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Correspondence address:
ETH Zurich, Laboratory of Physical Chemistry, HCI F 227
Vladimir Prelog Weg 2, 8093 Zurich, Switzerland
Mail: contact@ampere-society.org

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Editorial

Dear members of Groupement AMPERE,

despite the current spell of cold weather, summer is approaching fast and with it the EUROMAR conference in Warsaw, July 2th-6th 2017. After reinitializing the AMPERE Committee last year with a small group of members, we want to extend it this year with the aim to have representation of most European countries as well as a balance between fields of research. You are very welcome to propose candidates for the election in Warsaw (see the last pages of this issue for current members). Please submit names of proposed candidates to admin@ampere-society.org.

Due to the foundation of several new subdivisions and a more consistent policy of membership fee deduction from AMPERE conference fees, the traditional distribution of funds for student grants and tutorial speakers was no longer well balanced. The AMPERE Bureau has initiated a transition to a more transparent and more even distribution (see also the Minutes of the Zurich meeting on March 16th). Briefly, subdivisions will be able to make requests for funds that are then allocated by the Prize Committee. For the AMPERE meetings at the EUROMAR in Warsaw, the Prize Committee will prepare guidelines for this.

This Bulletin issue has a focus on Magnetic Resonance in Porous Media. You will find a conference report, a portrait of the MRPM subdivision, and four short articles on research that won awards at the Bologna meeting in September 2016. The second highlighted branch of magnetic resonance is EPR spectroscopy, with a portrait of Daniella Goldfarb and of the European Federation of EPR groups by Sabine van Doorslaer. I hope you enjoy reading.

Gunnar Jeschke
Secretary General of Groupement AMPERE

Portrait: Prof. Daniella Goldfarb

• why magnetic resonance and why EPR?
The wealth of information it can provide, the many different types of experiments that can be done so you never get bored by always doing the same experiment and the availability of the theoretical formalism that can be used to design pulse sequences and to simulate rich spectra that reproduce so well the experimental ones is fascinating. Why EPR – there is still lots of room for developments.

• What is your favorite frequency? 95 GHz

• What do you still not understand? How to raise children.

• Luckiest experiment you have ever done.
Choosing a Gd(III)-Gd(III) model compound with a short distance of 2.1 nm to demonstrate that Gd(III) can be a good spin label for distance measurements. Now we understand that this is the worst choice one could make, but somehow it worked…

• What was the worst mistake you have made during your lab time?
Not adding comments to a huge (to me it looked huge) computer program I wrote during my PhD.

• Most memorable conference story?
While a post-doc, at an ENC meeting in Asilomar standing in line, a nice elderly man (at least this is way he looked to me, young at the time) standing behind me said " Hi I am Charlie", it took me a while to realize that this was Charlie Slichter and I became speechless…

• With whom (historical person) would you like to meet?
My father (historical for me), who died young and I have a lot to tell him.

• When do you get your best ideas?
When looking at data or listening to lectures not in my field.

• If you had just one month time for travelling – where would you go to?
Walk the Israel trail.

• Your idea of happiness?
Spending time on the beach in northern Israel with my loved ones.

Positions: Scientist , Weizmann Institute of Science (full professor)

Awards: Israel Chemical Society prize of excellence (2016)
Kolthoff Prize 2011/2012, The Technion
International Zavoisky Prize (2009)
Bruker lecture prize, EPR group of the Royal Society of Chemistry (2007)

Homepage: https://www.weizmann.ac.il/chemphys/EPR_group/

Education:
1973 - 1976 B.Sc. in chemistry (with honors), Hebrew University, Israel.
1976 - 1978 M.Sc. in Chemistry, University of Rhode Island, R.I., U.S.A.
1980 - 1984 Ph.D., Department of Isotope Research, Weizmann Institute of Science, Rehovot, Israel. Advisor Prof. Zeev Luz.
1984 - 1987 Post-doc, Depart of Chemistry, University of Houston. Advisor Larry Kevan.

Interests: Pottery

Report on the 13th International Bologna Conference on Magnetic Resonance in Porous Media

The 13th International Bologna Conference on Magnetic Resonance in Porous Media (Bologna MRPM13), chaired by Villiam Bortolotti (DICAM Department, University of Bologna) was held successfully from September 4th to 8th 2016. The Conference took place at the prestigious School of Engineering and Architecture of the University of Bologna, Italy, which made available its facilities, enabling the meeting to enjoy excellent logistics.

This was the 13th event in a series of outstanding conferences - started at the University of Bologna in 1990 - on the progress of our understanding of structure, molecular dynamics, and fluid transport in porous media, thanks to the use of Magnetic Resonance techniques. After MRPM7 (2004) the community joined the Groupement Ampere as the MRPM Division, so that today the Conferences are Ampere Events.

The 13th MRPM conference proved once more to be a very stimulating event, very well attended, with 165 delegates, including 53 students, from 22 countries across the world. As in previous meetings, both academia and industry were well represented, and 101 participants became Groupement Ampere members by taking Ampere membership at the Conference.

The topics covered a wide range of magnetic resonance methods and applications with a wide variety of new experimental results, theoretical models and apparatus.

The conference was preceded on October 3rd and 4th by an NMR School. Four tutorial lectures were presented by Bernhard Blümich, Jean-Pierre Korb, Ville-Veikko Telkki, and Lizhi Xiao. The first day of the Conference began with two extended, invited keynotes lectures presented by Rainer Kimmich and Bernhard Blümich. The remainder of the meeting comprised 11 further invited and 51 contributed talks and 93 posters covering 11 themes: Connected porous systems and NMR relaxometry; Plants, Soils, and Environmental Sciences; Chemical Engineering and Related Materials; Diffusion and Applications; Advances in Technology and Hardware; Petrophysics and Flow; Advances in Methodology and New Research Fields; Biomedicine and Food; Colloquium on Mobile Magnetic Resonance; Non-destructive Testing and Cultural Heritage; Simulation and Multidimensional Inversion.

The MRPM13 proceedings, composed of selected peer reviewed manuscripts, will be published as a special issue of Microporous and Mesoporous Materials (Invited and Oral contributions) and a special issue of Diffusion Fundamentals (Poster Contributions).

Bologna MRPM13 closed with the award ceremony of the Giulio Cesare Borgia Prize for Young Researchers (3000 Euros, sponsored by the Dipartimento di Ingegneria Civile, Chimica, Ambientale e dei Materiali of the University of Bologna). The committee, composed of Christoph Arns, Bernhard Blümich, Villiam Bortolotti, Petrik Galvosas, Paola Fantazzini and Frank Stallmach, assigned the prize to Dan Benjamini (National Institutes of Health, USA), with the following motivation: "For his contribution to advancing 2D Laplace NMR to human MRI" p.7.

In addition, three best poster presentations were also awarded. The poster committee, composed of Denis Grebenkov, Jonathan Mitchell and Rustem Valiullin, decreed a tie between Mariane B. Andreeta (University of São Paulo, Brazil) p.11, Catherine M. Kirkland (Montana State University, USA) p.14. Jie Wang (China University of Petroleum-Beijing, China) p.16.

The Organizing Committee is extremely grateful to the meeting sponsors: Niumag; Bruker BioSpin GmbH; MR Solutions; Oxford Instruments; Stelar Srl; Pure Devices GmbH; Jeol SpA; Lab-Tools Ltd; University of Bologna; Department of Civil, Chemical, Environmental, and Materials Engineering and Department of Physics and Astronomy.

During the General Assembly, chaired by Christoph Arns, it was decided that the 14th Bologna MRPM Conference will be held in February 2018 in Gainesville (USA) organized by Sergey Vasenkov and Russ Bowers (University of Florida). It was agreed that Yi-Qiao Song (Chairman), Sabina Haber-Pohlmeier (Vice-Chair), Petrik Galvosas (MRPM12 Chairman), Villiam Bortolotti (MRPM13 Chairman), Sergey Vasenkov and Russ Bowers (MRPM14 Chairpersons), and Paola Fantazzini (ex officio) should serve on the steering committee for the next two years.
Finally, 20 new members of the scientific advisory committee were elected or re-elected to replace those stepping down after 4 or more years of service. In addition, two persons were elected as honorary members.

Villiam Bortolotti
Conference Chair
villiam.bortolotti@unibo.it

Giulio Cesare Borgia Prize for Young Researchers

Marginal distributions constrained optimization (MADCO) used to accelerate 2D MRI relaxometry

D. Benjamini, P. J. Basser
Quantitative Imaging and Tissue Sciences, NICHD, National Institutes of Health, Bethesda, MD 20892, USA

Introduction:
Multidimensional NMR experiments allow us to study correlations between relaxation properties, such as T_1 and T_2 and physical parameters, such as the diffusivity (D). In the 2D case, when the kernels have an exponential form, application of a 2D inverse Laplace transform (ILT), which is a classic ill-conditioned problem, is required. The most common and efficient 2D-ILT algorithm [1] is typically used in 2D relaxometry experiments that involve a CPMG acquisition, which results in high-density sampling of the signal decay. Although multidimensional diffusion/relaxation experiments have been of great interest in recent years, preclinical and clinical applications remain infeasible. In high-field MRI scanners, specific absorption rate limits the use of multi-echo or CPMG pulse trains, and the large amounts of data required cannot be collected in *in vivo* experiments due to long scan times.
The goal of this work is to vastly reduce the number of acquisitions required for an accurate 2D diffusion/relaxation spectrum reconstruction. Recently, a strategy was introduced that used the marginal 1D distributions of the desired 2D function as equality constraints [2] to stabilize and reduce the number of acquisitions. Here we apply the concept of marginal distributions constrained optimization (MADCO) to multidimensional NMR experiments.

Methods:
Although the method is equally applicable to other types of multidimensional experiments, we chose to demonstrate it on a D-T_1 polyvinylpyrrolidone (PVP) water solution phantom. Doped water and PVP were used to create a 3-peaks MRI phantom. Two purified water samples with 0.18 mM and 0.5 mM gadopentetate dimeglumine were prepared, along with a 20% w/v PVP water solution sample. The corresponding relaxation times and diffusivities (T_1,D), as measured separately for each sample (referred to as ground truth, Fig. 1A). MRI data were acquired on a 7 T Bruker wide-bore vertical magnet with an inversion recovery DW EPI sequence. The full 2D experimental set had 40 diffusion gradient linear steps, and 37 inversion times (τ) with logarithmic spacing. A single 5 mm axial slice with a matrix

size and resolution of 64x64 and 0.2x0.2 mm, respectively, acquired with 2 averages and 4 segments. For D-T_1 measurements, for a given recovery time the fully recovered data are subtracted from the data, and the signal attenuation can be expressed as:

$$M(\tau, b) = \sum_{n=1}^{N_{T1}} \sum_{m=1}^{N_D} \mathbf{F}(T_{1,n}, D_m) \exp(-\frac{\tau}{T_{1,n}}) \exp(-bD_m) \qquad (1)$$

In this work we suggest a simple way to stabilize the estimation of $F(T_1,D)$ in Eq. 1, while significantly reducing the number of required acquisitions and improving accuracy, by constraining the solution according to the following relations:

$$\sum_{n=1}^{N_D} \mathbf{F}(T_1, D_n) = F(T_1) \quad \text{and} \quad \sum_{n=1}^{N_{T1}} \mathbf{F}(T_{1,n}, D) = F(D) \qquad (2)$$

These marginal distributions can be separately estimated from 1D experiments, which require an order of magnitude less data than a conventional 2D acquisition.

Results and Discussion:

The performance of MADCO was determined and compared with the conventional method by estimating the D-T_1 distribution by using 500 random subsamples from the full data at 19 logarithmically distributed acquisitions, from 7 to 1480. 2D distributions and their 1D projections obtained from MADCO and conventional analyses of the signal using 7 and 1480 acquisitions, respectively, are shown in Figs. 1 B and C. Purposely oversampled, the full acquisition scan time in the 2D experiment was ~37 h. As shown, the D-T_1 distribution estimated with the conventional method was far from accurate, even when the full data set was used (Fig. 2C). Conversely, applying the proposed method led to very good agreement with the ground truth distribution, even when only 7 randomly sampled data points were used (Fig. 2B). This immense improvement in accuracy and efficiency translates to a reduction in the required 2D scan time from 37 h to 10 min.

Conclusion:

The potential impact of this work is directed towards preclinical and clinical applications, where it would allow a comprehensive investigation in a reasonable time frame by using the MADCO method in conjunction with a variety of 2D MRI experiments. Furthermore, our work may be extended beyond 2D, since application of the marginal distributions constrained optimization principle in higher dimensions enables the main limitation of experimental time to be lifted.

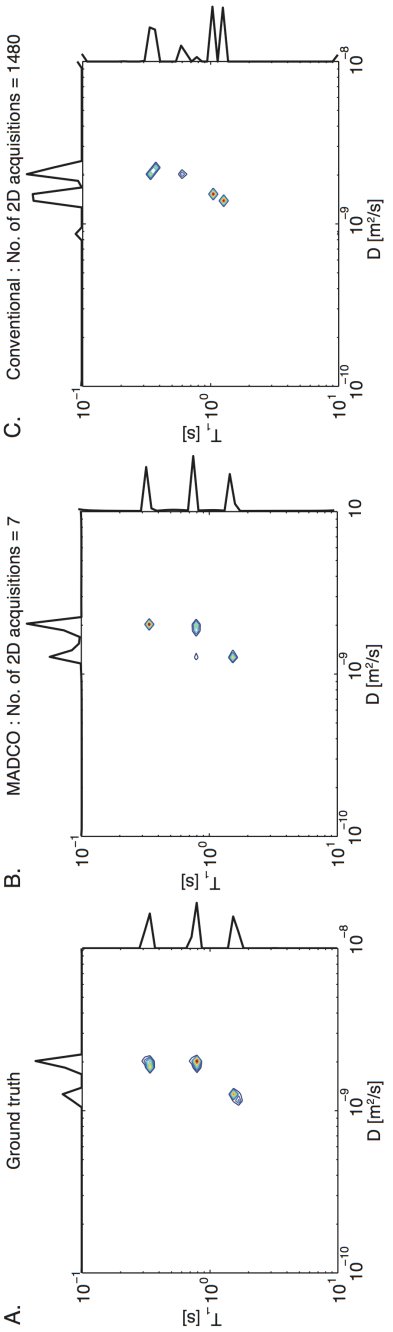

Figure 1 – D-T_1 distributions. (A) Ground truth, estimated using (B) MADCO with 7 acquisitions, and (C) conventional using 1480 acquisitions.

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Posterprize winners of the

13th International Bologna Conference on Magnetic Resonance in Porous Media

Mariane B. Andreeta
Topological study of porous media through μCT imaging and complex networks

Catherine M. Kirkland
Detecting microbially induced calcite precipitation (MICP) in a model well-bore using downhole low-field NMR

Jie Wang
Hydrodynamics and 2D NMR characterization of wettability in saturated rocks

Topological study of porous media through μCT imaging and complex networks

M. B. Andreeta[a], R. S. Polli[a], E. Lucas-Oliveira[a], F. A. Rodrigues[b], T. J. Bonagamba[a]

[a]São Carlos Institute of Physics, University of São Paulo, PO Box 369, 13560-970, São Carlos, SP, Brazil, [b]São Carlos Institute of Mathematics and Computer Science, University of São Paulo, PO Box 668, 13560-970, São Carlos, SP, Brazil.

The interconnecting system of pores and throats in porous materials is a high complexity system. The development of methods that allow quantifying its topological and morphological properties is of vital importance to understanding the structure of the material. The application of μCT imaging to this media has opened a new branch of research, which uses image processing algorithms to quantify the pore-throat interconnection network and assess properties such as pore size distribution and throat size distributions [1,2]. In order to extract this information, the 3D porous matrix is characterized by assessing the total void volume, pore surface and fractal dimension amongst other properties. Furthermore, the media can be segmented into pores and throats, forming a large network in which the pores are the nodes and the throats are the edges. This segmentation allows a new form of visualization of the porous structure and the possibility of applying network theory to analyze its topology. In this work, we propose the extraction of the pore network, not divided into pores and throats, but segmented into regions. The resulting network is used to characterize the topology of the system by measurements of degree distribution, node/edge centralities and molecular diffusion (through random walk). We have demonstrated that this information provides a powerful tool to analyze the media's morphology. A direct application is the identification preferential paths of molecular diffusion, an important quantity measured by the NMR techniques.

This new analysis was first applied to characterize the morphology of wormholes in carbonates, provided by Cenpes/Petrobras. Wormhole is the denomination of a pathway formed by the application of an acid treatment as a stimulation procedure for the reservoir, a method of enhanced oil recovery (EOR). This treatment consists of a reactive fluid flow injected in the inner rock of the reservoir, which creates a preferential path (wormhole) that optimizes the extraction of the hydrocarbon fluids [3,4]. Therefore, the characterization of the wormhole's structure is of vital importance to assess the efficiency of the stimulation procedure.

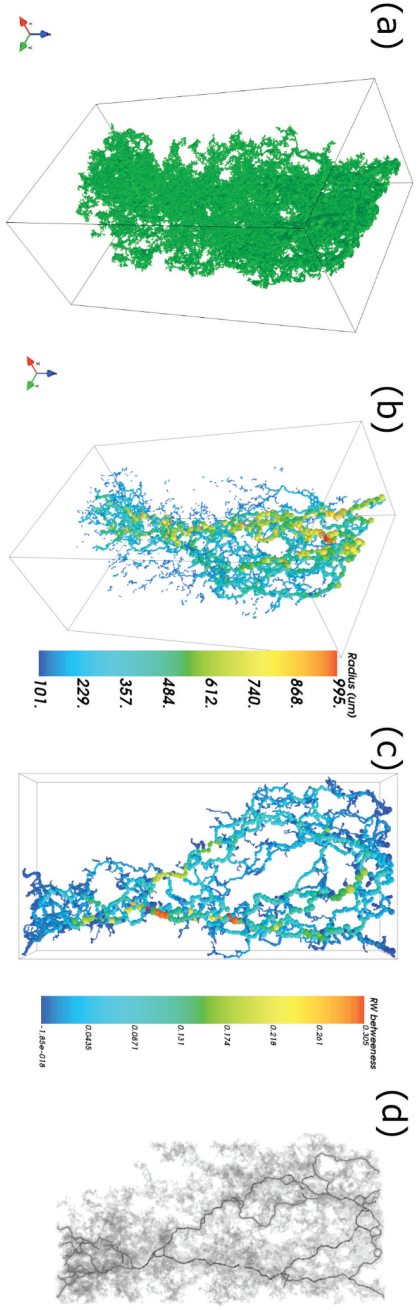

Figure 1
Structural evaluation of a wormhole on acidified Indiana Limestone sample. (a) Visualization of the acidification pathway. (b) Network extracted by the application of the modified Max Ball Algorithm. (c) Current flow betweeness (also known as random walk betweeness centrality) scores for each node. (d) Pathways of preferential molecular diffusion selected from the data. (all images were acquired with the developed software).

This study used the μCT images to reconstruct the 3D porous matrix of the rock cores after acidification. A percolation algorithm was used to identify the wormhole, having any other pores excluded from the measurements. Then, a modified Max Ball Algorithm [5], developed on this project, was applied to construct the pore interconnection network. This network did not present the free scale characteristic, as it is found in most networks in nature, but instead an exponential decay behavior on the connection of nodes. In addition, the network presented the "small world" property, which shows that the typical pore is easily accessible with a small number of steps. Through measurements of node closeness centralities and current flow betweeness centralities, the method allowed to identify the main paths of molecular diffusion and fluid flow that had the largest hydraulic radius (Figure 1). We have found that the lengths and number of connecting preferential paths correlates with the acid flow used. We intend to apply the method to identify the ramifications lengths, and use it as a complementary technique on the choice of the acidification procedure that can provide the best results in carbonates. For further work, the network extracted will be used to simulate 1D and 2D NMR experiments in order to find the correlations of the network's topology to the NMR relaxation times distributions.

Acknowledgments: We thank Carlos Speglich and Rodrigo Surmas from Petrobras for the raw data used on this work and for the collaboration.

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Detecting microbially induced calcite precipitation (MICP) in a model well-bore using downhole low-field NMR

Catherine M. Kirkland[a,b], Sam Zanetti[a], Adrienne J. Phillips[a,e], Elliot Grunewald[c], David O. Walsh[c], Sarah L. Codd[a,d]

[a] Montana State University, Center for Biofilm Engineering, PO Box 173980, Bozeman, Montana, USA, 59717. [b] Montana State University, Department of Chemical and Biological Engineering, PO Box 173920, Bozeman, Montana, USA 59717. [c] Vista Clara Inc., 12201 Cyrus Way Ste. 104, Mukilteo, Washington, USA, 98275. [d] Montana State University, Department of Mechanical and Industrial Engineering, Montana State University, PO Box 173800, Bozeman, Montana, USA. [e] Department of Civil Engineering, Montana State University, PO Box 173900, Bozeman, Montana, USA.

Microbially induced calcite precipitation (MICP) has been widely researched in recent years due to its relevance for engineering applications including subsurface barriers for hydrodynamic control and sealing of reservoir cap rocks [1]. Subsurface applications of MICP are inherently difficult to monitor non-destructively and with spatio-temporal resolution. Nuclear magnetic resonance (NMR), however, is commonly used to characterize the pore size distributions, porosity, and permeability of subsurface geologic formations [2]. These are the same physical properties affected by MICP, indicating that NMR well-logging tools may have potential for monitoring subsurface engineering applications of MICP. This investigation used a low-field NMR well-logging probe to monitor MICP in the pore spaces of a sand-filled radial-flow bioreactor. Signal amplitude and T_2 relaxation were measured over an 8-day experimental period to identify the change in signal response due to MICP. No significant changes were recorded during the 3-day control period. Following inoculation with the ureolytic bacteria, *Sporosarcina pasteurii*, and subsequent injections of urea and calcium substrate pulses for 4 days, the NMR measured water content in the reactor decreased by approximately 24%. T_2 relaxation distributions bifurcated from a single mode centered about approximately 785 ms into a very fast decaying population (T_2 less than 10 ms) and a larger population with relaxation times greater than 1000 ms.

The reduction in signal amplitude indicates that pore water was displaced by calcite precipitation in the voids. Furthermore, the longer T_2 relaxation times suggest that calcite formation on the quartz sand mineral surface reduced the surface relaxivity, ρ, by shielding paramagnetic impurities from the pore fluid. The combination of changes in pore volume and surface minerology accounts for the changes in the T_2 distributions following

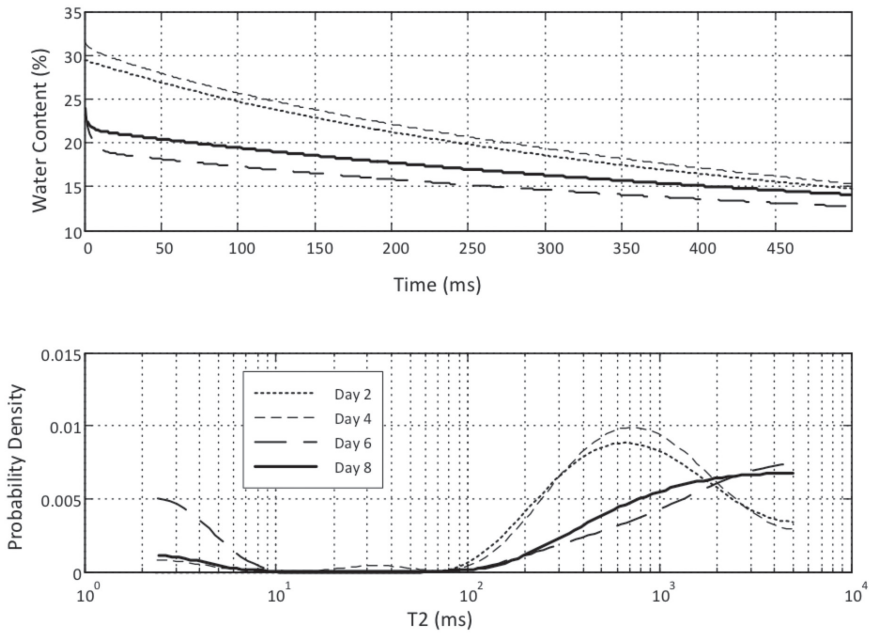

Figure 1
Selected multi-exponential signal decay curves and T_2 distributions. Day 2 data was collected during the control period prior to inoculation. MICP began on Day 4 and continued to Day 7. The Day 8 data was collected just prior to destructive sampling. The signal amplitude (water content) decreased by approximately 24% over the experimental period while the T_2 distribution split into a large population with slow relaxation and a small population with very fast relaxation.

MICP. Destructive sampling and subsequent analysis with ICP-MS and gravimetric methods confirmed an evenly-distributed porosity reduction of approximately 16% due to calcite precipitation. These results indicate that the low-field NMR well logging probe is sensitive to the physical and chemical changes caused by MICP in a laboratory bioreactor.

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Hydrodynamics and 2D NMR characterization of wettability in saturated rocks

J. Wang, L. Xiao, L. Guo, G. Liao, Y. Zhang, F. Xiao

State Key Laboratory of Petroleum Resources and Prospecting, China University of Petroleum, Beijing, China

The hydrodynamics in porous media is extremely complicated due to surface characteristics such as wettability and heterogeneous pore structure. But it is critical for oil production and oil. Researches have been made on simulating and qualitatively interpreting NMR response to wettability with simple shapes of fluid and pore size distributions[1,2,3]. In reality, however, fluid and pore size distribution are hard to simplify because of wettability and pore geometry. Traditional NMR methods to evaluate wettability usually assume that wetting phase coating the pore surface and non-wetting phase centered in pores[2,4,5]. In addition, NMR wettability index so far is unable to apply to oil recovery. In order to take the above issues into account, we construct a rock model and related the effective relaxivity from NMR interpretation with contact angle. We simplify the heterogeneous wetting rock model and simulate the distribution of fluid within rock pores under the influence of heterogeneous wettability using Lattice Boltzmann Method (LBM)[6]. Then NMR responses have been simulated and interpreted. Relation between contact angle and effective relaxivity from NMR are constructed accordingly.

An example of fluid distribution influenced by wettability and saturation *(Figure 1)* is simulated by this method, and *2D* NMR simulation in a rock core based on fluid distribution are implemented as below.

The relaxation of part fluid in porous media is:

$$\frac{1}{T_{2s\_i}} = \rho_{\_i}\frac{WI}{S_{a\_i}}\left(\frac{S}{V}\right) = \rho_{\_i}\frac{S_{c\_i}}{S}\frac{V}{V_{\_i}}\left(\frac{S}{V}\right) = \rho_{eff\_i}\frac{1}{S_{a\_i}}\left(\frac{S}{V}\right) \quad (1)$$

$$\rho_{eff\_i} = \rho_{\_i} WI \quad (2)$$

Where i is the index of different fluid; T_{2s_i} is surface relaxation of one fluid and $\left(\frac{S}{V}\right)$ is the ratio of surface to volume; $\rho_{\_i}$ is relaxivity of fluid i and WI is defined as wettability index.

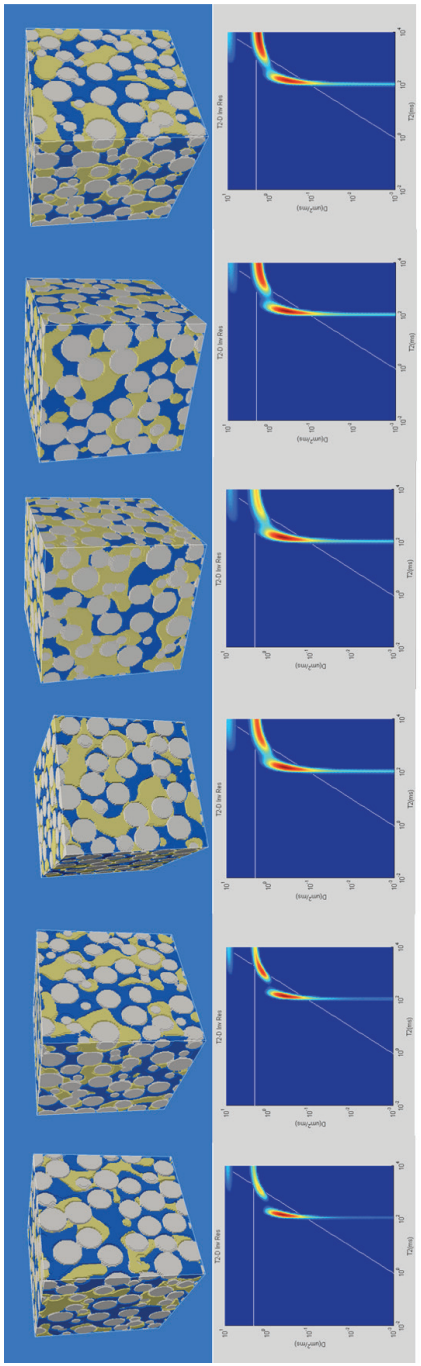


Figure 1 The first row is water and oil distribution by LBM method with different ratio of water wetting surface and oil wetting surface; the second row is the NMR signal simulated with fluid distribution in the first row.

To obtain the effective relaxivity, we apply Padé interpolation for restricted diffusion and *DCLM* for water saturation [2].
Padé approximant interpolation is applied by Latour et al. and the restricted water line for D-T_2 map is:

$$D(t) = D_0(1 - \gamma \frac{aL_D + (L_D / L_M)^2}{aL_D + (L_D / L_M)^2 + \gamma}) \quad (3)$$

$$\rho_{eff} = (S_{contcact} / S_{total})\rho \quad (4)$$

Where

γ=1-D_∞ / D_0 and $a = 9\sqrt{\pi} / (T_2 \rho_{eff})$

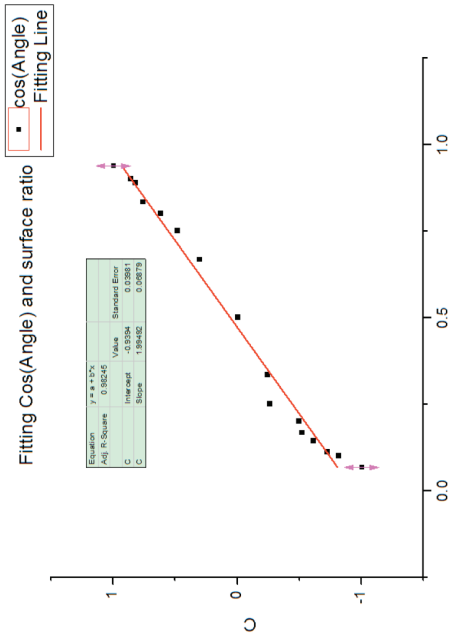
$L_D = \sqrt{D_0 T_{EL}}$

L_M is the heterogeneity length scale of the medium which will be much larger than L_D, thus $(L_D / L_M)^2$ can be viewed as 0.
The relationship between effective relaxivity and surface ratio of different wettability and can be used to obtain restricted water line.

The simulated results of fluid distribution with different pattern of wetting surface suggest that the apparent contact angles of fluid increase linearly with the ratios of different wetting surfaces(figure 2). Results obtained from 2D NMR map indicate that the effective relaxivity is related to different ratios of wetting surfaces of pore walls as shown in figure 2 and figure 3.

Figure 2 the fit between the ratio of water wetting surface to oil wetting surface and the values of cosine wetting contact angle.

Figure 3 the fit between the effective relaxivity and the ratio of water wetting surface to oil wetting surface.



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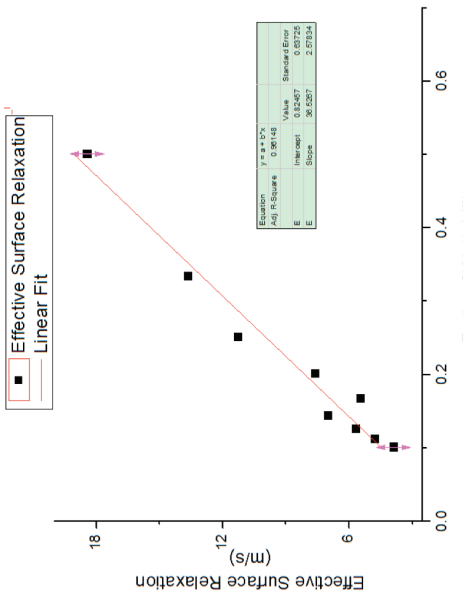

Figure 3 the fit between the effective relaxivity and the ratio of water wetting surface to oil wetting surface.

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Obituary
Prof. Sir Peter Mansfield
9 October 1933 - 8 February 2017

Sir Peter Mansfield, who died on 8th February of this year, was a pioneer of solid state NMR and co-inventor of MRI. His origination of MRI and subsequent development of many of the key ideas that still underpin this remarkable, non-invasive imaging technique was most prominently recognised through the award of the Nobel Prize in Physiology or Medicine in 2003– an award which he shared with the late Paul Lauterbur.

Sir Peter was born (in 1933) and educated in Lambeth in inner London. He left school at the age of 15, with no formal qualifications, to take up a role as a printer's assistant. An interest in rocketry, partially stemming from his exposure to V2 raids during the blitz, subsequently secured him a job in the rocket-propulsion department of Britain's Ministry of Supply. By taking evening classes while working on rockets during the day, he acquired the qualifications needed to study for a degree in physics, joining Queen Mary University in London in 1954. Sir Peter's final year project involved building a transistor-based CW NMR spectrometer, and success in this endeavour brought Sir Peter to the attention of Jack Powles (one of the earliest users of NMR in the UK), who offered him a PhD studentship. During his doctoral studies, Sir Peter built a pulsed spectrometer for solid state NMR experiments and using this system he discovered the solid echo. On completion of his PhD, Sir Peter took up a postdoctoral appointment with Charlie Slichter at the University of Illinois, where he worked on NMR studies of doped metals. While in the US, Sir Peter was recruited to a Lectureship in Nottingham University's Department of Physics by Raymond Andrew. He took up that appointment in 1964 and stayed in Nottingham for the rest of his career. In Nottingham, he initially worked on multi-pulse sequences for line-narrowing in solid state NMR, often in competition with John Waugh's group.

This work was carried out on one of the first computer-controlled NMR spectrometers, based around a Honeywell computer with 4 kB of memory, on which a fast Fourier transform was also coded. These developments brought him to thinking about ways of measuring crystal structure in solids via NMR "diffraction" and this led naturally to his first experiments in one-dimensional NMR imaging which were carried out on a small sample composed of layers of camphor.

Sir Peter had a long association with the Groupement Ampère and the NMR diffraction experiments were first reported at the ‚First Specialized Colloque Ampère', which was held in Krakow in September 1973 – the same year that Paul Lauterbur published his seminal Letter to Nature on NMR 'zeugmatography'. Quite quickly, Sir Peter's research focus moved entirely onto NMR imaging, and at the 18th Ampere Congress, which was held in Nottingham in 1974, new results were reported in what must have been one of the first ever conference sessions devoted to "NMR Image Formation". Over the next few years, Sir Peter introduced the slice selection process that is now used in nearly all MRI experiments, and produced the first images of live human anatomy (the finger of Andrew Maudsley, who was a PhD student at the time). This image helped to convince the UK's Medical Research Council to provide the funding needed for Sir Peter to construct a first 0.1 T whole-body scanner. Despite concerns at the time about the possibility that the voltages induced in the torso by switching on and off magnetic field gradients during the imaging process might cause a cardiac arrest, Sir Peter volunteered for the first experiments (a re-enactment was recorded later for the UK's Tomorrow's World television programme – a video segment which is well worth tracking down (https://www.nottingham.ac.uk/connectonline/searchlight/2016/mri-and-nottingham.aspx)) and the results were reported a few days later at the 1978 ENC meeting. Around this time, Sir Peter also conceived the echo planar imaging (EPI) technique, which allows a two-dimensional image to be generated from a single FID. Variants of EPI are used today in almost all MRI-based functional brain imaging experiments, but at the time of its invention, image acquisition times were of the order of tens of minutes, and it took more than ten years of work by Sir Peter, including the invention of actively-screened gradient coils and continued innovation in the use of cutting edge computer technology, to bring EPI to the point where it could be adopted for widespread use. In the early 1990's Sir Peter also built one of the first NMR microscopes, the first 3T human scanner and carried out early studies of porous media using MRI. Sir Peter was elected to the Royal Society in 1987, knighted in 1993, and won many honours and prizes in addition to the 2003 Nobel award. He retired from the University of Nottingham in 1994, but continued working as Emeritus Professor at

the eponymous, Sir Peter Mansfield Magnetic Resonance Centre (now the Sir Peter Mansfield Imaging Centre) for nearly twenty more years. In this period, Sir Peter returned to thinking about the voltages that are induced in the body by turning magnetic field gradients on and off (which generally cause uncomfortable peripheral nerve stimulation at switching rates significantly below those needed to cause cardiac stimulation) and developed new gradient coil designs aimed at increasing patient comfort by limiting these induced voltages, along with the acoustic noise that gradient switching also produces.

Many of the staff and students that worked with Sir Peter over his career (including myself) have continued in NMR and MRI research. Sir Peter was an inspiring person with whom to work: he was inventive, determined and driven, and set high standards of experimental rigour and scholarship in his lab (his former career as a printer's assistant was often evident in the red ink corrections on our manuscripts). He treated those who worked for him with kindness and consideration, and despite the remarkable success that he enjoyed, remained modest, unassuming and unfailingly polite. Outside of work, Sir Peter was devoted to his family, but after his retirement, he did make time to learn how to fly light aircraft and then helicopters. Sir Peter was sadly not in good health in recent years, but he did join us in January of this year for a one day symposium in celebration of the 25th year anniversary of the establishment of Nottingham's Magnetic Resonance Centre. As it turns out this was a final poignant opportunity for us to enjoy his company and show our appreciation of his life and work – all received with his usual wry smile. He is sorely missed by family, friends and colleagues.

Richard Bowtell
April 2017

Presentation of the subdivision Magnetic Resonance in Porous Media (MRPM)

Porous materials are ubiquitous in our environment and daily live. MR study of porous media started in the 1960s for the understanding of the porosity of rocks. In 1990, the first meeting of MRPM, named International Meeting On Recent Advances In MR Applications To Porous Media was organized by the University of Bologna, in Bologna, Italy.
In the following years since then, 13 conferences of MRPM have been held in many cities throughout the world, University of Kent (United Kingdom, 1993), Université Catholique de Louvain (Belgium, 1995), Statoil Research Center (Norway, 1997), University of Bologna (Italy, 2000), University of Ulm (Germany, 2002), Ecole Polytechnique (France, 2004), University of Bologna (Italy, 2006), Schlumberger-Doll Research (USA, 2008), University of Leipzig (Germany, 2010), University of Surrey (United Kingdom, 2012), Victoria University of Wellington (New Zealand, 2014), University of Bologna (Italy, 2016). In 2004 at the 7th conference, MRPM joined Ampere Society as a subdivision.
Since 2008, the MRPM conference was formally named International Bologna Conference On Magnetic Resonance In Porous Media, reflecting its heritage as well as its international character.

The MRPM conferences are often proceeded with a one- or two-day NMR school aimed at introducing the contemporary topics of MRPM to young scientists (post-graduate students, PhD students and post-doctoral fellows).
In recent years, MRPM conferences also include the Mobile NMR Workshop (CMMR) to communicate the development and applications of Mobile Magnetic Resonance, and to promote hands-on experience of mobile NMR equipments.
A special Young Investigator session is held for the presenters to compete for the Giulio Cesare Borgia Prize for Young Researchers. The Borgia award was established in memory of the MRPM founder Giulio Cesare Borgia for his contribution to MRPM and for the particular attention he always paid to the enthusiasm, passion, and courage of young people who undertook the difficult and adventurous path of scientific investigation in this fascinating area of research. Since 2004, the Borgia award has been awarded to Dimitris Sakellariou, Rustem Valiullin, Kate E. Washburn, Denis Grebenkov, Jonathan Mitchell, Jeffrey L. Paulsen, and D. Benjamini. In addition, poster awards are also competed and presented at each conference.

MRPM is overseen by its executive committee, division committee, supported by the International Scientific Advisory Committee. The General Membership composed of MRPM meeting attendees who are also registered automatically as members of the AMPERE Society. The Division Committee is responsible for carrying out the business of the Division, including the scientific organization of the conferences. The Executive Committee is responsible for the management, administration, and finances of the Division. The General Meeting with the full membership has the final authority of the Division and takes place at the end of MRPM conferences.

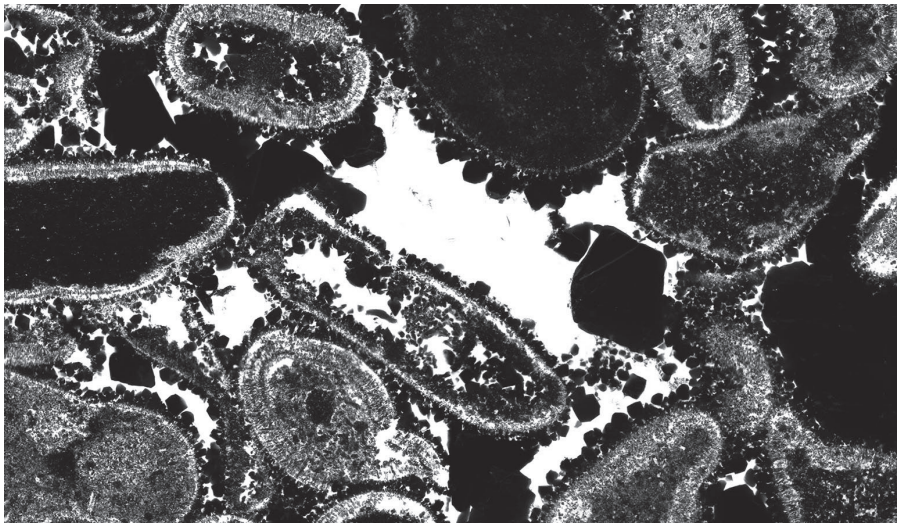
The MRPM conference is devoted to the progress in MR theory and techniques for the understanding of porous media and the associated applications.
Porous materials are important in many disciplines and have applications in research, industries and biomedical topics. For example, inorganic sedimentary rocks share much similarity with biological tissues in term of porosity, pore space dimension, and the importance of the interstitial fluids. Current topics include relaxation and diffusion to probe pore space and fluid dynamics, MRI, solid-liquid interactions, spectroscopy methods in inhomogeneous field, signal enhancement techniques, fluid and tracer flow, solid-fluid mixture dynamics and flow. The most discussed materials include many natural and artificial porous materials, such as rocks, cements, biological tissues, foodstuffs, plants and wood, particle packs, sediments, soils, pharmaceuticals, zeolites, and bioconstructs.
Another emerging topic is the study of cultural heritage materials (paintings, statues, monuments, etc). Innovative techniques to study structure, behavior of fluids, and their interactions in every kind of new data acquisition and processing techniques are also a strong feature.

In addition to the application of MR techniques, development of new techniques, instruments, physical understanding and interpretation methods specific to the challenges of porous media are very important. Recent examples of such topics are complex diffusion physics, internal magnetic fields, and multi-dimensional experiments and inversion. Low-field NMR is a particularly popular topic as it has the potential to transition NMR technology to more applications outside research laboratories.

The MRPM conference is often attended by up to 200 people from many countries with a substantial growing participation from Asia. Over the years, the conference has enjoyed a strong financial support from many academic institutions in particular University of Bologna, MR equipment and service providers, scientific publishing companies, and petroleum industry. They help fund the Student Travel Award in order to encourage more student participation in the conference.
The work presented at MRPM conferences have been published in Magnetic Resonance Imaging (1990-2008), Diffusion Fundamentals (2008-2016), American Institute of Physics Proceedings (2008-2010), and Microporous and Mesoporous Materials (2012-2016).

Information of all previous conferences can be found at:
dhttp://www.mrpm.org/

Yi-Qiao Song,
April 2017



confocal microscopy of austin chalk, a carbonate rock full of small fossils.
Foto provided by Yi-Qiao Song

Presentation of the European Federation of EPR Groups (EFEPR) Division of the Ampere Society

The European Federation of EPR (electron paramagnetic resonance) groups (EFEPR) is an organization which links the different regional EPR groups in European countries and other countries in the region. EFEPR is devoted to interchange of information between the different groups. The idea of the EFEPR was first put forward during a joint conference organized by the British, the oldest ESR group in Europe, and the then more newly formed Italian ESR group in 1991. A steering committee chaired by Klaus Moebius, Free University of Berlin, was at that time set up and this gave rise in the following year to the birth of EFEPR. Up till early September 2016, the only organisms of the federation were the president and the assembly of the EPR groups during the triennial meeting. At the EFEPR2016 meeting in Turin, the structure of the EFEPR was changed. Next to the new president (Sabine Van Doorslaer), two vice-presidents (Carole Duboc and Donatella Carbonera) were elected that are now in regular contact with representatives of the different countries.

The activities of EFEPR include a triennial conference that provides a forum for scientists engaged in EPR spectroscopy to present and discuss recent results and developments. The most recent conference was held in Torino from 4-8 September 2016, the next will be held in Slovakia in 2019. These conferences cover all aspects of EPR spectroscopy, including applications in the fields of physics, chemistry, materials, biology and medicine, new techniques, instrumentation developments and theory and are typically attended by 150-200 scientists. In addition, EFEPR organizes EPR schools targeted at young researchers (PhD, early postdoc-level) in which they disseminate modern EPR methodology. These schools include lectures, tutorials and hands-on training on EPR instruments. The first school was held in 1999 in Caorle (Italy) and the most recent one was held in Berlin in August 2015. The schools are for about 100 students and are extremely popular. There is a huge effort done to keep the costs for the students to a minimum. The EFEPR is actively pursuing possibilities to organize a next school in 2018.

Furthermore, the EFEPR website (http://efepr.uantwerpen.be/efepr/) contains an updated overview of all EPR groups in Europe, upcoming magnetic resonance meetings and offers to all the EPR groups the possibility to post new positions (faculty, postdoc, PhD) on the website.

Sabine Van Doorslaer (Antwerp)
April 2017

Minutes of the meeting of the Ampere Bureau

in Zürich, on March 16, 2017

Members Present:
B. Blümich, B. Meier, G. Jeschke, L. Frydman, S. Jurga, M. Ernst, G. Bodenhausen, A. Böckmann, S. Haber-Pohlmeier, J. Dolinsek,
Video conferencing:
Y.-Q. Song, L. Frydman. M. John, W. Kozminski, J. van Duynhoven, T. Vosegaard
Excused:
C. Redfield, V. Chizhik, H. W. Spiess, S. Van Doorslaer

Agenda:

1. Approval of the minutes of the AMPERE Bureau meeting in Aarhus July 4, 2016
2. Report on the state of the AMPERE Society (B. Blümich)
3. Financial Report (G. Jeschke)
4. EUROMAR Division (L. Frydman)
5. Financial report EUROMAR division (C. Redfield)
6. Report on the Andrew and AMPERE Prizes (B. H. Meier)
7. Final reports past meetings:
   - Food MR 2016, Karlsruhe (Germany) (J. van Duynhoven)
   - AMPERE NMR School Zakopane (Poland) 2016 (S. Jurga)
   - EUROMAR 2016 Aarhus (Denmark) (T. Vosegaard)
   - MRPM13, Bologna (Italy) (Y.-Q. Song)
   - Ampere Biol. Sol.-St. NMR School, Mallorca (A. Böckmann)
   - Spinus 2016 (V. Chizhik)
8. Future meetings:
   - EUROMAR 2017, Warsaw (Poland) July 2-6 (W. Kozminski)
   - AMPERE NMR School Zakopane (Poland) June 25-July 1 (S. Jurga)
   - ICMRM 2017, Halifax (Canada) August 13-17 (M. Johns)
   - EUROMAR 2018, Nantes (France) July 1-5 (L. Frydman)
9. Changes in the Guidelines for AMPERE Events
10. Management of financial resources
11. Varia
12. Date of the next meeting

11:00 hours G. Jeschke opened the meeting. On request from L. Frydman, the Euromar topics (4 and 5, parts of 7 and 8) were discussed at the beginning of the meeting.

A1.
The minutes of the AMPERE Bureau meeting in Aarhus, July 4, 2016, published in the AMPERE Bulletin 263/264, were approved unanimously.

A2.
B. Blümich delivered a short report on the state of the Groupement AMPERE. During the last year, two eminent scientists (Erwin Hahn 9.6.1921-20.9.2016 and Sir Peter Mansfield 9.10.1933-8.2.2017), who were both closely connected to AMPERE as guest and honorary members, respectively, passed away. We will always remember these two great scientists and their contributions to the field. The past fall was the 65th anniversary of the Groupement AMPERE which was founded in 1951. Despite its age, the society is very active and supports many activities. The AMPERE Bulletin has been improved and made more interesting (portraits of important scientists, subdivision reports, prize lecture reports) due to the efforts of Gunnar Jeschke and his team. The new statutes were approved at the last General Assembly to reflect the changes in the growing society. The renewal of the AMPERE Committee has also been started with term limits for the membership. One of the important tasks this year will be to make sure all national MR societies and all groups are represented in the AMPERE Committee. There was a large number of activities in 2016 and also in 2017 there are many activities planned. The Groupement AMPERE has grown significantly and we have to make sure that the financial resources of the society are used to support our mission and that all subdivisions benefit from it. This will be discussed in more detail in point 10. The membership numbers are stable with about 450-500 permanent members and about 800 transient members from conference registration.

A3.
G. Jeschke explained the current status of the finances of AMPERE. The finances are stable and the major expenses are the student grants and the prizes sponsored by AMPERE. Currently, the Groupement AMPERE has a fortune of about Euro 50’000.- plus the endowment for the Andrew prize. The financial report is attached as an Appendix to the minutes.

A4.
L. Frydman reported about the state of the EUROMAR division. The location for the next three meetings have already been fixed (Warsaw 2017, Nantes 2018, Berlin 2019 combined ISMAR/EUROMAR) and there will be 1-2 proposals for 2020. There have been some changes and additional prizes that will be given at the EUROMAR. The Russell Varian prize is no longer sponsored by Agilent but there are some new sponsors. The Varian prize

will be changed to be awarded to young investigators and will alternate with the new AMPERE prize. Elsevier will fund three JMR awards for student presentation (similar to the ones at the ENC and ISMAR) and the winners of the JEOL student award will now also be selected by the program committee. This is the last year as the chairman of EUROMAR and the search for a successor is underway. Several people have been approached and so far two people have agreed to be willing to serve as chairman. Additional suggestions for candidates are welcome. The EUROMAR Board of Trustees will vote in Warsaw on the new chairman.

A5.
C. Redfield apologizes for not being able to participate in the meeting. A written report about the EUROMAR finances was presented by G. Jeschke. As decided by the EUROMAR Board of Trustees, the main expenses were for the student travel stipends (Euro 16'000.-) to reduce the fortune of EUROMAR. In general, the finances are very healthy due to the positive financial results of the conferences in the past few years.

A6.
B. Meier reported about the state of the Andrew prize selection for 2017. There are 8 new proposals and 7 proposals from last year for the Andrew prize and currently the committee is in the first round of discussions. The AMPERE prize will not be awarded this year but the prize committee suggests to solicit nominations by announcing it for next year in the AMPERE Bulletin. Self nominations will not be accepted.

A7.
The reports for the past meetings were accepted. The AMPERE Bureau thanks all the scientific and local organizers for their time and effort.

Food MR 2016 Karlsruhe (J. van Duynhoven): The meeting had 126 participants which has become by now the average number of participants for this meeting. There were many good speakers and the participants had a very diverse background. The bylaws of the subdivision have been drafted and will be discussed and approved at the next meeting. The next meeting will be organized in Brittany/France in 2018. A report about the meeting was published in the Bulletin 265.

NMR School 2016 Zakopane (St. Jurga): The meeting was again very successful with 20 teachers and 80 students from 13 countries. The program was very diverse with lectures, oral presentations by young researchers, poster sessions, and practical lab-training courses. There were also cultural events (organ recital by D. Michel) and excursions (river rafting). Report in Bulletin 265.

EUROMAR 2016 Aarhus (T. Vosegaard): the highlight of the meeting was the newly awarded Richard R. Ernst prize (sponsored by Bruker) given to Alex Pines in the presence of Richard R. Ernst. There were about 640 participants among which were about 150 students. There were 121 talks and 324 posters with about 25% of the talks and posters presented by women. The main expense was the rent for the conference hall but nevertheless a small profit of about Euro 10'000.- resulted that will be split with the EUROMAR division. (Report in Bulletin 265)

MRPM13, Bologna (Y.-Q. Song): the meeting went very well with about 165 attendees mostly from Europe. There was an increase in attendance compared to the previous meetings and it was a well received meeting. A final report has been prepared and sent to G. Jeschke for publication in this AMPERE Bulletin (p. 18). There is a new chair (Y.-Q. Song) and vice chair (Sabine Haber-Pohlmeier) of the subdivision.

Ampere Biological Solid State NMR School, Mallorca (A. Böckmann): The school had 26 students from 9 countries and was organized on Palma de Mallorca with very good local support by Rosa Maria Gomila Ribas and Gabriel Martorell. The school was organized with a minimum budget (support by Bruker, EBSA and Inext) and all speakers paid for their own cost. There are cheap flights to Mallorca from many places in Europe and there is also cheap accommodation available (report see Bulletin 266). It was decided that the next school in 2018 will again be organized in Mallorca by M. Ernst.

Spinus 2016, St. Petersburg (V. Chizhik): There was a report about the Spinus 2016 school published in the AMPERE Bulletin 266. There is a Spinus 2017 event planned for April of this year.

A8.
Future meetings for 2017-2018

EUROMAR 2017, Warsaw (W. Kozminski): The preparations are going well. The conference will be organized similar to last year in Aarhus. The structure of the program will be similar with the tutorials in the middle of the week to make them more attractive and integrated in the conference program. There will be at least two satellite meetings: (i) the AMPERE NMR school in Zakopane (see below) and (ii) a COST workshop about relaxation organized by D. Kruk. There might be additional satellite events but they are not yet finalized. The rooms in the Marriott hotel in Warsaw are reserved also for the various board meetings. The expected cost is about Euro 250'000.- with a slightly higher planned income. The main sponsors/exhibitors have been agreed to come (Bruker, JEOL) and the registration is open. There will be a reminder for award nominations.

AMPERE NMR School Zakopane (S. Jurga): The organization is well under way with many speakers having agreed to come. The organizers hope for a larger attendance this year due to the EUROMAR being held in Poland in the week after the school.

ICMRM 2017, Halifax (M. Johns): The speakers have been invited and the registration is open as of today. There will be a satellite meeting about Rheo-NMR and it is planned to have a named lecture to commemorate Erwin Hahn which will be given by Eiichi Fukushima. The ICMRM subdivision is well underway.

EUROMAR 2018, Nantes (L. Frydman): the program committee for Nantes 2018 has been selected last year and will meet for the first time in Warsaw. The organization of the conference is well underway.

A9.
The Guidelines for AMPERE Events have been revised to reflect the current situation. The benefits of subdivisions are now listed to make it more obvious what AMPERE does for them. These guidelines are not applicable for conferences that are organized under the "Auspices of the Groupement AMPERE". The changes in the guidelines were accepted unanimously.

A10.
A more transparent distribution of funds to support our mission and all subdivisions equally is required due to the growth of the AMPERE society. To estimate how much the different subdivisions contribute to the income of the AMPERE society, a simple model with an average membership fee of Euro 20.- per conference participant was used. This averages the variations of fees for student and full members and multiple conference participations. Based on this model, the EUROMAR generates an income of about Euro 14'000.- while most of the other subdivisions generate an income of about Euro 1'250.- per year.
The AMPERE Bureau would like to support the schools and conferences organized by the subdivisions through student stipends, named lectureships and other innovative ideas. There will be an annual budget for this support that is decided by the AMPERE Bureau. The subdivisions can make proposals to the Prize Committee which will award the money. The detailed criteria will be worked out by the Prize Committee until June so that they can be approved by the AMPERE Bureau. Starting in 2018 this new system will be implemented.
For this year, the AMPERE Bureau decided to closely follow last years distribution of funds. The EUROMAR conference will be supported with Euro 5'000.- for student travel stipends and a named tutorial lecture (Euro 1'500.-), the AMPERE NMR school will be supported by Euro 4'000.- for student travel stipends, and the ICMRM 2017 will be supported by a named lecture (Euro 1'000.-). The Bureau would like to support the Erwin Hahn lecturer (see above) but this needs to be coordinated and checked with the organizers.

A11.
Varia: The new AMPERE Committee was started last year and we need to nominate additional people this year. There will be a call for nominations in the Bulletin to make sure all groups are represented.

A12.
The next annual meeting of the AMPERE Bureau will be on March 22, 2018 in Zurich. The Bureau meeting during the EUROMAR in Warsaw will be on Tuesday July 4, 2017, the Committee meeting will be on Wednesday July 5, 2017.

At 13:30 hours G. Jeschke closed the meeting and thanked all the present members for their time and effort.

Zürich, 16.3.2017
Matthias Ernst

Balance of the Accounts of the Groupement Ampere

Period from March 15. 2016 to February 28. 2017

	Debit CHF	Debit Euro	Credit CHF	Credit Euro	Debit USD	Credit USD	Have CHF	Have Euro	Have USD	Euro Euromar	CHF Euromar
Totale fortune on March 15. 2016							**221'701.23**	**7'652.18**	**0.00**	**56'823.81**	**71'646.89**
Membership Fees				27'700.10							
Conferences and Prizes											
Prizes and Travel Grants	11'270.58	10'687.53								16'000 -	
BiolSolidState School		3'235.62		7'946.17							
conference surplus			14'396.45								
Varian Award						2'650.00					
Wiley contribution to Euromar										3'500.00	
Administration											
Ampere Bulletin	2'162.60										
Bureau Meetings Zurich	668.20										
miscellaneous / Webhosting	902.35										
Bank											
Interest (Coupons)			524.55								
Interest (Accounts)			85.00								
Charges, Handling Costs (Deposits, Bank)	400.15	144.63			12.65					44.30 -	12.00 -
Gains/Losses Andrew Wertschriftendepot			2'889.06								
Total	15'403.88	14'067.78	17'895.06	35'646.27	12.65	2'650.00					
ZKB Privatkonto							2'245.65				
ZKB Eurokonto, NMR School								1'958.27			
ZKB Eurokonto - Ampere								24'956.64			
ZKB Eurokonto - BiolSolidStateNMR								2'315.76			
ZKB Anlagesparkonto							16'838.90				
ZKB Anlagesparkonto - ANDREW							27'563.57				
ZKB Sparkonto - Hyperpolarisation							7'339.55				
ZKB Sparkonto - EPR							7'421.95				
ZKB Sparkonto - FOOD NMR							3'651.05				
ZKB Sparkonto - MRPM							31'314.10				
ZKB Sparkonto - SMRM							35'440.35				
ZKB Dollar Account - Varian	NEW								2'637.35		
ZKB Wertschriftendepot - ANDREW							92'377.29				
ZKB Privatkonto - EUROMAR											71'634.89
ZKB Eurokonto - EUROMAR										44'279.51	
Total fortune on February 28. 2017							**224'192.41**	**29'230.67**	**2'637.35**	**44'279.51**	**71'634.89**

Euro = 1.095 CHF

Executive Officers and Honorary Members of the AMPERE Bureau

The AMPERE BUREAU includes the executive officers (which take the responsibility and the representation of the Groupement between the meeting of the committee), the honorary members of the Bureau and the organizers of forthcoming meetings.

Executive Officers 2016 - 2019

President	Bernhard Blümich
Vice Presidents	Janez Dolinšek Anja Böckmann
Secretary General	Gunnar Jeschke
Executive Secretary	Matthias Ernst
EF-EPR Representative	Sabine van Doorslaer
SRMR Representative	Michael Johns
MRPM Representative	Yi-Qiao Song
MR-FOOD Representative:	John van Duynhoven
Hyperpolarisation Representative:	Geoffrey Bodenhausen
EUROMAR Representative	Lucio Frydman
EUROMAR Treasurer	Christina Redfield
Past President	Beat Meier
Honorary Member	Hans Wolfgang Spiess
Honorary Member	Stefan Jurga

Executive Officers 2016 - 2019

B. BLÜMICH
Macromolecular Chemistry, RWTH Aachen University, D-52074 Aachen, Deutschland
Tel. +49 241 802 64 20, Fax +49 241 802 21 85, e-mail: bluemich@itmc.rwth-aachen.de
J. DOLINŠEK
Institute Jozef Stefan, Department F5, Jamova 39, SI-1000 Ljubljana
Tel. +386 1 4773 740, Fax +386 1 4263 269, e-mail: jani.dolinsek@ijs.si
A. BÖCKMANN
Institute of Biology and Chemistry of Proteins, IBCP, F-69367 Lyon, France
Tel. +33 472 72 26 49, Telefax +33 472 72 36 04, e-mail: anja.bockmann@ibcp.fr
G. JESCHKE
Laboratorium für Physikalische Chemie, ETH Zürich, CH-8093 ZURICH, Switzerland
Tel. +41 44 632 5702, Fax +41 44 633 1448, e-mail: Gunnar.Jeschke@phys.chem.ethz.ch
M. ERNST
Laboratorium für Physikalische Chemie, ETH Zürich, CH-8093 ZURICH, Switzerland,
Tel. +41 44 632 4366, Fax +41 44 632 16 21, e-mail: maer@nmr.phys.chem.ethz.ch
S. VAN DOORSLAER
University of Antwerp, Departmet of Physics, Campus Drie Eiken, Universiteitsplein 1, 2610 Wilrjik, Belgium, e-mail: sabine.vandoorslaer@uantwerpen.be
M. JOHNS
School of Mechanical and Chemical Engineering, The University of West Australia, CRAWLEY, WA 6009, Australia, Tel. +61 8 6488 5664, e-mail: michael.johns@uwa.edu.au
Y.Q. SONG
Schlumberger-Doll Research, 1 Hampshire Street, Cambridge, MA 02139-1578 USA
Phone: +1 617 768 2333, Email: ysong@slb.com
J. VAN DUYNHOVEN
Unilever N.V., 100 Victoria Embankment, London EC4Y 0DY, United Kingdom, e-mail: john-van.duynhoven@unilever.com
G. BODENHAUSEN
EPFL, Institut des sciences et ingénierie chimiques, BCH 1529 (Batochime), 1015 Lausanne, CH, Tel. +41 21 693 94 31, e-mail: geoffrey.bodenhausen@epfl.ch
L. FRYDMAN
Weizmann Institute of Science, Department of Chemical Physics, 76100 Rehovot, Israel,
Tel: +972 8 934 4903, Fax: +972 8 934 4123, mail: lucio.frydman@weizmann.ac.il
C. REDFIELD
Department of Biochemistry, University of Oxford, South Parks Road OX1 3QU, United Kingdom, Tel. +44 (0)1865 613200, mail: christina.redfield@bioch.ox.ac.uk
B.H. MEIER
Laboratorium für Physikalische Chemie, ETH Zürich, CH-8093 ZURICH, Switzerland,
Tel. +41 44 632 44 01, Fax +41 44 632 16 21, e-mail: beme@nmr.phys.chem.ethz.ch
H.W. SPIESS
Max-Planck Institut für Polymerforschung, Ackermannweg 10, POB. 3148, D-55021 MAINZ, Germany, Tel. +49 6131 379120, Fax +49 6131 379320, e-mail: spiess@mpip-mainz.mpg.de
ST. JURGA
Instytut Fizyki, Uniwersytet im. A. Mickiewicza, Zaklad Fizyki Makromolekularnej, Umultowska 85, PL-61-614 POZNAN, Poland
Tel. ++48 61 829 5290, Fax ++48 61 829 5290, e-mail: stjurga@main.amu.edu.pl

AMPERE Committee

S. ASHBROOK
School of Chemistry, University of St. Andrews, North Haugh, ST. ANDREWS, KY16 9ST, United-Kingdom
J. BANYS
Vilnius University, Department of Radiophysics, Saulétekio 9 2040 VILNIUS, Lithuania
R. BOELENS
Bijvoet Center for Biomolecular Research, Utrecht University, Padualaan 8, NL-3584 CH UTRECHT, The Netherlands
V. CHIZHIK
University of St. Petersburg, Quantum Magnet.Phen.,Fac.of Physics, RU-198504 ST. PETERSBURG, Russia
J. DOLINŠEK
Institute Jozef Stefan, Jamova 39, SI - 1000 LJUBLJANA, Slovenia
I. FELLI
Department of Chemistry and Center for Magnetic Resonance (CERM), University of Florence Via L. Sacconi 6 50019 SESTO FIORENTINO, (FI), Italy
P. GIRAUDEAU
Université de Nantes, Faculté des Sciences et Techniques, 2 rue de la Houssinière, 44322 NANTES Cedex 03, France
D. GOLDFARB
Chemical Physics Department, Weizmann Institute of Science, 76100 REHOVOT, Israel
W. KOZMINSKI
Biological and Chemical Research Center, University of Warsaw, Krakowskie Przedmieście 26/28, 00-927 WARSAW, Poland
M. PONS
Institute for Research in Biomedicine, University of Barcelona, Josep Samitier 1-5, 80828 BARCELONA, Spain
V.V. TELKKI
Department of Physics, University of Oulu, P.O. Box 3000, 90014 OULU, Finland
C. THIELE
Technische Universität Darmstadt, Alarich-Weiss-Strasse 16, 64287 DARMSTADT, Germany
J. SPEVACEK
Inst. of Macromolecular Chemistry, Academy of Sciences of the Czech Republic, 162 - 06 PRAGUE 6, Czechia
S. VAN DOORSLAER
SIBAC Laboratory, University of Antwerp, Universiteitsplein 1, B-2610 WILRIJK, Belgium

Emeritus members

L. KIMTYS
Department of Physics, Vilnius University, Universiteto Str. 3, VILNIUS 2734, Lithuania
F. MILIA
NRC Demokritos, Physics Department, Aghia Paraskevi Attikis, GR - 15310 ATHENS, Greece
J. HENNEL, Inst. of Nucl. Phys. Ul. Radzikowskiego 152, PL - 31342 KRAKOW 23, Poland

Honorary members

R.R. ERNST
Laboratorium für Physikalische Chemie, ETH Zürich, CH-8093 ZURICH, Switzerland
J. JEENER
Université Libre - Plaine, CP 223, Bld. du Triomphe, B - 1050 BRUXELLES, Belgium
K.A. MÜLLER
IBM Zurich Research Laboratory, Säumerstrasse 4, CH - 8803 RÜSCHLIKON, Switzerland
K. WUETHRICH
Inst. f. Molekularbiologie u. Biophysik, ETH Zürich, CH-8093 ZURICH, Switzerland

Guest members

A. PINES
Dept. of Chemistry, University of California, BERKELEY CA 94720, USA, Delegate of ISMAR
J.A. NORRIS
Dept. of Chemistry, University of Chicago, South Ellis Ave. CHICAGO IL 6037-1403, USA
Delegate of the International EPR Society
K.A. McLAUCHLAN
Physical Chemistry Laboratory, Oxford University, South Parks Road, OXFORD OX1 3QZ, UK
Delegate of the International EPR Society
D. AILION
Dept. of Physics, Univ. of UTAH, 304 J. Fletcher Building, SALT-LAKE-CITY 84112, Utah, USA
J. BJORKSTAM
Electrical Engineergin (FT-10), University of Washington, 98195 SEATTLE WA, USA
S.H. CHOH
Department of Physics, Korea University, SEOUL 136-701, Republic of Korea
D. FIAT
University of Illinois, Dept. of Physiology and Biophysics, POB 6998, CHICAGO IL 60680, USA
E. FUKUSHIMA
ABQMR, 2301 Yale Blvd., SE, Suite C2, ALBUQUERQUE, NM 87106, USA
C.P. SLICHTER
Dept. of Physics, University of Illinois, 1110 W. Green Street, URBANA IL 61801, USA

Future conferences

Ampere Events 2017

Ampere NMR School 2017	Zakopane (Poland)	June 25 to July 1 2017
Euromar 2017	Warsaw (Poland)	July 2-6 2017
ICMRM 2017	Halifax (Nova Scotia)	August 13-17 2017
10th Alpine Conference on Solid-State NMR	Chamonix Mont Blanc (France)	September 10-14 2017

Other Events 2017

Spanish Biophysical Society	Sevilla (Spain)	June 6-8 2017
20th ISMAR conference	Québec City (Canada)	July 23-28 2017
SciX2017	Reno (USA)	October 8-13 2017

Ampere Events 2018

Euromar 2018	Nantes (France)	July 1-5 2018
FoodMR 2018	Brittany (France)	2018
MRPM14 Magnetic Resonance in Porous Media	Gainesville (USA)	in February 2018

Other Events 2018

SciX2018	Atlanta (USA)	October 21-26 2018

Ampere Events 2019

ISMAR / Euromar 2019	Berlin (Germany)	August 25-30 2019