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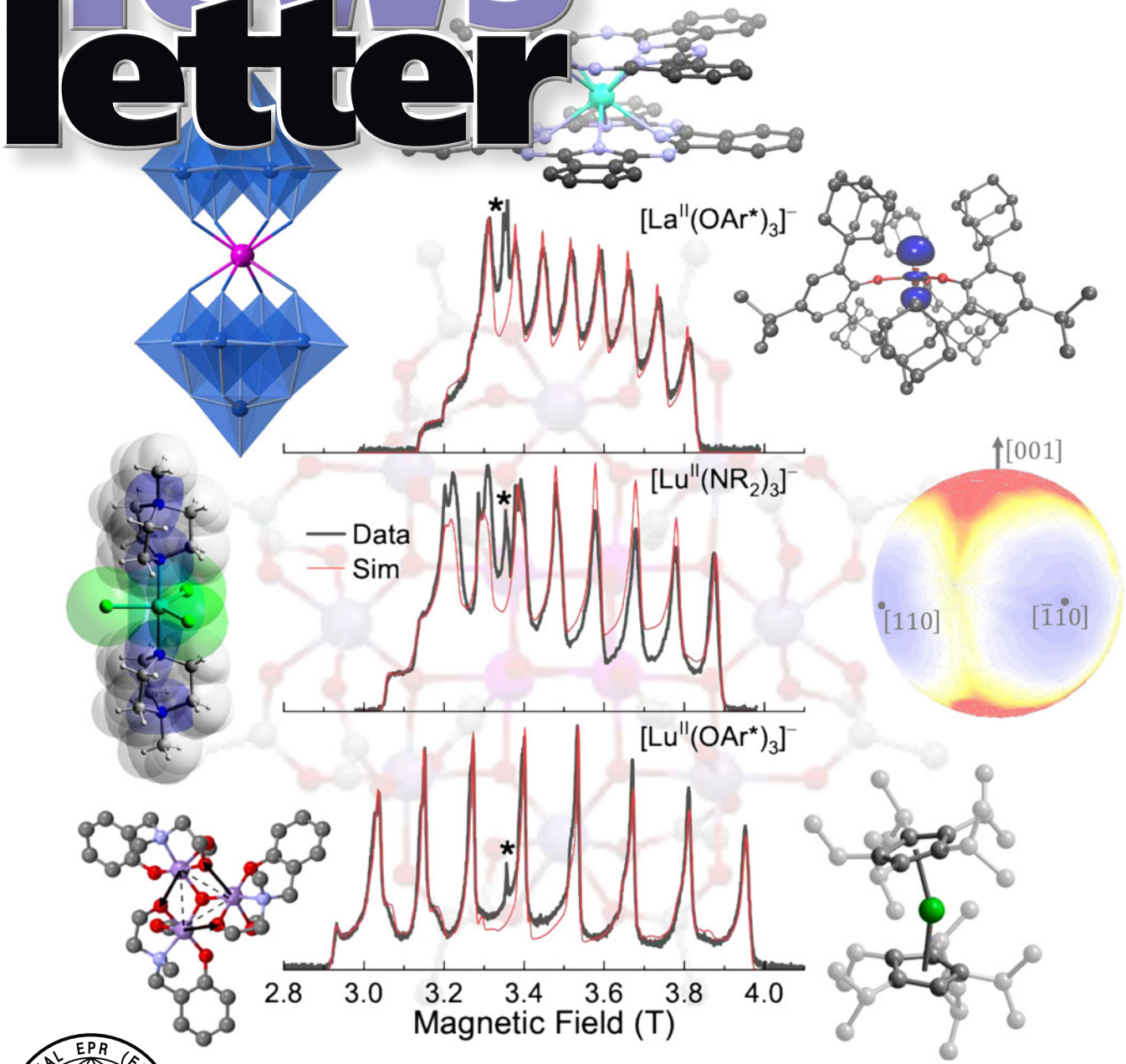
2025
volume 35 number 4



The Publication of the International
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Noboru Hirota (1936–2024)
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Asako Kawamori (1935–2024)
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Please feel free to contact us with items (news, notices, technical notes, and comments) or ideas for the *EPR newsletter*.
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WESTPORT
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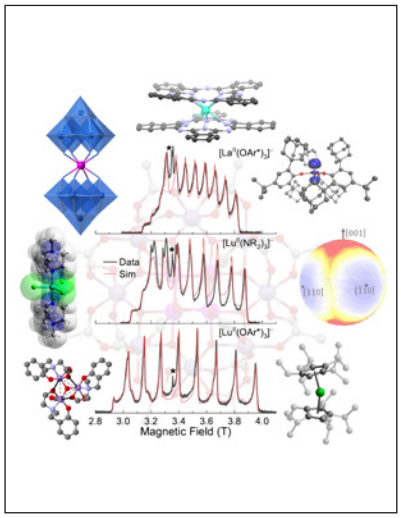


The cover picture illustrates aspects of the research of Stephen Hill, recipient of the Bruker Prize 2025. It shows a selection of molecular magnets that have been studied in his group (clockwise from lower left): a trigonal polynuclear Mn_3^{III} cluster;[1] a mononuclear trigonal bipyramidal Ni^{II} single-molecule magnet (SMM);[2] a $[Ho(W_5O_{18})_2]^{9-}$ clock qubit;[3] the Tb^{III} bis-phthalocyaninato SMM;[4] the $[Lu^{II}(OAr^*)_3]^-$ and $Lu(Cp^{iPr_4Et})_2$ hyperfine qubits;[5,6] with the first SMM, Mn_{12}-acetate[8] in the background. The colored sphere depicts the magnetic anisotropy of a Ho^{III} clock qubit (blue – easy, and red – hard direction).[7] The spectra (center) illustrate chemical control of the massive hyperfine interaction between a single unpaired electron residing in a mixed 5d/6s orbital with the $I = 7/2$ moments of the ^{139}La and ^{175}Lu nuclei. This interaction gives rise to spin qubits with enhanced coherence.[5]

1. https://doi.org/10.1103/PhysRevB.98.144433
2. https://doi.org/10.1039/C5SC02854J
3. https://doi.org/10.1038/nature16984
4. https://doi.org/10.1103/PhysRevMaterials.2.024405
5. https://doi.org/10.1038/s41557-022-00894-4
6. https://doi.org/10.1021/jacs.5c01947
7. https://doi.org/10.1021/jacs.3c09353
8. https://doi.org/10.1103/PhysRevLett.90.217204

epr newsletter

The Publication of the International EPR (ESR) Society

volume 35 number 4 2025

Are you interested to become a member of the International EPR (ESR) Society? Please find the registration/information form for new/continuing members of the IES for individual members on this Web site: https://ieprs.org.

Editorial

Dear colleagues,

The same as you, I believe that a promise is a promise. And how carefully one should promise something so that not to be uncomfortable when, for whatever reasons, a promise cannot be fulfilled! This is exactly what happened to me. In my editorial to the issue 35/3, I announced the IES Travel Grant report of Yannik Limbach but you will not find it in the current issue. There was a last-minute decision to upgrade his report to the template we use for an IES Poster Award report, i.e., to add a write-up on Yannik by his supervisor(s). Hope you agree that these write-ups demonstrate a wonderful student-mentor interaction full of harmony and mutual respect and understanding (see, e.g., Julian Stropp – Daniel Klose and Anand Anilkumar – Jason Sidabras duets (pp. 10, 11)).

Fortunately, two other promises are fulfilled right now on the spot! Welcome to the report of the IES Annual General Meeting 2025 (pp. 3–5), which undoubtedly shows that the diverse activities of our society increase its visibility and attraction to the magnetic resonance community.

Our heartfelt congratulations to magnetic-resonance-related Awardees 2025 (pp. 7–9)! Many of them are long-term friends of our publication, which were featured numerous times in our issues and contributed a lot to the development of the *EPR newsletter*.

For sure you would like to know what our New Year presents for you are to be found in our first issue 2026: the interview with Stephen Hill on the occasion of his Bruker Prize 2025, IES Poster Award reports of Sudipta Khamrui, Jennifer Naughton, Camille McDonnell, Pathorn Teptarakulkarn, Maria Chiara Pagliero, Matan Perez, Jascha Rueter, the report of the 10th EFEPR summer school ... and many other exciting contributions.

It is my pleasure to thank all contributors to the *EPR newsletter*, Executives of the IES, and our wonderful team of Associate Editors: Candice Klug, Hitoshi Ohta, and Sabine Van Doorslaer, and our ingenious Technical Editor Sergei Akhmin. Special thanks go to editors of long-lived columns: John Pilbrow, Candice Klug, Wolfgang Lubitz, and Stefan Stoll. Generous support of all sponsors of the IES is gratefully appreciated.

Happy New Year 2026 to you and all your near and dear! And I am never tired of repeating the motto of the *EPR newsletter*: "It is you who produce the news and we present it in our publication". Welcome to the *EPR newsletter* with your EPR-related material!

Laila Mosina

IES ANNUAL GENERAL MEETING 2025

Minutes of the Annual General Meeting of the International EPR/ESR Society for 2025 held at the 58th International Meeting of the RSC EPR Group, June 3rd 2025, University of London, UK*.

Agenda:

1. IES Executives (2024–2026)
2. 2025 IES Awards (Biology/Medicine, Physics, Young Investigator, IES Fellows)
3. Support of EPR activities (Poster Prizes, Best Paper Awards, EPR schools)
4. IES online activities (including X activities, IES Virtual EPR Meeting)
5. Report of *EPR newsletter* Editor
6. Sponsors and Patrons of the IES 2025
7. Report of the Treasurer
8. Update on efforts to establish shared EPR/PELDOR database

1. IES Executives (2024–2026)

President: Marina Bennati, University of Gottingen, MPI for Multidisciplinary Sciences
Vice President Europe: John Morton, University College London
Vice President Asia-Pacific: Sun Hee Kim, Korea Basic Science Institute Seoul
Vice President Americas: Sunil Saxena University of Pittsburgh
Secretary: Janet Lovett Univ. of St Andrews
Treasurer: Peter Qin, University of Southern California
Immediate Past President: Songi Han, Northwestern University
EPR newsletter Editor: Laila Mosina, Zavoisky Physical-Technical Institute
Social Media Officer: Christos Pliotas University of Manchester

2. 2025 IES Awards (Biology/Medicine, Physics, Young Investigator, IES Fellows)

2025 IES Medal in Biology/Medicine
Olav Schiemann, University of Bonn (presented at the EUROMAR 2025) For interview, see *EPR newsletter* 35/3, pp. 5, 6
2025 IES Medal in Physics
Patrice Bertet, CEA Saclay Univ. Paris-Saclay (presented at the ENC 2025). For interview, see *EPR newsletter* 35/3, pp. 7, 8
2025 John Weil Young Investigator Award
Nino Wili, Aarhus University (presented at RSC, London, 2025) For interview, see *EPR newsletter*, 34/1-2, p. 18
2025 IES Fellows
Michael K. Bowman Emeritus Professor Univ. Alabama, US (presented at RMC 2025). For interview, see *EPR newsletter* 27/1-2, pp. 8, 9
Hitoshi Ohta Emeritus Professor Kobe University, Japan (presented at RMC 2025). For interview, see *EPR newsletter* 29/3, p. 9

Call for nominations of 2026 Medals:
IES Gold Medal 2026
IES YIA 2026

3. Support of EPR activities (Travel Awards, Poster Prizes)

2025 Sponsored Conferences and 2025 Poster Prizes
2025 RSC (Chair J. Morton)
- Jennifer Naughton (University of Queensland, Australia) Structural characterisation of proteins via non-canonical amino acids, a new Gd^{3+} spin label, and Double Electron-Electron Resonance (DEER) Spectroscopy
- Gediminas Usevičius (Vilnius University, Lithuania) Superconducting YBCO planar microresonators for conventional high sensitivity ESR

2025 EUROMAR (Chair, V. Telkki)
- Julian Stropp (ETH Zürich) Sensitivity increase & 2D Deconvolution of ENDOR spectra with chirp pulses
- Sudipta Khamrui (Tel Aviv) High-field Magic Angle Spinning EPR of P1 Centers in Diamond

ENC/ISMAR 2025
- Maximilian Maylaender (University of Oxford, UK) Photoinduced and electrochemically induced charged paramagnetic states in organic semiconductors probed by EPR (see *EPR newsletter*, 35/3, pp. 12, 13)

2025 Rocky Mountain Conference (Chair S. Hill)
- Pathorn Teptarakulkarn (University of California Los Angeles, US) Magnetic Resonance Spectroscopy of a Model Hydrogenase
- Camille McDonnell (University of Maryland, US) Towards Quantum Diamond Microscope for Real-space, Wide-field Hyperpolarized NMR Imaging

10th EFEPR Summer School, Warwick (Chair E. Mc Innes)
- Anand Anilkumar (Medical College of Wisconsin, Milwaukee, WI, USA) Design, Simulation, and Fabrication of Sample Holders for EPR using Ultra-Precision 3D Printing Techniques
- Maria Chiara Pagliero (Università di Torino, Italy) Exploring Spin Dynamics of Cu(II) Transition Metal Ion Complexes. Implications for the development of MRI Diagnostic Probes

GDCH Magnetic Resonance Meeting, Bonn (Chair O. Schiemann)
- Matan Perez (Helmholtz-Zentrum, Berlin, Germany) Operando Monitoring of the Growth of Lithium Metal Dendrites Using EPR-on-a-Chip (EPRoC)
- Jascha Rüter (University of Bielefeld, Germany) Very Fast Bioorthogonal Spin Labeling with Tetrazine-Substituted GdIII Complexes

2025 13th EPR Workshop Biology/Medicine (Prize Chair M. Elas)
2025 PACIFICHEM (Prize Chair A. Smirnov)

Best Paper Awards 2024/2025
- Daniele Panariti (University of Padova, Padova, Italy) Control of excitation selectivity in pulse EPR on spin-correlated radical pairs with shaped pulses, Phys. Chem. Chem. Phys. (2024) 26, 3842–3856
- Mikhail Kolokolov,(International Tomography Center, Novosibirsk, Russia) Enhanced Binding Site Identification in Protein–Ligand Complexes with a Combined Blind Docking and Dipolar Electron Paramagnetic Resonance Approach, Journal of the American Chemical Society 2025 147 (16), 13677–13687

* Short report of the previous Minutes of the Annual General Meeting of the International EPR/ESR Society for 2024 held online at the 63rd Rocky Mountain Conference in Copper Mountain, Colorado, USA August 6, 2024 (Held via Zoom) published in *EPR newsletter* 34/4 (2024) pp. 3–6.

From left to right: Christos Pliotas and Anand Anilkumar.

From left to right: Christos Pliotas and Maria Chiara Pagliero.

Annual workshop Advances in Electron Spin Resonance, September 13–15, 2024, Cornell University, USA

Travel Grant awardees 2025
EUROMAR 2025
- Yannik Limbach and Marvin Lenjer (see *EPR newsletter*, 35/3, p. 15)

10th EFEPR Summer School 2025
- Ehsan Shirdel Tazehkand and Trent McHenry

4. IES online activities (incl. Twitter activities, IES Virtual EPR Meeting)

Social Media
New Blue Sky account (Feb 2025 – onwards), Domain: epr-esr.bsky.social, 70 followers to date, >15 posts
Inclusion in the "EPR–ESR Spectroscopy" Starter Pack
X account maintenance (Oct 2018 – onwards)

Domain: @EPR_ESR
1,036 followers to date, more than 20 posts over the last few months

IES Virtual EPR Meeting (IVEM)
All IVEM speakers get opportunity to be highlighted in the *EPR newsletter.* https://ieprs.org/on-line-activities

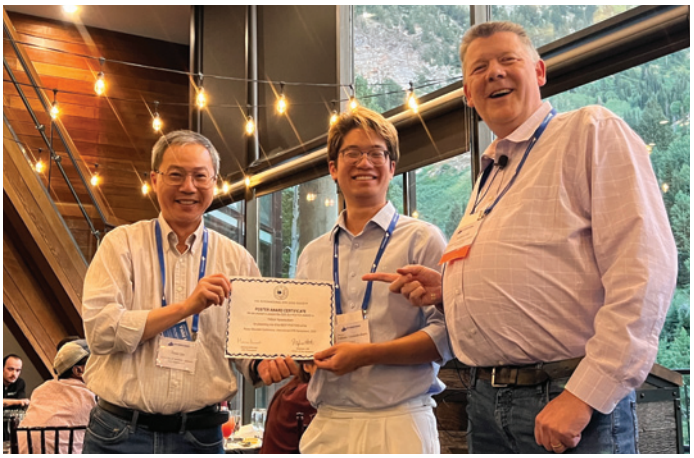
IVEM Coordinators
- Thomas Schmidt, NIH, USA
- Joseph McPeak, University of Copenhagen, DK
- Tomas Orlando, National High Magnetic Field Laboratory, Tallahassee, USA
- Yujie Zhao, Massachusetts Institute of Technology, USA

5. Report of the EPR newsletter Editor, Laila Mosina

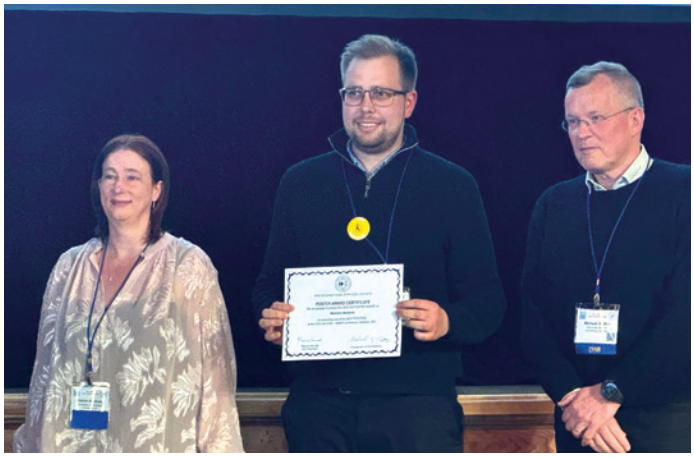
Since the IES AGM 2024 at the 63th Rocky Mountain Conference in Copper Mountain, we published two single issues 34/3 and 34/4, and a double one 35/1-2. We hope you had a look at these issues on the IES website and got copies.

All issues of the *EPR newsletter* compose an encyclopedia of all aspects of the research carried out by the EPR community and diverse activities of our society and also show that there is life beyond EPR.

From left to right: Stephen Hill, Camille McDonnell, and Peter Qin.



From left to right: Peter Qin, Pathorn Teptarakulkarn, and Stephen Hill.



From left to right: Sharon Ashbrook, St. Andrews, Maximilian Mayländer, and Michael Sattler, TU Munich.

In our issues, you can find any EPR-related information you are interested in. You will also meet with pioneers of magnetic resonance and learn how great discoveries were made, get an insight into great minds who share their ideas with us, read success stories of laureates of different magnetic resonance awards, look into the eyes of newcomers who make their first steps in the career in science and be charmed by their enthusiasm and vigor, to name a few.

We, the *EPR newsletter* team, do our best to add new facets to our publication, which enriches the life of our community.

Welcome to the *EPR newsletter*!

Now we work on the forthcoming issue 35/3. To remind you, we present the columns of the newsletter:
▪ Editorial ▪ IES business ▪ Awards ▪ IES Young Investigator Award Revisited ▪ Another Passion ▪ Anniversaries ▪ EPR newsletter Anecdotes ▪ In Memoriam ▪ Present Meets Future ▪ Software ▪ Tips and Techniques ▪ Notices of Meetings ▪ Conference Reports ▪ New EPR Faculty ▪ New Books and Journals (including EPR Hot Science) ▪ Market Place ▪ Reader's Corner ▪ Guest of the Issue

Please feel free to submit YOUR material, dear colleagues! You produce the news, and we present it in the *EPR newsletter*.

On behalf of the Editorial Board, I thank most heartily all contributors to the *EPR newsletter* with special thanks going to the CEOs of the IES and editors of the columns in the *EPR newsletter*: John Pilbrow, Candice Klug, Wolfgang Lubitz, Stefan Stoll, Sabine Van Doorslaer, and Sergei Akhmin, our Technical Editor.

I gratefully acknowledge collaboration with Associate Editors Candice Klug, Hitoshi Ohta, and Sabine Van Doorslaer.

6. Sponsors and Patrons of the IES 2025

Thank you, IES members!
Thank you, sponsors!
▪ ACERT ▪ Bruker BioSpin ▪ CIQTEK ▪ GMW Associates ▪ L&M EPR Supplies ▪ Rotunda Scientific Technologies ▪ Springer / Appl. Magn. Reson. ▪ Virginia Diodes ▪ LINEV ▪ High Q Technologies

7. Report of the Treasurer 2024–2025 (Peter Qin)

Beginning Balance (01/01/24)	**$ 71,744.76**
Deposits:	
Membership	$ 3,854.00
Sponsor Contributions	$ 60,570.00
Misc	$ 1,000.00
TOTAL deposits:	$ 65,424.00
Expenditures:	
Internet Commerce & Merchant Services, Banking	$ 354.49
IES Community Support (Conferences, Training, Poster Awards)	$ 7,700.00
IES Operation (Web, Printing, Editorial)	$ 13,728.42
Misc (Registration, Postage, etc.)	$ 74.58
TOTAL expenditures:	$ 21,857.49
Balance as on 12/31/2024	**$ 115,311.27**

John Weil Fund
Established in 2010 in memory of Prof. John Weil by family, friends, and colleagues to support John Weil Young Investigator Award.

Starting Balance on 01/01/2024:	**$19,141.00**
Deposits:	$ 0.00
TOTAL deposits:	$ 0.00
Expenditures: 2024 YIA	$ 1,000.00
Banking Fee	$ 0.00
TOTAL expenditures:	$ 1000.00
Ending Balance on 12/31/2024:	**$ 18,141.00**

8. Update on efforts to establish shared EPR/PELDOR database

Goal: creation of a database for EPR/PELDOR freely accessible. Initiator: T. Prisner

Bela Bode was elected from IES Board to coordinate together with T. Maly, now at Bruker, a first draft of website to input PELDOR/DEER data.

The IES Annual General Meeting 2025 was attended by all participants of the RSC EPR 2025.

A new Bio-EPR initiative devoted to challenging Structural Biology applications

The BioEmPiRe Centre for Structural Biological EPR Spectroscopy will launch in September 2026 in the School of Biological Sciences, at The University of Manchester.

BioEmPiRe brings together more than twenty world-class bioscientists from across the UK, the EU, India, and Australia. Its mission is to address fundamental biological questions using state-of-the-art pulsed dipolar EPR spectroscopy. The overarching goal is to understand the rules of life, support the design of transformative technologies, deliver integrated perspectives on health, and provide a modern research infrastructure for bioscience. Scientifically, the Cenre focuses on three major areas: (i) integral membrane proteins, (ii) membrane-associated proteins, and (iii) cytoplasmic protein complexes.

BioEmPiRe is led by Dr. Christos Pliotas, who also secured the BBSRC funding that enabled its creation. All current and future projects will focus on challenging biology and the development of new EPR-inspired tools to address it. These include home-built instrumentation for time-resolved EPR, chemical tools for in-cell EPR, and their application to challenging protein complexes. The aim is to position EPR as a widely applicable and leading component of modern, high-resolution structural biology. BioEmPiRe is not a core service facility: it operates through collaborative projects with the Pliotas Lab, which also provides expert support in EPR-tailored biology. A fully equipped wet laboratory in the same building (Michael Smith) enables large-scale expression, purification, and spin labeling of challenging proteins in bacterial, yeast, insect, and human cells. This allows any laboratory located worldwide to engage in EPR-based projects across a broad range of biological systems.

Members of the Pliotas Group (Postdoctoral researchers and PhD students). From Left to Right:
Top row standing: Xinyu Liu, Qaiser Waheed, George Browne, James Pullen, Christos Pliotas;
Middle row standing: Ruoning Pei, Anokhi Shah, Joshua Wort, Phitchakorn Somngam;
Bottom row: Yue Ma, Gaurav Nanakwani, Themiya Perera.

BioEmPiRe will develop close synergies with other EPR groups in Manchester, including the National EPR Facility. With EPR at its core, BioEmPiRe will provide an integrated structural biology platform to meet the growing needs of the wider bioscience community, complementing EPR with state-of-the-art CryoEM and computational modelling research expertise on the same site. The Centre is equipped with a new high-power (300 W) Bruker pulsed Q-band EPR spectrometer with an Arbitrary Waveform Generator (AWG) and an integrated cryogen-free cooling system, enabling the analysis of protein conformational states and dynamics by PELDOR/DEER techniques. This instrument was installed in January 2025, and following testing and optimization, has been fully operational since April 2025. BioEmPiRe also houses a Bruker X-band CW-EPR spectrometer with a bio-temperature controller capable of operating at liquid nitrogen temperatures, as well as "Boreas", a custom apparatus for flash-mixing and freezing samples for PELDOR/DEER applications, enabling near-millisecond time-resolved EPR.

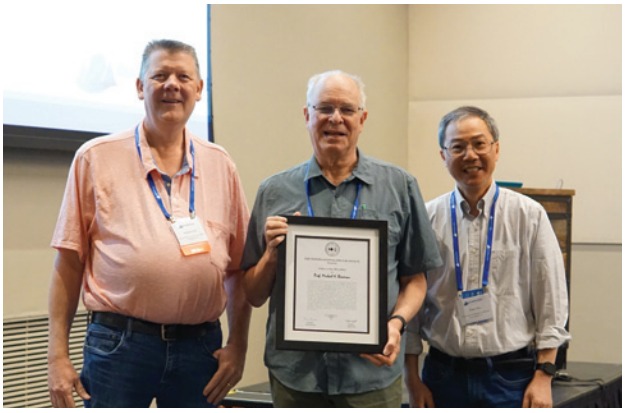
In early 2026, BioEmPiRe will receive the first in the UK Quantum X-band pulsed EPR spectrometer (FATHOM) from HighQ technologies. This platform enables high-throughput PELDOR/DEER experiments and requires only 2.4 µL of biological sample.

More information about the new BioEmPiRe initiative and videos regarding the installation of the new Bruker instrument could be found on the Pliotas Group Research Website: https://www.pliotasgroup.org/bioempire-centre

Christos Pliotas

Fellow of the IES (2025) to Professor Michael K. Bowman

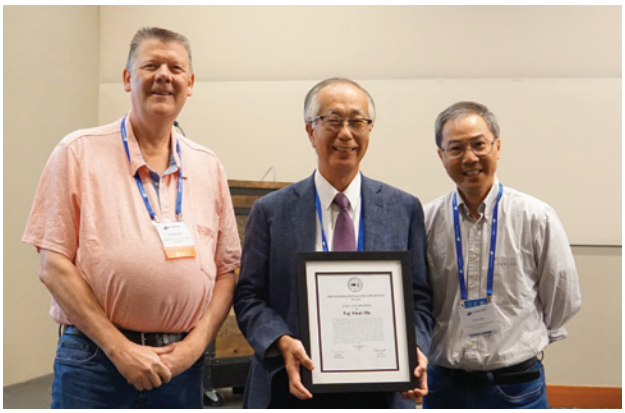
The International EPR Society is honored to recognize Professor Michael K. Bowman as a Fellow of the Society for his outstanding contributions to the field of Electron Paramagnetic Resonance (EPR) spectroscopy by advancing the methods and applications of pulse EPR. His pioneering work has provided groundbreaking insights into free radical reactions in chemical and biological systems, protein structure and function, and materials science. Professor Bowman's research leverages pulse EPR methods to measure nanometer-scale distances and to characterize reactive intermediates in proteins and nucleic acids, elucidating their structural dynamics and biological functions. His work on the cytochrome bc1 complex addressed how this enzyme regulates superoxide production, with wide-ranging implications for aging, metabolic diseases, and pathogen targeting. Equally significant, his studies of dopants in crystalline and non-crystalline solids, such as TiO_2, have advanced understanding of material properties, enhancing applications in nanotechnology and artificial photosynthesis.



From left to right: Stephen Hill, Michael Bowman, and Peter Qin. Rocky Mountain Conference 2025.

Fellow of the IES (2025) to Professor Hitoshi Ohta

The International EPR Society is honored to recognize Prof. Hitoshi Ohta as a Fellow of the Society. He has been a pioneer in the field of high-frequency/high-field EPR spectroscopy for spin systems in the THz range. His contribution to the studies of spin systems under multi-extreme conditions, which include high magnetic field up to 55 T using pulsed magnetic fields, high frequency up to the THz range, high pressure up to 2.5 GPa, and high sensitive detection using the micro-cantilever or nano-membrane, has been truly important for spin physics in condensed matter. He has published over 440 peer-reviewed scientific articles in high-standard journals. He also contributed to the EPR community for a long time by serving as Vice President, Acting President, and President of the International EPR/ESR Society, President of the Asia-Pacific EPR/ESR Society, and President of SEST in Japan.



From left to right: Stephen Hill, Hitoshi Ohta, and Peter Qin. Rocky Mountain Conference 2025.

2025 Medal in Physics to Professor Patrice Bertet

Prof. Patrice Bertet from CEA Saclay and Université Paris-Saclay is awarded the IES Medal in Physics for his groundbreaking contributions to the quantum physics of electron spin resonance (ESR), including seminal observations of fundamental phenomena in spin resonance as well as profound technological developments in spin sensitivity. His pioneering results include the first observation of cavity-induced relaxation of spins, as originally predicted by Purcell in 1946, and most recently, the demonstration of single-spin pulsed ESR achieved using novel single microwave photon detectors. Bertet's research is driven by pushing ESR spectroscopy into new domains and extremes, down to millikelvin temperatures. He has used Josephson parametric amplifiers to reach ESR sensitivity at the quantum limit of noise and employed vacuum-state squeezing to surpass these noise limits. By bridging quantum optics, superconducting circuits, and spin physics, Bertet has repeatedly redefined state-of-the-art ESR sensitivity through new paradigms for spin manipulation and detection. He has used these capabilities to study NV centers in diamond, dopants in silicon, and rare-earth ions in low-nuclear spin oxides, obtaining electron spin coherence times of tens to hundreds of milliseconds for near-surface spins. His sustained and transformative contributions to the field over the past 15 years make him a highly deserving recipient of this award.

From left to right: Marina Bennati and Patrice Bertet. ISMAR 2025.

2025 Medal in Biology/ Medicine to Professor Olav Schiemann

The Medicine/Biology Award for 2025 of the International ESR (EPR) Society is awarded to Professor Olav Schiemann for his seminal contributions advancing the field of EPR in Biology via his pioneering efforts to resolve structural aspects of spin labelled nucleic acids and proteins. He has advanced nucleic acid spin labelling methodology, the use of pulse dipolar EPR spectroscopy to provide detailed structural information of biomolecules, and determine paramagnetic metal binding sites in key nucleic acid and protein constructs. This includes time resolved measurements elucidating the pathways of conformational changes with high time resolution. Professor Schiemann has also been a tireless servant to the broad international EPR community. The IES is therefore proud to honor Professor Schiemann for his distinguished contributions to the society.

From left to right: Marina Bennati and Olav Schiemann. EUROMAR 2025.

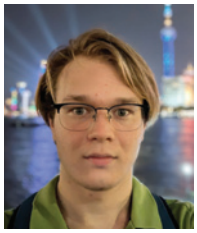
2025 John Weil Young Investigator Award to Dr Nino Wili

The 2025 John-Weil Young Investigator Award of the International EPR (ESR) Society is awarded to Dr. Nino Wili for his contributions to theory and instrumentation in the field of EPR. In particular, the IEPRS recognizes his studies that seamlessly integrate advanced concepts in pulsed EPR and in dynamic nuclear polarization. These studies have provided new insight into spin dynamics in systems where multiple nuclear spins are hyperfine-coupled to an electron spin. Further, they have cross-fertilized the field of EPR spectroscopy with modern concepts from the field of solid-state NMR. By demonstrating reverse polarization transfer from nuclear to electron spins, Dr. Wili has opened a new field of research.

From left to right: Nino Wili and Marina Bennati. RSC EPR conference 2025.

IES Best paper Award 2024/2025 to

Daniele Panariti (University of Padova, Padova, Italy): Control of excitation selectivity in pulse EPR on spin-correlated radical pairs with shaped pulses, Phys. Chem. Chem. Phys. (2024) 26, 3842–3856



Mikhail Kolokolov (International Tomography Center, Novosibirsk, Russia): Enhanced Binding Site Identification in Protein–Ligand Complexes with a Combined Blind Docking and Dipolar Electron Paramagnetic Resonance Approach, Journal of the American Chemical Society 2025 147 (16), 13677–13687

Bruker Prize for 2025 to Professor Stephen Hill

The RSC ESR Interest Group committee is pleased to announce that the Bruker Prize for 2025 is awarded to Professor Stephen Hill for his seminal contributions to EPR in terms of both world-leading and unique instrument design as well imaginative and expert application of high field EPR to the study of low dimensional systems. His work has opened up new avenues for EPR driven developments including in, but not limited to, the fields of quantum information science and the study of polymetallic transition metal complexes. Crucially, as Director of the Electron Magnetic Resonance user program at the NHMFL he has supported and fostered the international and national EPR communities with unique scientific expertise and admirable dedication.

From left to right: Stephen Blundell, Stephen Hill, Frédéric Jaspard (Bruker BioSpin), and Emma Richards. RSC EPR conference 2025.

2025 Richard R. Ernst Prize to Professor Thomas Prisner

"We award the 2025 Richard R. Ernst Prize to Prof. Thomas Prisner, for his significant contributions to the development and application of new methods in electron paramagnetic resonance (EPR) and dynamic nuclear polarization (DNP). Professor Prisner and his coworkers were instrumental in developing throughout the years advanced high-frequency technologies and experiments, that have enabled the execution of EPR and DNP NMR experiments at high fields – particularly on biomolecular samples in solids and liquids, in vitro and in cell. His continuous contributions in these areas are enabling new breakthroughs in a variety of disciplines that are increasingly impacting the fields of EPR and NMR at large, and serve as inspiration for additional progress throughout magnetic resonance."

Richard R. Ernst Prize Selection Committee

From left to right: President of the Bruker BioSpin Group Falco Busse, Thomas Prisner, and the Member of the Prize Committee Ville-Veikko Telkki. EUROMAR 2025.

International Zavoisky Award 2025 to Professor Jiangfeng Du

The International Zavoisky Award is presented in recognition of his outstanding achievements related to spin-qubit-based magnetic resonance spectroscopy

From left to right: Prime-Minister of the Republic of Tatarstan Aleksei V. Pesoshin, Jiangfeng Du, and Chairman of the Zavoisky Award Selection Committee Kev M. Salikhov. MDMR 2025.

IES Poster Prize at EUROMAR 2025

Julian Stropp:

EPR spectroscopy is a powerful tool for probing the structure, function, and reactivity of paramagnetic transition metal complexes. Among pulse EPR methods, ENDOR spectroscopy enables precise determination of hyperfine and nuclear quadrupole interactions, providing detailed insight into the geometric and electronic structure of the paramagnetic center. A key objective of my PhD research is to advance ENDOR methodology for structural characterization of copper proteins and Ti-based Ziegler–Natta catalysts [1]. Because samples are most often non-crystalline solids - such as frozen solutions or powders - two challenges frequently emerge in ENDOR spectroscopy: (i) low sensitivity for nuclei with large anisotropic hyperfine and nuclear quadrupolar couplings – typical for first-sphere ligands or metal nuclei – and (ii) spectral congestion from overlapping signals of multiple nuclei or species.

Previously, we demonstrated that replacing the conventional rectangular RF pulse with a frequency-swept (chirped) pulse leads to a substantial enhancement in Davies and Mims ENDOR signal intensity – up to tenfold for nuclei with broad hyperfine couplings [2]. Building on this, we targeted the issue of spectral overlap. We replaced the Hahn echo in the Davies ENDOR sequence with a chirp echo, giving rise to the CHEESY ENDOR approach [3]. Fourier transformation of the chirp echo yields the EPR spectrum [4], which in Davies ENDOR encodes the EPR hole pattern created by the initial microwave inversion pulse and the RF pulse. This effectively introduces a second (hyperfine) dimension in the ENDOR experiment without increasing overall acquisition time. The concept is closely related to the FID-detected hyperfine-selective ENDOR method introduced by Wacker and Schweiger [5], yet CHEESY ENDOR overcomes its limitation to systems, which exhibit long FIDs and narrow EPR lines. We successfully applied CHEESY ENDOR to the copper chaperone ScoI-Cu(II), which is involved in the CuA-center assembly in cytochrome oxidase [6]. In this complex, where ^{1}H, ^{14}N, and ^{63}Cu ENDOR signals overlap at X- and Q-band frequencies, our method allowed systematic separation of these contributions. Since the EPR dimension is unaffected by quadrupolar interactions to first order, we could also isolate the ^{63}Cu quadrupolar coupling, which is rarely observable due to the dominant hyperfine coupling. Simulations based on home-written, open-source scripts correctly reproduced the experimental features and provide a basis for efficient spectral analysis of unknown systems in the future. A comparison with the two other techniques, 2D Mims ENDOR and HYEND, shows competitive or superior sensitivity and resolution for CHEESY ENDOR. Yet when comparing to the number of initially excited spins, the multiplex advantage of CHEESY ENDOR remains somewhat below expectations due to the lower detection sensitivity with the current chirp echoes – an aspect warranting further improvement. Nevertheless, we envision that as AWG technology becomes increasingly common in commercial EPR spectrometers, CHEESY ENDOR will become widely accessible as a versatile approach within the realm of hyperfine spectroscopy.

I am deeply honored to have received the IES Poster Award for this work at EUROMAR 2025 and sincerely thank the committee for this recognition, as well as Daniel Klose and Nino Wili for their valuable ideas, guidance and inspiration in the whole project.

1. M. Inoue, J. Stropp, et. al., *Journal of the American Chemical Society*, **2025**,147, 16438–16449.
2. J. Stropp, N. Wili, et al., *Magnetic Resonance*, **2025**, 6, 33–42.
3. J. Stropp, et al., *Phys. Chem. Chem. Phys.*, **2025**, Accepted Manuscript
4. A. Doll and G. Jeschke, *Journal of Magnetic Resonance*, **2014**, 246, 18–26.
5. T. Wacker and A. Schweiger, *Chemical Physics Letters*, **1992**, 191, 136–141.
6. F. Canonica et al., *Sci. Adv.* **2019**, 5, eaaw8478.

Daniel Klose:

Joining our group for his master thesis in 2021, Julian took on the challenging mission to engage in characterization of the copper protein ScoI with a diverse set of EPR experiments right from the start, from multi-frequency cw EPR to the pulse hyperfine experiments ENDOR and HYSCORE in X & Q bands. We thus produced a rich data set, the global analysis of which posed a formidable challenge. Julian mastered this challenge bravely, without shying away from difficult questions, such as the often neglected quadrupole interaction of Cu(II), for which the data also allowed us to obtain a reasonable estimate.

Remarkably, Julian's enthusiasm appeared unstoppable, of course not only for EPR experiments, but also for all imaginable sequences of mountain sports. Thus, we were delighted yet not surprised that he was eager to continue with a PhD in EPR and hyperfine spectroscopy. Not though, without taking a pleasant winterly mountain break. So, he became a skiing teacher for the winter season 21/22, a kind of fame and bravery incommensurable to his bold successes in hyperfine spectroscopy, and a solid ground for an outstanding organization of our group's annual skiing weekends. More daring endeavors followed, with the current culmination of a ca. 4000 height meter alpine hike in a single day. Experience per time has been firmly established as a new measure of efficiency. Following this mantra also scientifically, during his PhD Julian has extended his skills to include EPR instrumentation and method development in the field of ENDOR spectroscopy, particularly for catalytic metal centers. Together we have extended the spectrometer that has allowed us to make use of RF chirp pulses to enhance ENDOR sensitivity, and applied them in several 2D hyperfine experiments – not least including the 2D CHEESY ENDOR experiment presented here that combines both RF & microwave chirp pulses to enhance both sensitivity and resolution.

IES Poster Prize at the 10th EFEPR Summer School

Anand Anilkumar:

I am deeply honored to thank the International EPR Society for awarding me the poster prize at the 10th EFEPR Summer School held at the University of Manchester, UK, and for the opportunity to discuss my research through the *EPR newsletter*. I am a third-year graduate student in the Department of Biophysics at the Medical College of Wisconsin (MCW), Milwaukee, where I work with Dr. Jason Sidabras on developing novel devices and technologies for EPR spectroscopy.

I joined the Sidabras lab in the fall of 2023 as a graduate student, to translate my background in microfluidics into the EPR world. Using novel resonators and microfluidic technology, we are developing high throughput, benchtop EPR setups, with automatic sample handling capabilities, tailored for advanced EPR techniques like Saturation Transfer EPR (ST-EPR) for protein samples. With the demonstration of these advanced resonator platforms integrated to microfluidics, we expect to increase the userbase for EPR, unlocking new possibilities in structural biology and biochemistry. The work I presented at the EFEPR summer school is a side quest, which we did on the applicability of 3D printing for the sample tube development.

I am really honored to present our findings at the summer school through the poster, in which we demonstrated the potential of Ultra-Precision 3D printing technology in fabricating sample tubes for aqueous EPR samples, through both simulations and experiments. The developed sample tubes showed an approximately 2-fold improvement in the signals, compared to PTFE capillaries. The seed idea for this work started from the *Mett et al. 2003* paper, where the authors placed rectangular slabs perpendicular to the electric field in a TE102 rectangular cavity. This minimized the losses and improved the EPR signal. Further improvement in the signal was observed by placing multiple flat cells parallel to each other and perpendicular to the electric field. As an extension to this approach to a TE011 mode in a cylindrical cavity, the authors in *Sidabras et al. 2005*, presented the 'Aquastar' cross-section for Teflon sample tubes, which resulted in a star shaped arrangement ideal for the cavity resonators. These designs improved concentration sensitivity by permitting larger sample volumes, ultimately yielding higher signal intensity.

As further pushing forward the sample tube development, we introduced ultra-precision 3D printing technique for printing the aquastar cross-sections smaller in outer diameter, for a TE01δ mode in the dielectric resonators. In this work, the sample volume is fixed at 3 μL. The simulations of this geometries showed a 2.6-fold increase in the EPR signal compared to a PTFE capillary. But, since the photopolymer resin used for printing have signal losses stemming from the inherent dielectric properties, we simulated the same aquastar cross-section with a thin wall holding the sample, which showed a 2.8-fold improvement in signal, but the design lacks structural stability. To improve the stability, without compromising much on signal, we introduced the concept of latticing, where we removed unnecessary material by replacing bulk plastics with interconnected network of beams. For ease of simulations and reducing computation time, we adopted the slicing approach based on symmetry where we simulated only a slice of entire geometry. From the simulations, we derived an inward relation of amount of plastic with signal.

To verify the results from the simulation, the sample tubes were printed using the BMF MicroArch S140 3D printer from the Boston Microfabrication, with a 10 μm printing resolution. The sample tubes with different lattice shapes, and plastic percentages were designed using the Autodesk Fusion 360 and were printed using the BMF 3D printer. The signal improvements for the sample tubes were tested by conducting power saturation experiments using a 100 μM TEMPOL solution in a home-built sapphire dielectric resonator connected to a Bruker E500 spectrometer. We observed an inward relation in the amount of plastic to signal from our experiments, like simulations and a slight deviation in the signal values, which originated mainly from the printing errors. We determined this error margin and optimized this to our simulations. As a conclusion to this work, we conducted a theoretical study of the effective permittivity value approximation to the lattices, which followed the similar relations from the simulations and experiments too. With this study, we streamlined the simulation procedure to be conducted with a minimum computational cost, optimized the fabrication and determined the printing error margin to be considered while developing the sample tubes. With these findings, we are projecting this approach in simulating complex cross-sections that can only be fabricated using Ultra-precision 3D printing techniques, like the 'Aquasun' and 'Aquasun+', which have significant amount of plastic to be reduced. In summary, this work granted me a better understanding of sample tube simulations using the ANSYS HFSS (High Frequency Structure Simulator) module, and the fabrication and experimental parameters to be considered, while developing these. We are currently writing this to a manuscript and are hoping to be published soon.

Finally, I would like to thank my supervisor, Dr Jason Sidabras, for his support and guidance throughout this study. I would also like to thank the Department of Biophysics, and the graduate school in MCW, for the travel support, and the National Institute of Health (NIH) for supporting this work and funding my doctoral studies.

Jason Sidabras:

Upon his return from 10th EFEPR Summer School, I was very excited to hear that Anand received the IES poster award! Having attended the EFEPR Summer school in 2015, I am aware of the amazing research projects this summer school brings together and I have experienced firsthand the quality of researchers from all over the world who gather. Winning this award is not only a testament to Anand's hard work and dedication to advancing EPR, but in his ability to disseminate his work with excitement.

Since Anand has joined my group in 2023, he has quickly come up to speed on electromagnetic simulations and using EPR for protein structure and dynamics. This ease of interdisciplinary pairing, no doubt, comes

from his Master's in Physics awarded from the prestigious Indian Institute of Science Education and Research (IISER) in Bhopal, India and his two years as a researcher that followed. It was during this time that his skills broadened from purely physics to applications in biological chemistry and microfluidics. In fact, it was this combination that made him a perfect fit for my lab.

His award-winning work combines ultra-precision 3D printing (Boston Micro Fabrication) with stop-flow EPR to bring the community closer to high throughput spectroscopy, where the concentration sensitivity bottleneck has always been daunting since one cannot easily increase volume (3 μL). Instead, by addressing the source of losses in aqueous samples (electric field) we can increase sensitivity for the same sample volume. Over the last 10 years, the hurdle has been fabricating these intricate geometries which has prevented the field from realizing the full potential of these optimized sample designs. Routinely we are using the extruded PTFE AquaStar which yields a factor of 6 over a capillary in a high-Q TE011 resonator. However, extrusion techniques lack the fine detail needed for these geometries, while 3D printing has plastic with losses that degrade the signal improvement. This is where Anand's timely idea of latticing the plastic comes in. By replacing a large percentage of the plastic with air, but maintaining the structure, one can gain more EPR signal for the same sample volume. This breakthrough allows us to reimagine sample tube geometries to improve EPR signal and we are eager to work with the community to disseminate these geometries.

Anand's recognition at the EFEPR Summer School marks an important milestone not just for him personally, but for our ongoing efforts for high-sensitivity EPR measurements. The latticed sample tube approach he presented represents a creative solution to a longstanding fabrication challenge, and I am excited to see how this work evolves as we push toward truly high-throughput EPR spectroscopy by combining even smaller resonators with microfluidics. His award is well-deserved, and I look forward to seeing his continued contributions to the EPR community as this project matures. Congratulations, Anand!

RSC INTEREST GROUP
ESR SPECTROSCOPY

The 58th Annual International Meeting of the RSC ESR Group
June 2025, University of London, UK

The 2025 meeting of the ESR Spectroscopy Group of the Royal Society of Chemistry was hosted by Prof John Morton and Dr Jonathan Breeze at University College London. This is the third time the meeting has been held in London since the millennium (2008, UCL and 2018 Queen Mary University of London).

Following a social event on Sunday 1st June the scientific sessions began with the first of our Plenary Lectures "Exploiting the EPR toolbox in copper(II) chemistry" by Prof Sabine Van Doorslaer. The programme over the four days accommodated a further three plenary lectures: Prof Sandrine Heutz "Exploiting spins in molecular semiconductors – from solar cells to quantum tech"; Dr Emmanuel Flurin "Single spin magnetic resonance by microwave photon counting"; and Prof Ilya Kuprov "Instrumental effects in optimal control pulse design". There were also four lectures from invited speakers: Dr Elisabetta Mileo "In-cell EPR: A combined approach using nitroxide radicals, SDSL and EPR to prove protein behaviour within cells"; Prof Helena Knowles "Electron spin resonance at the nanometre scale using diamond quantum sensors"; Dr Alice Bowen "A tale of two light-induced EPR experiments"; and Prof Enrico Salvadori "Native and photo-induced paramagnetic species in carbon nitride photocatalysts".

The JEOL Prize, which has been awarded annually at this meeting since 1997, session took place on Monday afternoon. The three finalists for this prestigious award for a talk by a junior member of our field were Jack Palmer "From charge-transfer states to separated charges: organic photovoltaics proved by transient and pulse EPR"; Annemarie Kehl "Frequency and time domain F-19 ENDOR spectroscopy: role of nuclear dipolar couplings to determine distance distributions"; and Hannah Eckvahl "Direct detection of the chirality induced spin selectivity effect in donor acceptor molecules". The prize lecture session was followed by a fully attended and eagerly anticipated JEOL sponsored reception, where JEOL representative Dr Michal Malon presented Annemarie Kehl from Max Planck Institute for Multidisciplinary Sciences in Göttingen with the Medal.

Tuesday had not one but two prizes also to junior members of our community. This year the Bruker ESR Thesis Prize was awarded to Dr Yujie Zhao from the University of St Andrews for her thesis "Methodology development of high sensitivity pulsed EPR and DNP". The Laudatio was given by her supervisor Prof Graham Smith and followed by the Bruker Thesis Prize talk by Yujie. Following this the IES Young Investigator Award was presented to Nino Wili. Prof Marina Bennati gave the Laudatio followed by Nino's talk titled "Improved multi-pulse sequences for hyperfine spectroscopy and dynamic nuclear polarization".

The IES General Assembly was then held and chaired by Prof Bennati, before a free evening.

On Wednesday Prof Stephen Hill (FSU National High Magnetic Field Laboratory) was presented with the Bruker Prize. Stephen is the 40th Bruker Lecturer. The Laudatio was given by Prof Stephen Blundell, and the highly illuminating talk was entitled "From molecular magnetic clusters to spin qubits: a high-field EPR spectroscopist's retrospective". As for the Bruker Thesis Prize, Dr Frédéric Jaspard from Bruker presented the awards, and we thank Bruker for their continuing support of this meeting and the Prizes. Following this, the delegates made their way across London – some by bike - to the drinks reception generously sponsored by Bruker, featuring their exciting raffle awards draw, and then the banquet at the beautiful Ironmonger's Hall.

The poster prizes were awarded at the meal. The IES Poster Prize winners were Jennifer Naughton (University of Queensland, Australia) "Structural characterisation of proteins via non-canonical amino acids, a new Gd3+ spin label, and Double Electron-Electron Resonance (DEER) Spectroscopy" and Gediminas Usevičius "Superconducting YBCO planar microresonators for conventional high sensitivity ESR". The SciMed/CIQTEK sponsored prize was awarded to Lorenzo Catini for his poster "Insights into recombination processes in organic solar cells through electrical detected magnetic resonance".

Prof. Christiane Timmel receiving her RSC Long Service Award

At the reception the after-dinner speech was given by the incoming Chair of the RSC ESR committee, Dr Emma Richards, who thanked the local organisers of the well organised and enjoyable meeting, the outgoing Chair Prof Christiane Timmel and the outgoing Secretary Dr Christopher Wedge. Shortly following the meeting, Prof Timmel's long service to the RSC, thus far including 17 years on

The attendees of the RSC ESR 2025 meeting

the RSC ESR Committee with 6 of these as Chair, was recognised by in a presentation by her Head of Department, with Prof Gunnar Jeschke and Prof Stefan Weber in attendance. She continues as the ex officio Chair this year, and is continuing her service to the RSC as she moves to the Faraday Committee. Since Emma had been the group's Treasurer this role has also changed, it is now taken by Dr Paul Jonsen, and the new Secretary is Dr Janet Lovett (also IES Scientific Secretary). The 58th RSC ESR meeting in London was a resounding success, we thank all attendees, the organisers and sponsors: Bruker, ICEoxford, CIQTEK, High Q Technologies, JEOL, AMP (Amplify my Probe), SciMed, QBLOX, Cryogenic and the IES.

2026 Meeting. Our next meeting will take place at the University of Essex, Colchester on the 13th to 16th April 2026 with Dr Dimitri Svistunenko as the local organiser. Please see https://www.esr-group.org/conferences/2026-conference-colchester/ for further information. Join the RSC-ESR-GROUP@JISCMAIL.AC.UK mail list or follow @esr-group.bsky.social to be notified when registration and abstract submission opens.

Dr Janet Lovett,
RSC ESR Group Secretary

The 46th International EPR Symposium / 64th Rocky Mountain Conference on Magnetic Resonance (RMCMR)
August 3–7, 2025, Snowbird, Utah, USA

The 46th International EPR Symposium was held from August 3rd to August 7th, 2025, at the beautiful location of Snowbird, Utah, just a 40-minute drive from Salt Lake City airport, surrounded by mountains and natural beauty. This was a departure from the meeting's usual location in Copper Mountain, Colorado, or Denver city, one that brought a change of scenery and freshness of the location while keeping the science as interesting as ever been in this meeting.

The pre-conference activity started with the Sunday program of Bruker EPR Users' meeting showcasing the latest hardware and software developments, which also featured FeMi Instrument's SpecMan4EPR software demonstration (note FeMi is not associated with Bruker); Bruker then hosted a generous reception.

The overall EPR Symposium comprised 15 oral sessions and two poster sessions, featuring 58 individual talks and 37 poster presentations.

On Monday morning, for the first time in the history of RMCMR EPR meeting, the conference started with a session on "Imaging". EPR imaging is an emerging area with the potential for significant growth in the future. The first lecture was given by Dr. Boris Epel (University of Chicago) with the title "EPR Oxygen Imaging: Methodology, Instrumentation, and Applications". Dr. Epel started his talk with the conclusion slide showing emerging and new applications of EPR oxygen imaging and talked backwards towards the basics of EPR imaging in the end, which made an interesting start of the meeting.

After the first session on Imaging, subsequent sessions covering diverse topics anchored by fifteen Invited Speakers, including (session topic in bracket): Aharon Blank, Technion – Israel Institute of Technology (Methods); Claudia Tait, University of Oxford (Radical Pairs); David E. Budil, Northeastern University, (Organic Spins); Gareth Eaton, Denver University (Spin Relaxation); Veronika A. Szalai, National Institute of Standards and Technology (Biomolecules); Michael T. Lerch, Medical College of Wisconsin (Spin Labeling); Howard Halpern, University of Chicago (Imaging); Jack Freed, Cornell University (special session-outreach); Johan van Tol, Florida State University (Color Centers); Christopher W. M. Kay, Saarland University (Methods); Olav Schiemann, University of Bonn (DEER/PELDOR); Periannan Kuppusamy, Dartmouth College (Imaging); Christopher D. Kroenke, Oregon Health & Science University (Imaging); Igor Tkach, Max Planck Institute for Multidisciplinary Sciences (Hyperpolarization); and Oleg G. Poluektov, Argonne National Laboratory (Radical pairs). In addition, two IES Fellows were recognized at the meeting, Hitoshi Ohta (Kobe University) and Michael K. Bowman (University of Alabama).

The evenings were crammed with events, including 2-hour poster sessions on both Monday and Tuesday. A Conference Reception and a Banquet were held respectively on Monday and Wednesday evenings, the latter celebrating poster and travel award winners and the remarkable career of John McCracken (Michigan State University), who gave the after-dinner speech, detailing his career and work in the study of the structure and function of metalloproteins and photosynthesis reaction centers. The IES poster prize winners were: Pathorn Teptarakulkarn, University of California Los Angeles, and Camille McDonnell, University of Maryland, College Park. The conference also supported prizes for oral presentation, one for the best student oral presentation and another for the best post-doc oral presentation, and the award winners were: Brittany Grimm (postdoc) – Florida State University and NHMFL, and Alysia Mandato (student) – University of Pittsburgh. The conference made 20 travel awards to students and postdocs.

The International EPR Symposium has bounced back well from the COVID years. The 2025 meeting was attended by ~112 EPR researchers from around the world. Of these, 39 were students, while 73 were faculty-level scientists from academia and industry. Of course, the success of the meeting would not have been possible without the generous support of several sponsors, including: International EPR Society (IES), ACERT, Bruker BioSpin, ColdEdge Technologies, Cryogenic Ltd, FeMi Instruments, High Q Technologies, National High Magnetic Field Laboratory, O2M Technologies, and Rotunda Scientific Technologies. Finally, the meeting of this scale cannot happen without the continuous work by the scientific programming committee and conference program committee, which met throughout the year to iron out all small details. The members of scientific programming committee were: Stephen Hill – Chair, Florida State University; Mrignayani Kotecha – Vice Chair, O2M Technologies, LLC; Victor Acosta, University of New Mexico; Claudia Avalos, New York University; Christoph Boehme, University of Utah; Sandra Eaton, University of Denver; Songi Han, Northwestern University; Petr Neugebauer, Central European Institute of Technology; Alexey Silakov, Penn State University; Sunil Saxena, University of Pittsburg; Stefan Stoll, University of Washington; Mark Tseytlin, West Virginia University. The conference programming committee members were Kurt Zilm, Yale University, Sandra Eaton, Denver University, and Sunil Saxena, University of Pittsburgh.

We hope that you will attend the next International EPR Symposium, which will be held again in beautiful Snowbird, Utah, from August 2 to 6, 2026.

Mrignayani Kotecha, O2M Technologies,
Conference Vice-Chair

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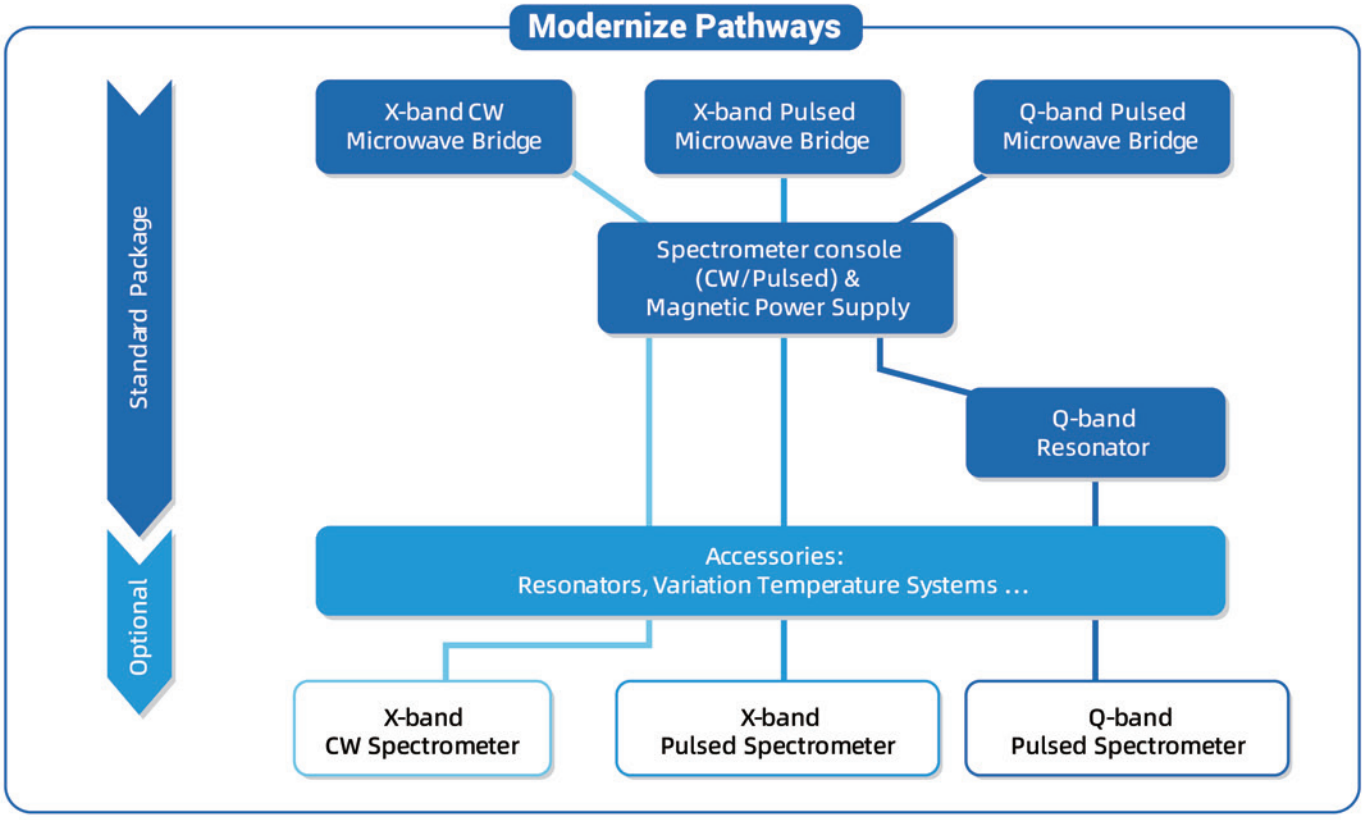

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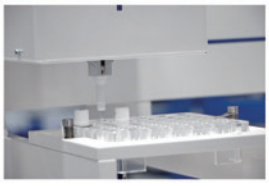

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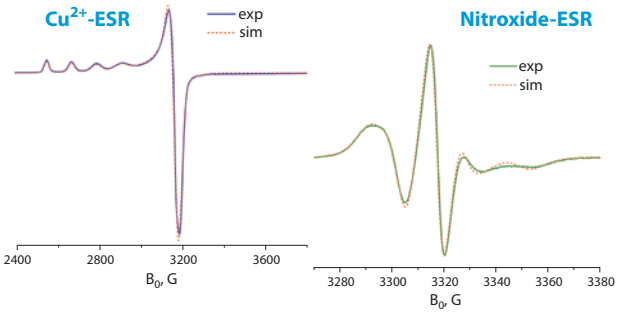
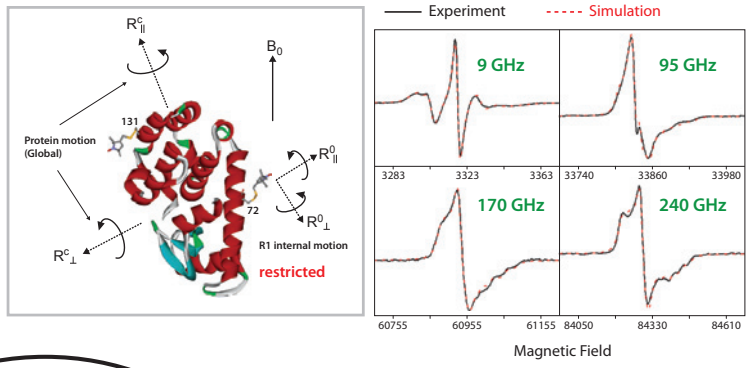
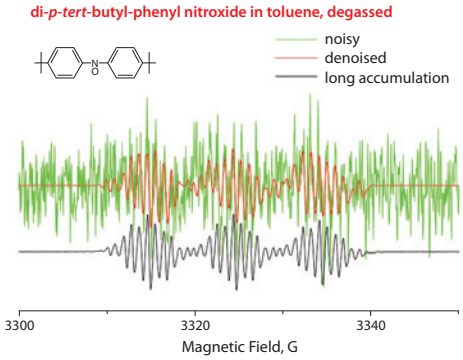


Multifrequency ESR

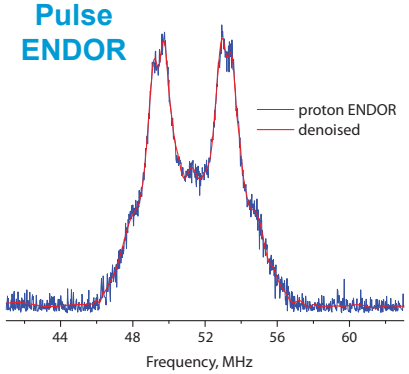


Denoising

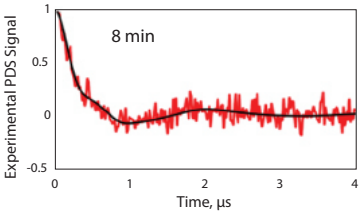


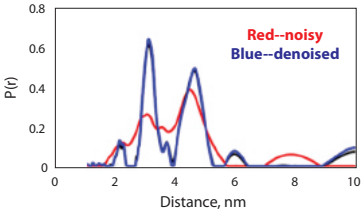
1) Perform
ESR Measurements
2) ESR Data Analysis
3) Advice on
ESR Experimental Design
4) Standard Samples
5) Contact Info Above

Pulse ENDOR

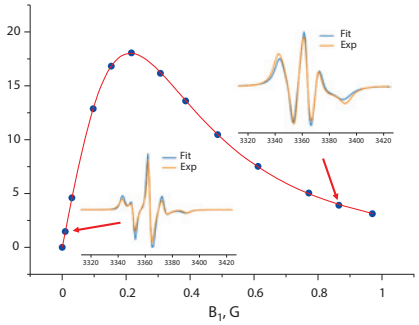


DEER & DQC



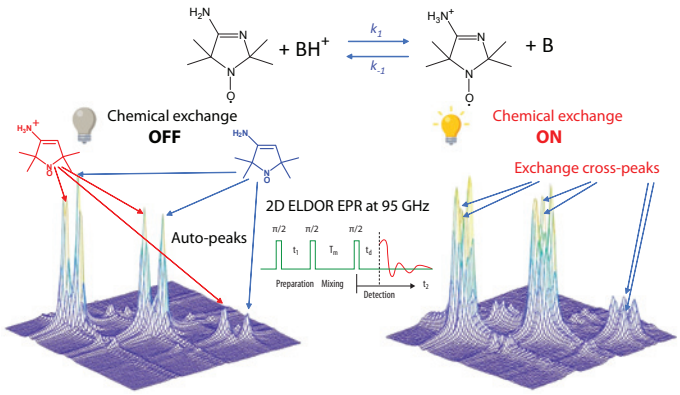


Simulation



Saturation Curve

2D ELDOR



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