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BIOGRAPHICAL SKETCH

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NAME: Juchem, Christoph

eRA COMMONS USER NAME (credential, e.g., agency login): CJUCHEM

POSITION TITLE: Professor of MR Physics, Medical University of Vienna, Austria

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Bonn, Germany		1995-1997	Physics
University of Madrid, Spain		1997-1998	Physics
University of Bonn, Germany	M.Sc.	1998-2001	Physics
Max-Planck Institute for Biological Cybernetics, Tübingen, Germany	Ph.D.	2001-2006	MR Physics / Neuroscience
Yale University, New Haven, CT, USA	PostDoc	2007-2008	MR Physics / MR Spectroscopy

A. Personal Statement

I am a Professor at the Center for Medical Physics and Biomedical Engineering at the Medical University of Vienna, Austria. In my research, I develop novel magnetic resonance methods and technology to establish optimized tools for neuroscientific and clinical applications. My long-term goal as a physicist is to realize the full potential of magnetic resonance spectroscopy (MRS) as a diagnostic tool. My clinical long-term goal is to understand the role that neurochemicals play in the protection of the human central nervous system (CNS) or, alternatively, how dysfunction promotes vulnerability towards neurodegenerative and -immunological diseases.

Reliable quantification of biochemicals with *in vivo* MRS relies on excellent spectral data quality, processing and quantification capability. In my research, I have optimized critical aspects of the measurement pipeline including experimental conditions (e.g. B0 shimming), MRS sequences (e.g. ‘ghost’ removal) and quantification (e.g. simulation of realistic basis spectra for linear combination modeling). I furthermore developed and disseminated the freeware INSPECTOR user-tool as a one-stop-shop solution for processing, quantification and quality assessment of *in vivo* MRS data (350+ downloads since 2017).

I have 20+ years of experience in developing and conducting *in vivo* MR experiments at 3.0-11.7 Tesla field in humans and animal models and have demonstrated my scientific expertise in 70+ publications, book chapters and patents, as a reviewer for 25 scientific journals and as a grant reviewer for 10 national research societies. I served as Co-Director of Yale's 7T Brain MR Spectroscopy Core, was elected Chair of the ISMRM Engineering and MR Spectroscopy Study Groups, and a member of the *NMR in Biomedicine*’s editorial board.

1. Landheer, K., Swanberg, K.M., **Juchem, C.** (2021). Magnetic resonance spectrum simulator (MARSS), a novel software package for fast and computationally efficient basis set simulation, *NMR Biomed.* 34:e4129. PMID: 3131877 (<u>*Cover Image of Special Issue*</u>)
2. Landheer, K., **Juchem, C.** (2021). Are Cramer-Rao lower bounds an accurate estimate for standard deviations in in vivo magnetic resonance spectroscopy? *NMR Biomed.* 34:e4129. PMID: 33876459 (<u>*Cover Image*</u>)

3. Landheer, K., Gajdosik, M, Treacy, M, **Juchem, C.** (2020). Concentration and effective T2 relaxation times of macromolecules at 3T, *Magn. Reson. Med.* 84:2327-2337. PMID: 32430924 (*Editor's Pick*)
4. **Juchem, C**., Theilenberg, S, Kumaragamage, C., Mullen, M., DelaBarre, L., Adriany, G., Brown, P.B., McIntyre, S., Nixon, T.W., Garwood, M., de Graaf, R.A. (2020). Dynamic Multi-Coil Technique (DYNAMITE) MRI on human brain. *Magn Reson Med* 84:2953-2963. PMCID: PMC8168279 (*Editor's Pick*)

B. Positions and Honors

Positions and Employment

2024-Present	**Professor (Tenure) & Chair, Division of Magnetic Resonance Physics**, Center for Medical Physics and Biomedical Engineering, **Medical University of Vienna**, Austria
2024-Present	Co-Director & Natural Scientific Lead, High-Field Magnetic Resonance Center (HFMRC), Medical University of Vienna, Austria
2023-2024	**Associate Professor (Tenure)**, Biomedical Engineering & Radiology, **Columbia University**
2019-2024	Affiliate Member, Zuckerman Mind Brain Behavior Institute (ZMBBI), Columbia University
2018-2022	Adjunct Faculty, Icahn School of Medicine at Mount Sinai (ISMMS), New York
2017	Visiting Professor, Comprehensive Heart Failure Center, University Hospital Würzburg, Germany
2016-2023	**Associate Professor (Tenure Track)**, Biomed. Engineering & Radiology, **Columbia University**
2012-2016	**Assistant Professor (Tenure Track)**, Departments of Radiology & Neurology, **Yale University**
2010-2016	System manager human 7 Tesla MR scanner, Yale MRRC, Dept. Diagnostic Radiology
2010-2016	Co-director of the 7 Tesla brain MR spectroscopy core at Yale MRRC, Dept. Diagn. Radiology
2008-2011	Associate Research Scientist, Yale MR Research Center, Dept. Diagnostic Radiology
2007-2008	Postdoctoral Associate, Yale MR Research Center, Dept. Diagnostic Radiology
2002-2006	Doctoral Studies, Max-Planck Institute for Biological Cybernetics and Eberhard-Karls University of Tübingen, Tübingen, Germany
1997-1998	Studies of Physics, Universidad Autónoma de Madrid, Spain
1995-2001	Studies of Physics, Rheinische Friedrich-Wilhelms University of Bonn, Germany

Other Experience and Professional Memberships

2016-2019	Member, ISMRM Annual Meeting Program Committee (AMPC)
2016-Present	Member, Institute of Electrical and Electronics Engineers (IEEE)
2014-2015	Member, Workshop and Study Group Review Committee, ISMRM
2008-Present	Member, MR Engineering Study Group, ISMRM
2007-Present	Member, German Physical Society (DPG)
2004-Present	Member, International Society for Magnetic Resonance in Medicine (ISMRM)
2002-Present	Member, DS-ISMRM (German Section of the ISMRM)

Journal Reviewer: 1) European Journal of Neuroscience, 2) Magnetic Resonance in Medicine, 3) Journal of Magnetic Resonance, 4) Nuclear Magnetic Resonance in Biomedicine, 5) Concepts in Magnetic Resonance A, 6) Biological Psychiatry, 7) Neurobiology of Aging, 8) Analytical Biochemistry, 9) Public Library of Science, 10) Magnetic Resonance Materials in Physics, Biology and Medicine, 11) IEEE Transactions on Biomedical Engineering, 12) IEEE Transactions on Applied Superconductivity, 13) Nature Biomedical Engineering, 14) Human Brain Mapping, 15) NeuroImage: Clinical, 16) Magnetic Resonance Imaging, 17) Applied Magnetic Resonance, 18) Tomography, 19) Journal of MR Imaging, 20) Medical Physics, 21) Multiple Sclerosis Journal, 22) Neuropsychopharmacology, 23) Scientific Reports, 24) NeuroImage, 25) Neurology

Editorial Board: 1) NMR in Biomedicine (2018 – 2022)

Grant Reviewer: 1) Dutch National Research Society (NWO), 2) Dutch Technology Foundation (STW), 3) Research Foundation Flanders (FWO), 4) National Multiple Sclerosis Society (NMSS) / USA, 5) Multiple Sclerosis Society / United Kingdom, 6) Swiss National Science Foundation (SNF), 7) Israel Science Foundation (ISF), 8) German Science Foundation (DFG), 9) Natural Sciences and Engineering Research Council (NSERC) of Canada, 10) National Institutes of Health (NIH, Ad hoc: EITN, SBIB-T, ITD, IGIS, BRAIN, Charter: IGIS)

Honors

2023-2024	Elected **Chair, MR Spectroscopy Study Group, ISMRM**
2014-2018	Distinguished Reviewer (5x), Magnetic Resonance in Medicine (MRM)
2014-2015	Elected **Chair, MR Engineering Study Group, ISMRM**
2013	Clinical and Translational Science Award (CTSA), Yale Center for Clinical Investigation (YCCI)
2011	**I.I. Rabi Young Investigator Award finalist**, ISMRM Annual Meeting, Montreal, Canada
2011	Stipend of the German Scholars Organization (GSO)
2010	1st place, Poster Award in Engineering Category, ISMRM Annual Meeting, Stockholm, Sweden
2007-2008	J.H. Brown & A. Brown Coxe postdoctoral fellowship in the medical sciences, Yale University
2006	Doctoral stipend of the Max-Planck Society
2004-06	3 ISMRM educational stipends, Annual Meetings: Kyoto/Japan, Miami Beach/FL, Seattle/WA
1997-1998	Erasmus Exchange Fellowship of the European Union

C. Contribution to Science

1. **Optimized experimental conditions and methods for clinical MR spectroscopy.**
   The best experimental conditions and MRS methods are a necessity for excellent spectral quality and meaningful biochemical profiling with MRS - not a choice. In my research, I developed innovative B_0 shimming techniques tailored to MRS applications in the animal and human brain. My lab was the first to show that spectra free of 'ghosting' artifacts can be predictably obtained for virtually any experiment type with numerically optimized suppression of unwanted coherence pathways without the need for experimental (trial-and-error) optimization. To the best of our knowledge, we were the first to demonstrate the benefits of the MEGA semi-LASER sequence for J-difference editing of the antioxidant glutathione (GSH) in the human brain at 7T. Taken together, the experimental and methodological work of my laboratory set the stage for high-level metabolic studies in clinical populations.
   a. Landheer, K., Gajdosik, M, **Juchem, C.** (2020). A semi-LASER, single-voxel spectroscopic sequence with a minimal echo time of 20.1 ms in the human brain at 3 T, *NMR Biomed.* 33:e4324. PMID: 32557880
   b. **Juchem, C.**, Cudalbu, C., de Graaf, R.A., Gruetter, R., Henning, A., Hetherington, H.P., Boer, V.O. (2020). B0 shimming for in vivo magnetic resonance spectroscopy: Experts' consensus recommendations. *NMR Biomed.* 34:e4350. PMID: 32596978
   c. Landheer, K., **Juchem, C.** (2019). Dephasing optimization through coherence order pathway selection (DOTCOPS) for improved crusher schemes in MR spectroscopy, *Magn. Reson. Med.* 81:2209-2222. PMID: 30390346
   d. Prinsen, H., de Graaf, R.A., Mason, G.F., Pelletier, D., **Juchem, C.** (2017). Towards Pathoneurochemical profiling of multiple sclerosis: Single-session measurement of glutathione, GABA and glutamate with MR spectroscopy at 7 Tesla, *J Magn. Reson. Imaging* 45:187-198. PMCID: PMC5167659
   e. **Juchem, C.**, Logothetis, N.K., Pfeuffer, J. (2007). 1H-MRS of the macaque monkey primary visual cortex at 7T: Strategies and pitfalls of shimming at the brain surface. *Magn Reson Imag*. 26:902-12. PMDI: 17467220

2. **Dynamic Shimming with Spherical Harmonic Shapes**
   Inhomogeneous B_0 magnetic fields cause spatial distortions and signal dropout in MRI. To date, limited B_0 homogeneity is a primary reason why the expected gains of high and ultra-high field MRI have not been fully kept. Researchers at Yale and Stanford demonstrated in the mid 1990's the gains in B_0 homogeneity that can be achieved when linear correction fields are tailored to specific slices and applied in a dynamic fashion, so-called dynamic shimming (as opposed to static shimming that considers the entire region-of-interest at once). Together with my colleagues, I further pushed the limits of spherical harmonic-based B_0 shimming with the first successful implementation of zero through third order dynamic shimming with full eddy-current and offset compensation. I carried out the research under the supervision of my PI at the time Dr. Robin A. de Graaf based on amplifier technology developed by Terence W. Nixon. Even today – 10 years later – the achieved B_0 homogeneity represents the gold standard for conventional B_0 shimming in the human brain.

a. **Juchem, C.**, Nixon, T.W., Diduch, P., McIntyre, S., Rothman, D.L., Starewicz, P., & de Graaf, R.A. (2010). Dynamic shimming of the human brain at 7 Tesla, *Conc. Magn. Reson.* 37B:116-128. PMCID: PMC2907895

b. Boer, V.O., Klomp, D.W.J., **Juchem, C.**, Luijten, P.R., de Graaf, R.A. (2011) Multi-slice ^{1}H MRSI of the human brain at 7 Tesla using dynamic B_0 and B_1 shimming. *Magn. Reson. Med.* 68:662-670. PMCID: PMC3306521

3. Multi-Coil B_0 Magnetic Field Control for B_0 Shimming and MR Imaging

For more than half a century B_0 magnetic correction fields were generated by dedicated, electrical coils resembling the shapes of low-order spherical harmonic terms. Although this approach does not allow fully satisfactory B_0 homogeneity in the rodent or human brain, the exclusive use of these shapes has never been questioned. I took the lead in initiating a complete paradigm shift and, together with my colleagues, developed a new and generalized method that allows the synthesis of advanced magnetic field distributions with generic (i.e. non-orthogonal) basis fields from a set of localized coils. Multi-coil B_0 shimming provides dramatically better B_0 homogeneity in the mouse, rat and human brain than standard methods and in the future should close to completely eliminate B_0 inhomogeneity as a problem.

a. **Juchem, C.**, Theilenberg, S., Kumaragamage, C., Mullen, M., DelaBarre, L., Adriany, G., Brown, P. B., McIntyre, S., Nixon, T. W., Garwood, M., de Graaf, R.A. (2020). Dynamic multicoil technique (DYNAMITE) MRI on human brain. *Magn. Reson. Med.* 84:2953-2963. PMID: 32544274 (*Editor's Pick*)

b. Rudrapatna, U., Fluerenbrock, F., Nixon, T.W., de Graaf, R.A., **Juchem, C.** (2018). Combined imaging and shimming with the dynamic multi-coil technique. *Magn. Reson. Med.* 81:1424-1433. PMCID: PMC4120278

c. **Juchem, C.***, Rudrapatna U.*, Nixon, T.W., de Graaf, R.A. (2015). Dynamic Multi-Coil Technique (DYNAMITE) Shimming for Echo-Planar Imaging of the Human Brain at 7 Tesla. *NeuroImage.* 105:462-472. PMCID: PMC4262558

d. **Juchem, C.**, Nixon, T.W., McIntyre, S., Rothman, D.L., & de Graaf, R.A. (2010). Magnetic field modeling with a set of individual localized coils, *J. Magn. Reson.* 204:281-289. PMCID: PMC2884296

4. Dissemination of Freeware Software Packages

To date, advanced solutions for optimized experiment preparation, analysis and quantification of MR spectroscopy are limited. Such methods are at the heart of my research program and I share MR sequences, algorithms and processing software with the MR community free of charge. I expect easy access to advanced methods to further promote both research and clinical potential of MR.

a. Gajdošik M, Landheer K, **Juchem C**. Pocket MRS: Mobile application for rapid analysis of magnetic resonance spectroscopy. CTV license: CU21108 (2021). innovation.columbia.edu/technologies/CU21108_PocketMRS

b. Landheer K, **Juchem C**. Magnetic Resonance Spectrum Simulator (MARSS). CTV license: CU19205 (2019). innovation.columbia.edu/technologies/CU19215_MARSS

c. Landheer K, **Juchem C**. Dephasing optimization through coherence order pathway selection (DOTCOPS) for improved crusher and phase cycling schemes in MR spectroscopy. CTV license CU18146 (2018). innovation.columbia.edu/technologies/CU18406

d. **Juchem C**. INSPECTOR - Magnetic resonance spectroscopy software for *in vivo* biomedical and clinical research. CTV license CU17130 (2017). innovation.columbia.edu/technologies/cu17130_INSPECTOR

e. **Juchem, C**. B0DETOX: B_0 detoxification software for magnetic field shimming. CTV license CU17326 (2017), innovation.columbia.edu/technologies/CU17326_B0DETOX

Complete List of Published Work in PubMed:
https://www.ncbi.nlm.nih.gov/pubmed/?term=Christoph+Juchem