and it lends the volume a certain asymmetry, with the autumn issue carrying the greater part of the experimental material and the earlier issues concentrating on theoretical and methodological work.

The scope of the volume remains faithful to the journal's long-standing profile – magnetic resonance in solids and closely related phenomena – yet the emphasis has shifted perceptibly. Where earlier volumes devoted considerable space to classical EPR of transition-metal complexes in diamagnetic hosts, the 2025 volume is dominated by three concerns: point defects in two-dimensional and van der Waals materials; the magnetic behaviour of compositionally complex oxides; and the application of nuclear magnetic resonance to the characterisation of porous media and to the instrumentation that such experiments demand. All three are areas in which magnetic resonance offers information that is difficult to obtain by other means, and all three have attracted renewed attention from the wider condensed-matter community.

2. Thematic panorama

2.1. Point defects in low-dimensional solids

The most conspicuous thread running through the volume is the study of defects in hexagonal boron nitride. Two papers, one appearing in the opening issue and one in the closing issue, address the negatively charged boron vacancy from complementary directions. In the first paper [2], Mamin and co-authors investigate how the hyperfine interaction with nitrogen-14 nuclei shapes the electron-nuclear double resonance response of the defect, thereby refining the microscopic model on which its use as a quantum sensor rests. In the second paper [11], Dmitrieva and co-workers revisit the same center, employing a combined approach that integrates density func-

tional theory with EPR methods to analyze the nuclear quadrupole interaction involving both nearby and distant nitrogen nuclei. Taken together, the two contributions illustrate a characteristic feature of contemporary defect spectroscopy: the interpretation of a single paramagnetic centre is no longer a matter of fitting a spin Hamiltonian to a spectrum, but of constructing a quantitative bridge between first-principles electronic structure and measurable hyperfine and quadrupole parameters.

2.2. Rare-earth ions and crystal-field theory

A second, more traditional strand concerns the spectroscopy of rare-earth ions and the analytical machinery of crystal-field theory. In the work by Shakurov et al. [6], which investigates Ho^{3+} ions in LaF_3 using high-frequency EPR, the zero-field splitting parameters, hyperfine interaction constants, and g-factors for the ion in a low-symmetry site have been determined; this adds to the still sparse body of subterahertz data for holmium. The theoretical counterpart to such measurements is provided by a derivation of compact analytical expressions that incorporate the spatial distribution of ligand electrons into the theory of the odd crystal field in the study by Popov et al. [3]. The importance of this last point should not be underestimated: conventional crystal-field parametrisations treat the ligands as point charges, an approximation whose inadequacy becomes apparent precisely in the odd-order terms that govern the mixing of states of opposite parity. That both papers appear in the same volume is fortunate, since the parameters extracted from experiment are of the kind that the refined formalism is designed to reproduce.

2.3. Magnetism of complex and high-entropy oxides

The third and largest group of papers is concerned with magnetic order in oxides of increasing compositional complexity. In a study by Vasilchikova and Vavilova [7], which presents a comprehensive investigation of the compound $LiMn_2TeO_6$ using NMR, magnetization measurements, and heat capacity analysis, a series of interconnected regimes characterized by slow spin dynamics were identified. Among these is a static magnetic phase that emerges only at low temperatures and under strong magnetic fields—a reminder that the phase diagrams of even moderately complex oxides remain incompletely understood. In the work by Yatsyk et al. [8], wich considers the opposite extreme of compositional disorder, the first magnetic characterisation of the high-entropy perovskite $Ca_{0.25}Sr_{0.5}La_{0.25}Mn_{0.5}Ti_{0.5}O_3$ [8] identifies ordering near 40 K together with a second anomaly around 300 K and weak ferromagnetic behaviour at low temperature.

Between these two extremes of chemical complexity lies a study of a structurally simple but magnetically anisotropic rare-earth titanate. Batulin and co-workers [13] report a systematic magnetisation study of $GdTiO_3$ single crystals grown by the optical floating-zone technique. While the ordering temperature itself is isotropic ($T_N \approx 32$ K), both the susceptibility and the spin-flop fields depend strongly on the crystallographic direction, and three distinct magnetic regimes are identified for each orientation. The result is significant less for any single number than for the benchmark it provides: a well-characterised, stoichiometric single crystal against which theoretical treatments of spin-orbit coupling and anisotropic exchange in rare-earth titanates can be tested. The authors also note the sizable magnetic entropy change associated with the field-driven transitions, pointing to possible magnetocaloric applications. The coexistence of several magnetic length scales in a single nominally simple compound is precisely the kind of problem for which local probes are indispensable, and it is to be expected that this system will attract further resonance work.

2.4. Nuclear magnetic resonance of porous media

A distinct and substantial cluster of papers in the closing issue addresses the characterisation of porous materials by nuclear magnetic resonance – a subject that has long been a strength of the Kazan school and that here receives renewed methodological attention. Ivanov and co-workers [12] demonstrate the combined use of classical NMR relaxation and the DDIF (Diffusion Decay in Internal Field) technique on a natural dolomite core, proposing a route to the surface relaxation parameter that does not require external physicochemical calibration or reference to literature values. The practical value of this contribution lies precisely in its self-sufficiency: the parameter that governs the interpretation of pore-size distributions is extracted from the same measurement that yields the distribution itself.

A complementary approach is taken by Sannikov and Klochkov [14], who explore low-field ^{129}Xe NMR of liquid xenon near the triple point as a probe of porous media. The paper is unusually candid about the experimental difficulties – low sensitivity in fields up to 1 T, the filling of the experimental cell, temperature-gradient control along the probe axis, and radio-frequency noise from electrical leads – and the greater part of its value lies in the solutions it proposes to these problems. Spin-lattice and spin-spin relaxation times of bulk xenon are measured, and preliminary results on porous media are presented. Together with the dolomite study, this work indicates a sustained interest in extending NMR porosimetry beyond the well-established protocols based on ^{3}He and conventional relaxation analysis.

2.5. Spin dynamics, magnetoelectric coupling and computation

Computational contributions frame the volume at both ends. A density-functional study by of Fe-Al-based ternary alloys [1] by Abdullin and Voronina addresses the ordering tendencies that underlie the magnetic behaviour of these technologically relevant intermetallics, while calculations on a Fe/$BaTiO_3$ heterostructure [5] expose the coupling between magnetic order and lattice distortion at a ferroelectric-ferromagnetic interface. In this work Piyanzina and co-workers demonstrated that the electronic and magnetic properties of the thin ferromagnetic Fe film can be effectively tuned by applying an external electric field.

Between these two scales lies a first-principles treatment of Rabi oscillations in disordered ensembles of spins adsorbed on a spherical surface (see work by Kovycheva et al. [10]), which is of interest less for any single numerical result than for the demonstration that coherent spin dynamics can be modelled in geometrically frustrated, randomly populated systems. The methodological distance between a density-functional theory calculation of band structure and a time-dependent treatment of a spin cluster is considerable, and the volume is notable for spanning it without loss of coherence.

2.6. Methodological and instrumental developments

Three papers extend the journal's methodological range. A statistical model based on a two-dimensional normal distribution is proposed for the zero-field splitting parameters extracted from the EPR spectra of human serum transferrin by Ibragimova et al. [4], offering a more faithful description of the heterogeneous metal-binding sites than a single-component fit permits. In the work of Galyaltdinov et al. [9], the initial stages of the thermal decomposition of graphene oxide were investigated using a combination of EPR spectroscopy (in the X- and W-bands), thermogravimetry, infrared spectroscopy, and X-ray powder diffraction. It was shown that in samples annealed at a temperature of 150°C, there is a sharp peak in the concentration of paramagnetic centers. This suggests that electrons are largely delocalized due to enlarging

and percolating of graphenic domains, and/or dangling bonds, formed at 130-150°C largely recombine. These new findings add critical details to understanding the fine chemical structure and chemistry of graphene oxide.

The third contribution in this section moves from the analysis of spectra to the apparatus that produces them. Alexandrov and co-workers [15] describe a control system for NMR experiments built around an interval-programmable pulse generator implemented on field-programmable gate arrays. The system synchronises up to 245 external devices, supports pulse intervals from 20 ns to 0.334 s, and permits nested loops and macros within a compact instruction set. Instrumentation papers of this kind rarely attract the attention that experimental results do, yet the flexibility they afford is a precondition for many of the more sophisticated sequences on which modern NMR relies. That the same group contributes both the dolomite porosimetry study [12] and the generator architecture [15] is itself instructive: the methodological and the instrumental are not separate enterprises but two faces of the same experimental practice.

3. Concluding remarks

The 2025 volume of *Magn. Reson. Solids* presents a body of work that is unified less by a single physical system than by a common methodological outlook: in almost every contribution, the interpretation of a resonance experiment or calculation is treated as an inference about a distribution, a coupling, or a hierarchy of energy scales, rather than as the extraction of a single parameter. This is visible in the defect studies, where hyperfine and quadrupole constants are computed rather than assumed; in the crystal-field work, where the point-charge idealisation is systematically relaxed; in the oxide magnetism, where local probes reveal phases invisible to bulk magnetometry; in the porosimetry papers, where the surface relaxation parameter is extracted without external calibration; and in the instrumentation paper, where the pulse sequence itself becomes an object of design.

It is also worth noting, as a matter of editorial record, that the volume maintains the journal's commitment to open access and to the free dissemination of results to authors and readers alike, in keeping with the principles on which the journal was founded at Kazan University in 1996. The coming volume will show whether the emphasis on low-dimensional defects, complex oxides, and NMR porosimetry is sustained; on the evidence of the present one, it is likely to be.

Readers and potential authors can find detailed information on the journal's official website (`http://mrsej.ru`) and its mirror "parent" site (`http://mrsej.kpfu.ru`). It should be noted that the journal is indexed in databases such as Web of Science (ESCI, Clarivate Analytics), Scopus (Elsevier), the Russian Science Citation Index (RSCI/eLibrary), and others. All published articles are assigned a Digital Object Identifier (DOI). The journal *Magn. Reson. Solids* is included in the "White List" of Russian scientific journals (level 1).

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