Speaker Biographies & Abstracts
(listed alphabetically)

Kristie Adams, Ph.D.
President and CEO
Steelyard Analytics, Inc.
Gaithersburg, MD

Dr. Adams is the President and CEO of Steelyard Analytics, Inc., a contract NMR spectroscopy laboratory located in the heart of the I-270 biotech corridor in Gaithersburg, MD. Steelyard Analytics is the US daughter company of Spectral Service AG, located in Cologne, Germany. Dr. Adams received her Ph.D. in Chemistry from Louisiana State University in 2007. Following a postdoctoral appointment at the National Cancer Institute in Frederick, MD, she accepted a position at the United States Pharmacopeial Convention (USP) in 2011, where her research was focused on developing compendial (q)NMR spectroscopic methods for quality control of medicines, foods, dietary supplements and excipients. In 2015, Dr. Adams moved to DuPont, where, as a Research Investigator, she utilized (q)NMR spectroscopic methods to deliver critical technical solutions for a broad range of applications across DuPont business units. Dr. Adams actively collaborates with the global NMR community, with standards-setting organizations such as AOCS and USP, and currently serves as the Vice President of PANIC (Practical Applications of NMR in Industry Conference).

Presentation
Public qNMR Resources, validNMR, NMR Wiki, qNMR.org
Wednesday, October 2, 2019, 2:00-2:20 p.m.

- Many qNMR resources are available on the Internet.
- Most top-level hits are vendor contributions.
- Other resources exist, such as nmrwiki.org, qnmr.org and validnmr.com.
- This presentation is intended to highlight these public resources and describe what can be found within each.
- Hopefully, this presentation will stimulate discussion amongst participants regarding the “state of qNMR information” on the Internet.

Sitaram Bhavaraju
NMR Team Lead
USP
Rockville, MD

Ram Bhavaraju obtained Ph.D. in Organic Chemistry, from the University of Rhode Island (URI). Academic qualifications include M.Phil., M.Sc., and B.Sc., chemistry degrees all in India. Research involved extensive use of NMR and qNMR. He also worked as Researcher at URI Pharmacy dept.
His employment at Spectra Systems Corporation, RI, a specialty chemical company, focused on development and characterization of organic dyes and fluorescent materials.
Since joining USP's Reference Standards Laboratory in 2008, he contributed to over 2,500 USP Reference Standards. Ram leverages qNMR at USP labs, aiming towards high quality standards. He is a senior member of American Society for Quality. Additionally, he is highly experienced in practical aspects of ISO lab documentation, internal and external auditing, and includes ISO 17025 audits, all focused on engaging quality assurance for product development using NMR. He has presented qNMR work at meetings such as the First USP/CENAPT q-NMR Summit (2016), PANIC Industry validation meeting (2017), and the qNMR summit in Tokyo, Japan (2018).

Presentation
Quantitative ^{1}H NMR Study Case: Ticagrelor Related Compound A
Wednesday, October 2, 2019, 1:00-1:20 p.m.

- Counter ion measurement
- qNMR potential
- stoichiometry verification by qNMR

Mandelic acid is a counter ion associated with Ticagrelor Related Compound A. The estimation of mandelic acid in Ticagrelor RC-A is done using qHNMR. We used the Absolute qHNMR "100%" method[†] with Internal Calibrant (IC) for the determination of counter ion. The per cent composition and purity evaluation of mandelic acid, and stoichiometric verification of the test sample are discussed.

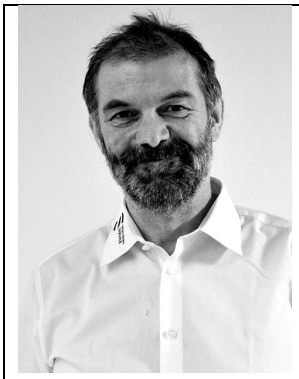
[†] *Importance of Purity Evaluation and the Potential of Quantitative 1H NMR as a Purity Assay*, G.F. Pauli et. al., J. Med. Chem., 2014, 57(22), 9220-9231.

Charlotte Corbett, Ph.D.
Special Testing and Research Laboratory
DEA
Dulles, VA

Dr. Charlotte Corbett has worked as a forensic drug chemist for 17 years. She has specialized in nuclear magnetic resonance (NMR) for the past seven years. The U.S. Drug Enforcement Administration (DEA) utilizes NMR for purity determination, structure differentiation, identification, and structure elucidation. DEA continues to simplify quantitation through automation. New compounds are identified on a weekly basis. DEA strives to assist forensic laboratories with new technology, such as low resolution NMR, comparison spectra, and expert analysis.

Presentation
qNMR Challenges and Limitations
Wednesday, October 2, 2019, 3:00-3:20 p.m.

- Why is any other method used for quantitation?
- Improvements are needed in acquisition and processing of mixtures.
- At least one clean signal region cannot always be achieved.
- Improved signal-to-noise is required for low-purity components.



Bernd Diehl, Ph.D.
CEO
Spectral Service AG
Cologne, Germany

EDUCATION

1988	Philipps University Marburg
	Dr. rer. nat, Dipl. Chemist, Organic Chemistry and NMR Spectroscopy

PROFESSIONAL EXPERIENCE

1988 – 1990	Bayer Research Center, Head of NMR Spectroscopy
1990 – Present	Spectral Service AG, Founder and CEO

LECTURESHIPS

1998 – 2000	Universities of Marburg and Bonn, NMR Spectroscopy
2013 – Present	University of Applied Science Bonn-Rhein-Sieg: NMR Spectroscopy
2015 – Present	University of Würzburg: Mass Spectrometry, Habilitation in Pharmaceutical Chemistry

PROFESSIONAL ASSOCIATIONS

President of ILPS (International Lecithin and Phospholipid Society)

Chair of AOCS (American Oil Chemists' Society) Phospholipid Division

Member of ACS, GDCh, DGF, Euro Fed Lipid, Nordic Lipidforum

Presentation
Establishing a qNMR CRO Business
Wednesday, October 2, 2019, 4:25-4:35 p.m.

Multinuclear NMR, Chirality and Holistic Quality Analysis
Thursday, October 3, 2019, 9:25-10:00 a.m.

Christoph Freudenberger
NMR Application Scientist
Bruker Biospin AG
Fällanden, Switzerland

EDUCATION

2003 – 2004 Institut für Org. Chemie & Biochemie II TU München, Germany
Postdoc with Dr. Burkhard Luy and Prof. Dr. Horst Kessler

Polymer gels as alignment media for measurement for residual dipolar couplings
MD simulation of small molecules in alimenting media
Pulse sequence development

2000 – 2003 Abteilung Organische Chemie I Universität Ulm, Germany
PhD with Prof. Dr. Hans-Ulrich Siehl

Dissertation: «NMR spectroscopic and computational studies on the β-silyl effect in carbo cations and on ion pair formation in ionic liquids»

1994 – 1999 Universität Ulm, Germany
Diploma degree in chemistry

PROFESSIONAL EXPERIENCE

2004 – 2011 Currenta GmbH & Co. OHG Leverkusen, Germany
Laboratory Manager for NMR Spectroscopy

Structure Elucidation im Methodenverbund NMR – HLPC/GC-MS – IR.
qNMR and identification studies in a GxP environment
Development and validation of SOP's und analytical methods
Customer acquisition, sales and profit budgeting

2011 - Present Bruker Switzerland AG Fällanden, Switzerland
Application Development – Head of Validation

Validation of new hardware and software products
Organization of round robin tests
Application development for qNMR
Training for customers and employees
Team leader of international 2nd-level-support group

Since 2018: Committee member at ValidNMR for instrument qualification and hardware topics

---

Presentation
Application of Quality by Design Principles to the Development of qNMR Methods
Thursday, October 3, 2019, 11:40 a.m. - 12:00 p.m.

Klaus Fritsch
Manager Compliance
Mettler-Toledo GmbH
Greifensee, Switzerland

Klaus Fritsch is Manager Compliance of the Global Business Area “Laboratory Weighing” within Mettler-Toledo. He has been with Mettler-Toledo since 2005, acting as senior metrologist and consulting the industry to achieve compliance with applicable regulations when using weighing instruments. He received his Ph.D. in Physics by the Technical University of Munich, Germany, in 1997. Prior to joining Mettler-Toledo, he worked as a consultant for the pharmaceutical and chemical industry, mainly focusing on risk management and process safety.

Fritsch is member of the USP Expert Panel responsible for the General Chapters <41> and <1251>, the EURAMET technical committee responsible for the calibration guideline cg-18 on Non-automatic Weighing Instruments, and a working group of the ASTM International Committee E41 that targets balance calibration and testing. He is furthermore active in several ISO working groups, for example the ISO/TC48 subcommittee responsible for volumetric apparatus, thereby focusing on pipette calibration.

The objective of his work is to ensure that the metrological concepts and requirements stipulated by the various standards are sound but still easy to adapt by the industry. He is building a bridge between standard-setting organizations, national metrological institutes and the industries that are affected by the regulations.

Presentation
Good Weighing Practice for Accurate qNMR Sample Preparation
Thursday, October 3, 2019, 11:05-11:40 a.m.

Gabriel Giancaspro, Ph.D.
Vice President, Science-Dietary Supplements & Herbal Medicines
USP
Rockville, MD

Dr. Giancaspro is the Vice President, Science—Dietary Supplements and Herbal Medicines, for USP. His department provides staff support to Expert Committees responsible for setting USP's standards for dietary supplements, herbal medicines, and food ingredients.

Previously, he was the Director for Dietary Supplements in the Documentary Standards Division at USP responsible for the development of monographs and general chapters for botanical and non-botanical dietary supplements, safety evaluations, performance standards, and the publication of the USP Dietary Supplements Compendium.

Before joining USP, Dr. Giancaspro's teaching and research experience included medicinal chemistry, drug analysis, and drug stability at the Pharmacy School at the University of Buenos Aires. He also has extensive industrial experience as the former Technical Director of Rigecin, Schwabe-Argentina and Kampel-Martian, in charge of Regulatory Affairs, Analytical Research and Development, and Quality Control of parenterals, herbal medicines, and oncological medicines.

Dr. Giancaspro holds a Pharmacist degree and a Ph.D. in pharmaceutical sciences (medicinal chemistry) from the University of Buenos Aires, Argentina.

Presentation
Welcome – Fifth International qNMR Summit
Wednesday, October 2, 2019, 8:40-8:50 a.m.

Krish Krishnamurthy
Applications Scientist
ChemPacker
San Jose, CA

- Received his Ph.D. in Synthetic Organic Chemistry and his NMR research career started with his post-doctoral tenure with Prof. (late) George Olah. He explored NMR applications in the study of structure and dynamics of carbocation intermediates.
- He spent next three decades between Pharma and vendor (Varian) labs pursuing research in pulse sequence development in small molecule NMR. He is currently an independent researcher focusing on time-domain data processing.
- He is the recipient of 2018 James Shoolery award (SMASH conference) in recognition of his life-time contribution to the field of small molecule NMR.

Presentation
CRAFT – qNMR in Time-Domain, a New Paradigm
Wednesday, October 2, 2019, 9:00-9:30 a.m.

- "Yet another data processing (sigh)", but why?
- How are phase correction and baseline correction (ir)relevant for NMR signal quantitation? What does phase and baseline error mean in time-domain?
- What is CRAFT?
- Examples to demonstrate the value/benefit of time-domain quantitation. CRAFT rewrites conventional definitions of phase correction, baseline correction and peak overlap
- Looking ahead….

Pekka Laatikainen
CEO
Spin Discoveries
Kuopio, Finland

Master of Science (organic chemistry). CEO and programmer in the company Spin Discoveries Ltd since 2018. Specializing in software development (c++, java, python, html). Developer of ChemAdder software.

Presentation
The New Dimensions of Quantum Mechanical Spectral Analysis (QMSA)
Thursday, October 3, 2019, 8:30-8:50 a.m.

The coupled nuclear spins floating in sea of molecular electrons obey the laws of quantum mechanics so that frequencies of complex 1H NMR spectra can be calculated within experimental accuracy from chemical shifts and coupling constants. When the effects of molecular environment are added to the model, even the smallest spectral details can be interpreted. This forms the basics of computerized QMSA, pioneered by computer programs like LAOCOON. QMSA offers invaluable applications from efficient data storage to quantitative NMR. The known bottleneck of QMSA, the steeply growing computation time according to the size of spin-system, has been overcome. For example, our ChemAdder software allows simulation of testosterone or urine spectra (with >210 metabolites and >1000 spin-particles) in < 1 sec on a standard desktop, and their complete iterative fitting demands typically < 1 min. Other novel QMSA concepts include field independent Adaptive Spectral Libraries (ASL), qQMSA of isotopomer 2D HSQC spectra, the multispectral QMSA (simultaneous fitting of different types of spectra, for example, real and imaginary), and the holistic QMSA which utilizes prior knowledge about chemical shift variations so that the current and accumulated analyses are consistent – approaching the case that all the spectra are fitted simultaneusly. A parallel analysis of even a large spectral set requires just a few clicks, from samples to results (mg/ml).

Cesar Lau-Cam, Ph.D.
Professor, Pharmaceutical Sciences
College of Pharmacy and Health Sciences
St. John's University
Jamaica, NY

Educational background:
Felipe Santiago Salaverry H.S., Lima, Peru, 1955
B.S. Pharmacy, University of San Marcos, Lima, Peru, 1963
M.S. Pharmaceutical Sciences (Pharmacognosy), University of Rhode Island, 1966
Ph.D. Pharmaceutical Sciences (Pharmacognosy), University of Rhode Island, 1969

Professional background:
Science Advisor, US Food and Drug Administration, NY Field Office, Brooklyn, NY, 1979-1988
Teaching consultant, Harlem Hospital, M.S. program in nursing, New York, NY, 1988-1994

Areas of expertise:
Drug analysis. phytochemistry, pharmacology and toxicology of natural products

Courses taught:
Medicinal chemistry, biochemistry, nutraceutics, immunology, infectious diseases

---

Presentation
Working with George
Wednesday, October 2, 2019, 4:15-4:25 p.m.

Michael Levy, M.Sc., M.B.A.
Vice President, Research & Innovation
USP
Rockville, MD

Michael Levy is Vice President, Head of USP's Quality Institute, and Head of Research & Innovation. The Quality Institute focuses on generating a rigorous evidence base for global discussions on public and regulatory policy reforms to advance quality of medicines. The Institute strives to improve public health outcomes and provide the rationale for investments in quality.

Research & Innovation is the scientific team responsible for the identification, assessment, and as appropriate, incubation of emerging technologies and capabilities relevant to USP's standard-setting processes and allied programs.

Mr. Levy's diverse background includes shaping public policy through advocacy, counseling biopharmaceutical and healthcare regulatory executives and staff as a management consultant, and providing deep scientific and technical expertise to academic and industry researchers. He previously served as Deputy Vice President, Science & Regulatory Advocacy, at the Pharmaceutical Research and Manufacturers of America (PhRMA), where he shaped the drug development and regulatory review processes—with an emphasis on using non-traditional data and advanced analytics to inform clinical trial design and regulatory decision making. Mr. Levy also served as an Associate Principal at McKinsey & Company, where he supported biopharmaceutical companies and regulators on a broad set of topics in Research and Development and technology enablement. Earlier in his career, Mr. Levy was part of the team that sequenced Human Chromosome XIV as part of the Human Genome Project, and was lead bioinformatician in a bioinformatics start-up.

Mr. Levy earned his Masters of Business Administration Degree from Cornell University's Johnson Graduate School of Management, and his Master of Science and Bachelor of Science degrees from Concordia University in Montreal, Canada.

Presentation
USP George Hanna Award qNMR Award Announcements
Wednesday, October 2, 2019, 4:35-4:45 p.m.

Yang Liu
Science Fellow, Research & Innovation
USP
Rockville, MD

Yang Liu received the Ph.D. degree (Pharmacognosy) from University of Illinois at Chicago, College of Pharmacy, where he worked with Professor Guido Pauli, and studied quantitative NMR, countercurrent chromatography, and eutectic phenomenon in natural products.
Yang Liu is experienced in NMR applications, including identification and quantification of natural products, synthetic APIs, and natural/synthetic polymers. As the USP Global Fellow in 2017, he has worked on a project about reference standard determinations using qNMR and development of NMR digitization in Prof. Pauli's laboratory. In 2018, he transited the project to the USP Rockville campus, and was honored to accept a USP qNMR Fellow position.

Presentation
Updates and Future Vision of qNMR at U.S. Pharmacopeia
Thursday, October 3, 2019, 1:45-2:00 p.m.

- Introduction of U.S. Pharmacopeia
- Quantitative NMR value in U.S. Pharmacopeia scope
- Quantitative NMR in the World pharmacopoeias
- Needs of updating (quantitative) NMR related documents
- Pharmacopeial vision for quantitative NMR

Gustavo Martos
Organic Programme
The International Bureau of Weights and Measures (BIPM)
Sèvres, France

Gustavo Martos graduated in Biochemistry in 2007 in the University of Granada and completed his PhD in 2012 on protein allergens, work that resulted from collaboration between the Spanish Research Council and the Mount Sinai School of Medicine (NY, USA). Interested in high-order clinical measurements, he moved to the Institute for Reference Materials and Measurements of the European Commission where he worked on the production of reference materials for antibody measurements standardization. In 2015 he undertook a position at the French National Metrology Institute (LNE) to work on the development of reference methods based on isotope dilution mass spectrometry for the characterization and quantification of protein and peptide standards. Dr Martos joined the International Bureau of Weights and Measures (BIPM) in 2017 as analytical scientist, where he has further developed his interest in high accuracy measurements, mainly applied to the purity determination of large and small organic compound materials by NMR and mass spectrometry. At the BIPM, he contributes to research programs and key comparisons aimed at supporting National Measurement Institutes (NMIs) in demonstrating world-wide equivalence of chemical measurements.

Presentation
Universal Calibrator Suite for the Widespread Application of qNMR in Analytical Laboratories
Thursday, October 3, 2019, 8:50-9:25 a.m.

- National Measurement Institutes (NMIs) are increasingly incorporating qNMR as a primary ratio reference measurement procedure for the main component content assignment of organic materials.
- The BIPM and AIST/NMIJ are undertaking a joint research program to support NMI activities in this area.
- Seven compounds that, if appropriately characterized for an intended use as Certified Reference Materials, could serve as internal standard reference materials (ISRMs) for use in 1H qNMR have been identified and are proposed to constitute a comprehensive toolbox to support the purity determination of a broad range of organic compound reference materials by 1H qNMR.
- The main experimental parameters influencing 1H qNMR results have been studied for selected analyte/IS combinations, particularly those parameters that influence the integral ratio. Optimized conditions have been established for accurate 1H qNMR that produce results having relative measurement uncertainties at the level of 0.1% in suitable cases.
- A series of validation studies have been undertaken that demonstrate the consistency of purity assignments performed with various combinations of the seven ISRMs in four deuterated solvents.
- Guidelines for the use of each of the individual ISRMs are now available for open-access download at the BIPM website. They include recommendations for best practice in their use, worked examples of their application and description of any limitations associated with their use in specific solvents including any potential for interferences or bias.

Toru Miura
Research Chemist
FUJIFILM Wako Pure Chemical Corporation
Saitama, Japan

Presentation
General Rules for Quantitative Nuclear Magnetic Resonance Spectroscopy (JIS K 0138:2018)
Thursday, October 3, 2019, 1:00-1:20 p.m.

Joo-Wan Nam, Ph.D.
Assistant Professor
College of Pharmacy, Yeungnam University
Gyeongsan-si, Gyeongsangbuk-do, Korea

EDUCATION

3/2001-2/2005	B.S., Pharmacy, Ewha Womans University, Seoul, Republic of Korea
3/2005-2/2007	M.S., Pharmacognosy, Ewha Womans University, Seoul, Korea Thesis Advisor: Prof. Eun-Kyoung (Yuny) Seo Dissertation Title: Constituents of Two Indonesian Gingers, *Alpinia galanga* and *Curcuma heyneana*
9/2007-8/2011	Ph.D., Pharmacognosy, Ewha Womans University, Seoul, Korea Thesis Advisor: Prof. Eun-Kyoung (Yuny) Seo Dissertation Title: New Diarylheptanoids from the Seeds of *Alpinia katsumadai* with Heat Shock Protein Modulation Activity

PROFESSIONAL EXPERIENCE

9/2011-12/2012	Post-Doctoral Research Associate Pharmacognosy (Advisor: Prof. Eun-Kyoung (Yuny) Seo) College of Pharmacy, Ewha Womans University, Seoul, Korea
1/2013-2/2016	Post-Doctoral Research Associate Department of Medicinal Chemistry and Pharmacognosy (Advisor: Prof. Guido F. Pauli) College of Pharmacy, University of Illinois at Chicago, USA
3/2016-Present	Assistant Professor College of Pharmacy, Yeungnam University, Gyeongsan-si, Gyeongsangbuk-do, Korea Adjunct Research Assistant Professor College of Pharmacy, University of Illinois at Chicago, USA

Presentation
Peak Purity in qNMR: Towards Solving the Challenge of Chronically Impure Proanthocyanidins Signals
Wednesday, October 2, 2019, 1:40-2:00 p.m.

- The qualitative and quantitative analysis of proanthocyanidins (PACs)-rich articles still relies heavily on chemical assays and has limitations in sensitivity and specificity.
- To overcome the limitations of chemical analysis of PACs using chromatography, qNMR has been proposed as an alternative.
- However, due to the structural complexity of PACs, there are many inherent obstacles (e.g. signal overlapping, atropisomerism, near identical spectra) in interpreting NMR spectra of them.
- Quantum Mechanical-^{1}H iterative Full Spin Analysis (HiFSA), low-temperature NMR, qCNMR OPACs can be applied to characterize and quantify OPACs.

José Napolitano, Ph.D.
Senior Scientist II, Structural Chemistry
Discovery Platform Technologies (DPT)
AbbVie Inc.
Chicago, IL

José Napolitano is a senior scientist and NMR spectroscopist at AbbVie in North Chicago, IL. He received his B.Sc. degree in chemistry on 2004 (Universidad Simón Bolívar, Venezuela), and completed his Ph.D. studies in chemistry and chemical engineering on 2010 (Universidad de La Laguna, Spain). Shortly after, he joined Dr. Guido Pauli's research group at University of Illinois at Chicago as a postdoc. In 2013, he joined AbbVie's Global Pharmaceutical Research & Development (GPRD) organization. As part of the structural chemistry team, he provides advance spectroscopic support to synthetic, analytical, and process chemists and engineers involved in drug discovery, development, and manufacturing activities. His research interests include the development of NMR-based analytical methods, as well as the application of computational and spectroscopic approaches to solve complex structural and stereochemical problems.

Moderator:

Morning Session II – qNMR Methodology
Wednesday, October 2, 2019, 11:00-12:00 p.m.

Afternoon *Session II – qNMR Application*
Wednesday, October 2, 2019, 1:00-2:30 p.m.

Morning Session II – Selected Abstracts
Thursday, October 3, 2019, 10:30-12:00 p.m.

Afternoon *Session I – qNMR and Regulations*
Thursday, October 3, 2019, 1:00-2:00 p.m.

Matthias Niemitz
CEO
NMR Solutions Ltd.
Kuopio, Finland

Experience: > 20 years in quantum mechanical NMR spectral analysis including qNMR
Current Position: President at NMR Solutions

Presentation
The Five Most Well-Known Secrets of Quantitation by NMR
Wednesday, October 2, 2019, 11:15 a.m.-12:00 p.m.

Every qNMR practitioner is aware of the best kept secrets of qNMR. While they might be perceived as raising tough questions, this presentation points out the undeniable facts behind them and explains why and how they hold the key for the further qNMR development. The five most well-known qNMR secrets are:

● **Secret #1:** We quantify NMR signals/resonances/peaks as if they represent the target analyte - knowing that the purity of a single NMR resonance is essentially unknown.

● **Secret #2:** We know that NMR is one of the very few analytical methods with a well-established quantum theory foundation - but we do not use it for (q)NMR.

● **Secret #3:** We are well aware that chemical shifts and coupling constants are field independent, under given conditions - but we fail to utilize these natural constants for the benefit of qNMR analysis.

● **Secret #4:** We realize that integration has major theoretical limitations and practical challenges but it is still our workhorse of NMR quantitation.

● **Secret #5** : Knowing that deconvolution is unaware of even basic NMR rules, we still use it trying to match NMR reality/spectra - while QM tools exist that can handle even the most severe overlap and higher order resonances with full NMR-awareness.
Considering these well-known secrets, the best-kept qNMR secret seems to be that current state-of-the-art tools exist that *do* make use of QM methods in qNMR *practical* by providing software algorithms that take full advantage of contemporary computational power.

Yuzo Nishizaki, Ph.D.
Researcher
Division of Food Additives, NIHS
Tokyo, Japan

Dr. Yuzo Nishizaki obtained his Ph.D. from Tokyo University of Agriculture and Technology (TUAT) in 2014 with Professor Y. Ozeki. His main focus was elucidation of biosynthesis of secondary metabolites, exemplified by a polyacylated anthocyanin. Dr. Nishizaki joined Division of Food Additives in National Institute of Health Sciences (NIHS) as a researcher in 2014. His research is focused on the analysis and identification of constituents in natural food additives and the development and improvement of official analytical methodology for regulatory science applications. From 2018 to 2019, he joined Professor Pauli's laboratory at the University of Illinois at Chicago (UIC).

Presentation
External Standardization in qNMR
Wednesday, October 2, 2019, 10:00-10:30 a.m.

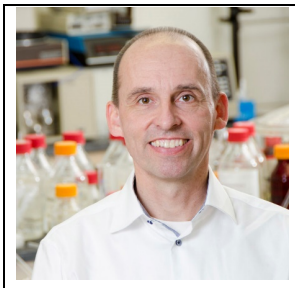
- External calibration quantitative NMR based on the principle of reciprocity
- Optimization of automatic 90° pulse width calibration
- Extracting the factors that relate to accuracy and precision in quantitative values
- Providing guidelines for the implementation of EC-qHNMR methodology
- The EC-qHNMR with my setting has only 1% error

Markus Obkircher
Head of Reference Materials and Proficiency Testing
Director, R&D MilliporeSigma
Sankt Gallen, Switzerland

Markus Obkircher is the head of Merck's Reference Materials Research & Development division with teams in the US and Switzerland. He is responsible for the in-house development of new analytical standards and certified reference materials. Prior to this position he was R&D Manager in Buchs, Switzerland, with a strong focus on synthesis, characterization and certification of reference materials. He joined Merck / Sigma-Aldrich five years ago after heading the development unit for a custom API manufacturer. Before that he completed his post-doctoral studies at Harvard in Boston and his PhD thesis in Basel, Switzerland.

Presentation
Proficiency Testing to Improve your qNMR Laboratory Performance
Thursday, October 3, 2019, 10:30-11:05 a.m.

- Certified Reference Materials (CRM)
- Proficiency Testing and inter-laboratory comparison studies
- qNMR scheme on PT platform (ISO 17043)
- ^{1}H, ^{31}P and ^{19}F qNMR
- Performance assessment of laboratories
- Z scores, Hampel



Guido F. Pauli, Dr. rer. nat., FAPA
Director, Center for Natural Products Research (CENAPT)
Professor, University of Illinois at Chicago College of Pharmacy
Chicago, IL

Trained as a pharmacist with specialization in pharmaceutical analysis, Dr. Pauli holds a doctoral degree (Dr. rer. nat.) in pharmacognosy. He is currently the Norman R. Farnsworth Professor of Pharmacognosy, Director of the Program for Collaborative Research in the Pharmaceutical Sciences (PCRPS), and Associate Director of the Institute for Tuberculosis Research (ITR) at the University of Illinois at Chicago College of Pharmacy. His basic and translational research project involve bioactive natural products (NPs) from diverse sources, particularly plants and actinomycetes, NP technologies (CENAPT), dietary supplements (Botanical Center), clinical and dental intervention materials, drug discovery, the NAPRALERT database, and institutional training programs. Main research interests encompass the metabolomic analysis of natural health products, botanicals, anti-TB hit-to-lead development, dental biomodifiers, and pharmaceutical analysis. He has expertise in the development of analytical methods and innovative approaches, including quantitative NMR and countercurrent separation. Dr. Pauli seeks to address challenges posed by nature's metabolomic variation and enhance the understanding of natural products as health products and sources of new drugs. His academic track record includes mentoring of 18 Ph.D. students, 21 postdocs, 17 visiting scientists, and international collaborations worldwide. His 210+ peer-reviewed publications are associated with an h-index of 45 (Scopus).

Presentations

Introduction: qNMR Advancements and Persisters
Wednesday, October 2, 2019, 8:50-9:00 a.m.

The Five Most Well-Known Secrets of Quantitation by NMR
Wednesday, October 2, 2019, 11:15 a.m.-12:00 p.m.

Every qNMR practitioner is aware of the best kept secrets of qNMR. While they might be perceived as raising tough questions, this presentation points out the undeniable facts behind them and explains why and how they hold the key for the further qNMR development. The five most well-known qNMR secrets are:

- **Secret #1:** We quantify NMR signals/resonances/peaks as if they represent the target analyte - knowing that the purity of a single NMR resonance is essentially unknown.

- **Secret #2:** We know that NMR is one of the very few analytical methods with a well-established quantum theory foundation - but we do not use it for (q)NMR.

- **Secret #3:** We are well aware that chemical shifts and coupling constants are field independent, under given conditions - but we fail to utilize these natural constants for the benefit of qNMR analysis.

- **Secret #4:** We realize that integration has major theoretical limitations and practical challenges but it is still our workhorse of NMR quantitation.

- **Secret #5** : Knowing that deconvolution is unaware of even basic NMR rules, we still use it trying to match NMR reality/spectra - while QM tools exist that can handle even the most severe overlap and higher order resonances with full NMR-awareness.

Considering these well-known secrets, the best-kept qNMR secret seems to be that current state-of-the-art tools exist that *do* make use of QM methods in qNMR *practical* by providing software algorithms that take full advantage of contemporary computational power.

The Pioneering qNMR Work of George M. Hanna at FDA
Wednesday, October 2, 2019, 4:00-4:15 p.m.

The work of the late George Hanna at the FDA laboratories in the New York Regional Laboratory in Brooklyn spanned the years 1984-2006. He focused on the quality control of pharmaceutical preparations.

- Dr. Hanna pioneered the use of NMR for quantitation using 90 MHz NMR equipment for most of his work, thereby showing that "low-field" qNMR is feasible.
- Until the early 2000s, he was the only scientist publishing regularly on qNMR. His first 1988 article described the qNMR quantitation of dicyclomine in commercial tablets.
- In the following years, he extended qNMR to purity determination, the analysis of mixtures, and enantiomeric purity. He continued these developments throughout an 400 MHz instrument upgrade in 1999 and contribute to the scientific literature until 2006.

Dr. Hanna's work also shows that the development of qNMR fell behind the general progress made with NMR instrumentation, although he had already demonstrated that the method is fully operable with even the most basic NMR equipment.

Moderator:

Morning Session I – qNMR Methodology
Wednesday, October 2, 2019, 9:00-10:30 a.m.

Afternoon *Session I – qNMR Application*
Wednesday, October 2, 2019, 3:00-4:00 p.m.

Afternoon *Session III – qNMR Pioneers*
Wednesday, October 2, 2019, 4:00-4:45 p.m.

Morning Session I – Invited Talks
Thursday, October 3, 2019, 8:30-10:00 a.m.

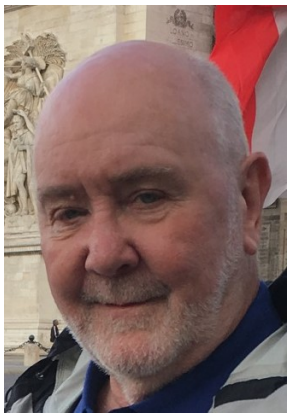
Afternoon *Session II – qNMR and the Future of Measurement*
Thursday, October 3, 2019, 2:30-5:00 p.m.

Rasika Phansalkar, B.Pharm., Ph.D.
Scientist I, Technical Development
Biogen, Inc.
Chicago, IL

Dr. Phansalkar received B.Pharm. from the University of Mumbai, India. In 2011 she joined Dr. Guido Pauli's lab at UIC and received Ph.D. in Pharmacognosy in 2017. Her doctoral research was focused on qNMR method development for multi-target standardization of botanical extracts and development of proanthocyanidins-based dental biomaterials. During the post-doctoral studies in 2017-2018 at the UIC Institute of Tuberculosis Research under the leadership of Dr. Scott Franzblau, Dr. Phansalkar investigated large-scale fermentation of actinomycetes using LC-MS based metabolomic profiling, as well as conducted method development for preparative isolation of anti-TB active cyclic peptide ecumicin. Dr. Phansalkar is currently a Scientist I at Biogen, Inc.; she is part of the analytical development team focused on LC-MS and NMR method development for small-molecule pharmaceuticals and anti-sense oligonucleotides (ASOs) as candidates for neurodegenerative disorders therapy.

Presentation
qNMR in the Analysis of Anti-Sense Oligonucleotides (ASOs)
Wednesday, October 2, 2019, 1:20-1:40 p.m.

- Anti-sense oligonucleotides (ASOs) are investigated as new therapies for neurodegenerative disorders.
- Similarly to peptides, ~ 20 mer ASOs are synthesized on a solid phase support in 3' to 5' direction with the base sequence complementary to the target mRNA
- Synthetic modifications are such as alkylation of the sugar moiety /base and replacement of phosphodiester (P=O) linkage with phosphorothioate linkage (P=S) improve potency, nuclease stability and reduce immunogenicity.
- Presence of a phosphorothioate linkage introduces a phosphorus chiral center. Several chiral phosphorus atoms can yield thousands of diastereomers leading to a high chemical complexity and therefore complex NMR spectra.
- A distinct group of NMR resonances belonging to the anomeric ribose protons are well resolved from other signals which can be leveraged for qHNMR giving the first opportunity in the complexity!
- In the event of spectral overlap from the impurities, the second opportunity in addressing complexity is ^{31}P qNMR.
- An example of total oligo purity determination using ^{31}P qNMR and triphenyl phosphate as an internal calibrant will be discussed. Additionally, P=O to P=S ratio of an ASO can be accurately determined using ^{31}P NMR.



Joseph Ray, Ph.D.
Adjunct Professor
University of Illinois at Chicago College of Pharmacy
Chicago, IL

Dr. Joe Ray received his BS in Chemistry from Loyola University of Maryland in 1964, his PhD from Carnegie-Melon University in organic chemistry in 1968, and, after a post-doctoral position at The Ohio State University, joined the Amoco NMR lab in 1970. After 29 years and many name changes, when Amoco became British Petroleum, Joe took early retirement in 1999. In 2000, Joe joined the NMR group at Baxter Healthcare where he served as the Senior Subject Matter Expert until 2019. In early 2019, Dr. Ray took a position at the University of Illinois at Chicago College of Pharmacy. During his career, Joe has used multinuclear, multidimensional, high-resolution and solid-state NMR to characterize petroleum, polymers, catalysts, other organics and, most recently, biologically important systems. Emphasis was on the quantitative and qualitative analysis of gases, liquids and solids. Both 1D and 2D techniques have been developed and used to solve structure - property relationships for diverse business groups.

Presentation
Sodium NMR – An Exercise in Industrial Validation
Wednesday, October 2, 2019, 3:40-4:00 p.m.

- Quantitative ^{23}Na NMR of sodium solutions was obtained using benchtop spectrometers
- Sodium levels in saline and renal solutions were determined
- A simpler method with less potential for sample preparation errors than the traditional ones was developed
- Results were better than those obtained by mainstay ion analysis techniques: potentiometric titration and flame photometry
- Commercial software, eNoval, was used to establish an Analytical Target Profile
- A validated method was established for sodium levels at 2% with a 95% confidence level

Tucker Rubino
Lab Weighing Market Manager
Mettler-Toledo
Columbus, OH

Tucker joined METTLER TOLEDO in 2016. He has an extensive background in Forensic and Synthetic Chemistry. Upon graduating with a Chemistry and Psychology degree, Tucker worked for Cayman Chemical Company developing and synthesizing emerging street drugs for use as analytical standards. Following that, he spent many years working as a Forensic Scientist for the Columbus Police Department in the Drug Chemistry Section. He has practical experience performing drug analysis, testifying, and complying with ISO17025 standards, especially in the realm of electronic transfer of results. In his current role at METTLER TOLEDO, Tucker is responsible for the Business Strategy, Marketing, Product, and Training for the Laboratory Weighing Business.

Presentation
Solutions for Automated Data Integrity and Integration
Wednesday, October 2, 2019, 9:30-10:00 a.m.

- This presentation will discuss the criteria for data integrity based on recent guidance issued by various regulatory agencies
- It will provide practical solutions to improve data management processes
- Address data integrity weaknesses typically found in a laboratory
- Discuss the parameters of ALCOA+
- Display how the efficiency gain and data quality can justify the integration effort quickly

Takeshi Saito
Chief Senior Researcher
NMIJ/AIST
Tokyo, Japan

In the last two decades, Dr. Takeshi Saito has been engaged in development of nuclear magnetic resonance methodology as a quantitative tool for organic materials' analysis. He proposed a new metrological traceability scheme using qNMR in a production of organic reference materials. He is also involved in development of Spectral Data Base System (SDBS) at NMIJ/AIST (https://sdbs.db.aist.go.jp).

Presentation
Progress in Proposal of an ISO Standard for Purity Assessment by qNMR
Thursday, October 3, 2019, 1:20-1:45 p.m.

- An international standard for quantitative nuclear magnetic resonance is proposed
- The ballot for the proposal will be closed on 2019-10-01
- We anticipate the ballot to be approved
- Brief background for this topic will be presented

Dan Sorensen, Ph.D.
Analytical Team Leader
Eurofins CDMO | Alphora Research Inc.
Mississauga, ON

Dr. Sorensen graduated in 2002 from University of Copenhagen, Denmark, with a PhD in natural products chemistry. The same year, he moved to Montréal, Québec, Canada, to join Ecopia Biosciences Inc. as a Research Scientist and continue work on the discovery of novel natural products for treatment of infectious diseases and cancer. In 2004, he joined the Merck Frosst Centre for Therapeutic Research as a Senior Research Scientist to focus on structural characterization of drug metabolites and other support of medicinal chemistry programs a well as management of the NMR facility. After the closure of Merck Frosst at the end of 2010, he relocated to McMaster University in Hamilton, Ontario, as an NMR Application Specialist with special responsibilities for external contract research work. In an additional interim role as Quality Manager, he led the design and implementation of a Quality Management System and two successful Health Canada audits that enabled the McMaster NMR facility to achieve GMP compliance and obtain/maintain a Drug Establishment Licence for testing of APIs. In 2017, he moved to Eurofins CDMO | Alphora Research Inc. in Mississauga, Ontario, where he is currently an Analytical Team Leader and NMR Specialist and is working to design, develop, qualify and improve analytical methods for development and manufacture of drug substances.

Presentation
qNMR in a Contract Development and Manufacturing Organization
Thursday, October 3, 2019, 2:30-3:00 p.m.

- Implementation of qNMR for development and manufacture of drug substances (API)
- Highlight of applications of qNMR throughout the drug development process
- The valuable advantage of qNMR accuracy, power and speed
- Obstacles to the use of qNMR as a universal method
- Regulatory expectations of qualified instruments and procedures

Aaron Urbas, Ph.D.
Research Chemist, Chemical Sciences Division
NIST
Gaithersburg, MD

Aaron Urbas is a research chemist in the Chemical Sciences Division at the National Institute of Standards and Technology. He received his PhD in Analytical Chemistry from the University of Kentucky and has been at NIST since 2007. He is currently involved in the development of applications and reference materials for vibrational and nuclear magnetic resonance spectroscopies. His past research efforts are in a diversity of areas including forensics, polymers and metabolomics.

Presentation
Improving Comparability in Organic Chemical Measurement: qNMR at NIST
Wednesday, October 2, 2019, 3:20-3:40 p.m.