Last updated 11/2025

# Daniel Frank Gochberg

daniel.gochberg@vumc.org, 615-322-8356, https://www.vumc.org/vuiis/person/daniel-gochberg-phd

Seeking faculty or staff position.

---

## EDUCATION:

| | |
|---|---|
| 1987 – 1991 | Massachusetts Institute of Technology<br>Cambridge, MA<br>B.S. Degree in Physics<br>Thesis: Oscillations in networks of non-linear oscillators |
| 1992 – 1998 | Yale University<br>New Haven, CT<br>M.S., Ph.D. Degrees in Physics<br>Dissertation: Relaxation and magnetization transfer in biological NMR systems |
| 1998 – 2000 | Post-doctoral Research Fellow<br>Dept. of Diagnostic Radiology<br>Yale University School of Medicine |

## ACADEMIC APPOINTMENTS:

| | |
|---|---|
| 2000 – 2002 | Associate Research Scientist<br>Dept. of Diagnostic Radiology<br>Yale University School of Medicine |
| 2002 – 2012 | Assistant Professor of Radiology & Radiological Sciences<br>Assistant Professor of Physics<br>Vanderbilt University |
| 2012 – 2019 | Associate Professor of Radiology & Radiological Sciences<br>Associate Professor of Physics<br>Vanderbilt University Medical Center |
| 2019 – present | Professor of Radiology & Radiological Sciences<br>Vanderbilt University Medical Center |

## PROFESSIONAL ACTIVITIES:

### Intramural

| | |
|---|---|
| 2004 – 2010 | Steering Committee, Predoctoral Training grant, T32 EB03817, "Predoctoral Training in Biomedical Imaging" |
| 2009 – 2012 | Member, Graduate Program and Admissions Committee<br>Vanderbilt University Physics Department |
| 2011 – 2012 | Representative of the Physics Department to the Vanderbilt Graduate Faculty Delegate Assembly |

| | |
|---|---|
| 2003 – 2013 | Steering Committee, Postdoctoral Training grant, T32 EB001628, "Postdoctoral Training in Biomedical MRI and MRS" |
| 2007 – 2017 | Associate Director, Center for Small Animal Imaging, Vanderbilt University Institute of Imaging Science |
| 2017 – present | Founding Committee and Director of Graduate Studies<br>Masters in Imaging Science (MIS) program<br>Vanderbilt University Institute of Imaging Science |
| 2022 – present | Research Compliance Expert for Radiology Dept |

**Extramural**

| | |
|---|---|
| 2002 | Moderator, Contrast Mechanisms & Relaxometry, International Society for Magnetic Resonance in Medicine meeting, Honolulu, HI |
| 2006 | Poster award winner and selected speaker, International Workshop on Myelin Imaging, Vancouver, Canada |
| 2014 | Session Chair/Discussion Leader, Gordon Research Conference, In Vivo Imaging, Andover, NH, USA |
| 2017 | Organizing Committee, Music City CEST: 6th International Workshop on Chemical Exchange Saturation Transfer (Nashville, TN) |
| 2020 | Moderator, Signal Enhancement: The Power & the Glory, International Society for Magnetic Resonance in Medicine meeting |

**Grant Reviewer**

| | |
|---|---|
| 2009 | NIH (National Institute of Health), ZRG1 SBIB-V (58) |
| 2009 | CIHR (Canadian Institutes of Health Research) |
| 2010 | NSF (National Science Foundation) |
| 2013 | NIH, 2014/01 NOIT |
| 2017 | NIH, BMIT-B study section |
| 2024 | Israel Science Foundation |

**Manuscript Reviewer**

| | |
|---|---|
| Journals | Nature Medicine<br>Proceedings of the National Academy of Sciences (PNAS)<br>Magnetic Resonance in Medicine (Distinguished Reviewer)<br>Magnetic Resonance Imaging<br>Journal of Magnetic Resonance Imaging<br>Journal of Chemical Physics<br>Journal of Magnetic Resonance<br>Journal of Neuroscience Research<br>Physica B<br>Contrast Media & Molecular Imaging<br>NeuroImage<br>PlosOne<br>Bone<br>Medical Physics<br>Scientific Reports |

**Awards**

| | |
|---|---|
| April 2017 | Outstanding Teacher Award (highest quality score, based on course evaluations)<br>CEST Imaging<br>ISMRM 25th Annual Meeting, Honolulu |
| June 2018 | Outstanding Teacher Award (highest quality score, based on course evaluations)<br>Probing Biomolecules: Magnetic Susceptibility & CEST/MT<br>ISMRM 26th Annual Meeting, Paris |

## TEACHING ACTIVITIES:

**Graduate School Courses:**

| | |
|---|---|
| 1992 – 1994 | Yale University<br>Section Instructor, Physics P165, undergraduate Physics lab |
| Spring 2002 | Yale University<br>Co-instructor, Applied Physics 110b, Perspectives on Technology<br>8 lectures |
| Spring 2003 | Vanderbilt University<br>Instructor, Graduate seminar in NMR spectroscopy methods<br>Developed and organized course<br>11 lectures |
| Summer 2003 | Vanderbilt University<br>Instructor, BME-395, Magnetic Resonance Imaging Summer Course<br>Developed and organized course<br>12 lectures |
| Spring 2006 | Vanderbilt University<br>lecture, Phys-325-1, Physical Measurements of Biological Systems |
| Spring 2007 | Vanderbilt University<br>lecture, BME-276, Biological Basis of Imaging |
| Fall 2007 | Vanderbilt University<br>lecture, Phys-228-1/Rad-5228-6, Physics of Medical Imaging |
| Fall 2007 | Vanderbilt University<br>Instructor, BME 395, Mathematical Methods in the Imaging Sciences<br>Developed and organized new version of this course<br>25 lectures |
| Spring 2008 | Vanderbilt University<br>lecture, Phys-325-1, Physical Measurements of Biological Systems |
| Fall 2008 | Vanderbilt University<br>lecture, Phys-228-1/Rad-5228-6, Physics of Medical Imaging |
| Fall 2008 | Vanderbilt University<br>Co-instructor, CPBP-315-1, Scientific Communications in the Imaging Sciences |

| | |
|---|---|
| Fall 2009 | Vanderbilt University<br>lecture, Phys-325-1, Physical Measurements of Biological Systems |
| Fall 2009 | Vanderbilt University<br>Instructor, BME 395, Mathematical Methods in the Imaging Sciences<br>25 lectures |
| Spring 2010 | Vanderbilt University<br>lecture, BME 258, Foundations of Medical Imaging |
| Fall 2011 | Vanderbilt University<br>lecture, Phys-325-1, Physical Measurements of Biological Systems |
| Spring 2012 | Vanderbilt University<br>lecture, BME-304c, Contrast Mechanisms in Imaging |
| Spring 2012 | Vanderbilt University<br>lecture, VUIIS seminar, "How to give a talk" |
| Spring 2013 | Vanderbilt University<br>Co-instructor, BME-304c, Measurement Methods for Biomedical Engineers<br>3 lectures |
| Spring 2014 | Vanderbilt University<br>Instructor, Phys-352a, Magnetic Resonance Physics<br>Developed and organized course<br>24 lectures (16 by Gochberg, 8 guest lecturers) |
| Fall 2014 | Vanderbilt University<br>lecture, ASPIRE module on Effective Oral Communication Methods.<br>(Course Director: Bruce Damon)<br>1 class |
| Spring 2025 | Vanderbilt University<br>Co-instructor, IMSCI-6035, Imaging Biomarkers<br>6 lectures |

**Continuing Education**

| | |
|---|---|
| May 2012 | International Society of Magnetic Resonance in Medicine 20th Scientific Meeting (Melbourne)<br>Educational Course (audience of several hundred)<br>Session: MR Properties of Tissue, "What Does the Future Hold" |
| May 2014 | International Society of Magnetic Resonance in Medicine 22nd Scientific Meeting (Milan)<br>Educational Course (audience of several hundred)<br>Session: MR Physics for Physicists, "Multiquantum Coherence, Editing, and Multidimensional NMR" |
| April 2017 | International Society of Magnetic Resonance in Medicine 25th Scientific Meeting (Honolulu)<br>Educational Course (audience of several hundred)<br>Session: CEST Imaging, "CEST, Basic Principles, Contributions to Z-Spectrum" |

| | |
|---|---|
| June 2018 | International Society of Magnetic Resonance in Medicine 26th Scientific Meeting (Paris)<br>Educational Course (audience of several hundred)<br>Session: Probing Biomolecules: Magnetic Susceptibility and CEST/MT: Part 1,<br>"What Are We Really Measuring in CEST?" |
| May 2019 | International Society of Magnetic Resonance in Medicine 27th Scientific Meeting (Montreal)<br>Educational Course (audience of several hundred)<br>Session: MRS to CEST & What Is In-Between,<br>"CEST in Tissue: What are We Measuring?" |
| May 2019 | Society for MR Radiographers & Technologists 28th Annual Meeting (Montreal)<br>Educational Course<br>Session: Advanced Applications,<br>"CEST Sequences and Sensitivities" |

**Graduate Students** (Primary Mentor)

| | |
|---|---|
| 2003 – 2008 | Xiawei Ou, Ph.D. Physics, Vanderbilt University. Currently an Associate Professor of Radiology and Pediatrics, University of Arkansas for Medical Sciences. |
| 2003 – 2008 | Arman Kussainov, Ph.D. Physics, Vanderbilt University. Returned to Kazakhstan. |
| 2007 – 2015 | Vaibhav Janve, Ph.D. Physics, Vanderbilt University, Currently a Post-doctoral fellow at Vanderbilt University Medical Center |

**Post-Doctoral Fellows**

| | |
|---|---|
| 2004 – 2007 | Wilson Barros, Ph.D. in Physics from Federal University of Pernambuco, Brazil. Currently tenured Professor of Physics, Universidade Federal de Pernambuco, Recife, Brazil. |
| 2008 – 2011 | Ke Li, Ph.D. in Physics from Vanderbilt University. Currently an Applications Engineer at GE Healthcare. |
| 2008 – 2012 | Zhongliang Zu, Ph.D. in Medical Physics from Peking University. Currently a Research Associate Professor, Vanderbilt Radiology & Radiological Sciences |
| 2015 – 2018 | Eugene Lin, Ph.D. in Chemistry from UCSD, currently an Assistant Professor, National Chung Cheng University, Taiwan. |
| 2016 – 2018 | Christopher Lankford, Ph.D. in Biomedical Engineering from Vanderbilt University. Currently on the faculty at Montgomery Bell Academy. |

**Doctoral Committees**

| | |
|---|---|
| 2003 – 2008 | Xiawei Ou (Vanderbilt Physics) |
| 2003 – 2008 | Arman Kussainov (Vanderbilt Physics) |
| 2005 – 2008 | Adrienne Dula (Vanderbilt Biomedical Engineering) |
| 2004 – 2009 | Heather Whitney (Vanderbilt Physics) |
| 2007 – 2010 | Xin Hong (Vanderbilt Biomedical Engineering) |
| 2007 – 2011 | Jared Cobb (Vanderbilt Biomedical Engineering) |
| 2008 – 2011 | Adam Horch (Vanderbilt Biomedical Engineering) |

| | |
|---|---|
| 2007 – 2013 | Subechhya Pradhan (Vanderbilt Physics) |
| 2011 – 2013 | Richard Baheza (Vanderbilt Biomedical Engineering) |
| 2007 – 2015 | Vaibhav Janve (Vanderbilt Physics) |
| 2013 – 2015 | Hua Li (Vanderbilt Physics) |
| 2012 – 2016 | John Spear (Vanderbilt Physics) |
| 2013 – 2016 | Chris Lankford (Vanderbilt Biomedical Engineering) |
| 2014 – 2016 | Kathryn West (Vanderbilt Biomedical Engineering) |
| 2019 – 2023 | Thammathida Ketsiri (Vanderbilt Biomedical Engineering) |
| 2022 – present | Hannah Alderson (Vanderbilt Biomedical Engineering) |
| 2023 – present | Bibek Dhakal (Vanderbilt Physics) |

**Doctoral External Examiner**

| | |
|---|---|
| August, 2023 | Luke Reynolds (Physics, University of British Columbia) |

**Master Committees**

| | |
|---|---|
| 2011 – 2012 | Joshua Banks (Vanderbilt Physics) |

**Vanderbilt VICTR Studio Grant Mentorship**

| | |
|---|---|
| May, 2013 | Adrienne Dula (Vanderbilt Radiology and Radiological Science) |

## OTHER SIGNIFICANT ACTIVITIES:

Founding Board Member, Edgehill Village Neighborhood Association, 2013-2020

Co-author, $250,000 grant for construction of a park in the Edgehill neighborhood on behalf of the Edgehill Village Neighborhood Association, Nashville Metropolitan Development and Housing Agency, October 2011

## RESEARCH PROGRAM:

**Completed, as PI**

| | | |
|---|---|---|
| 8/01/14-7/31/19 | R01 CA184693 (**Gochberg, D.F.**)<br>35% effort<br>NIH/NCI<br>CERT imaging of cancer | Total Budget: 1,602,855 |
| 3/01/14-2/28/19 | R01 EB017767 (**Gochberg, D.F.**)<br>41% effort<br>NIH/NIBIB<br>CERT imaging of muscle | Total Budget: $1,411,020 |
| 7/12/05-7/31/10 | R01 EB001452 (**Gochberg, D.F.**)<br>55% effort<br>NIH<br>Quantitative MT imaging development and application | Total Budget: $1,375,474 |
| 9/1/04-8/31/07 | R21 EB002893-01 (**Gochberg, D.F.**)<br>30% effort<br>NIH<br>The structural dependence of CRAZED imaging | Total Budget: $412,190 |
| 1/1/03-12/31/04 | VUMC Discovery Grant (**Gochberg, D.F.**)<br>10% effort | Total Budget: $99,265 |

Vanderbilt University Medical Center
Quantitative MT imaging development and application

9/01/98-8/31/00 F32 CA080650 (**Gochberg, D.F.**) Total Budget: $31,720
100% effort
NIH Individual National Research Service Award
Determinants of proton spin relaxation in tissue

**Completed, as Co-Investigator**

8/11/25-present R01 EB036574 (Zu, Z.) Total Budget: $1,686,528
5% effort
NIH/NIBIB
Advancing machine learning for CEST MRI analysis through partially synthetic data

7/30/25-present R01 NS140757 (Zu, Z.) Total Budget: $1,691,160
8% effort
NIH/NINDS
Developing a novel machine learning method with partially synthetic data for rapid and precise pH mapping in ischemic stroke

1/05/21-3/4/23 R01 EB014308 (Tantawy, M.N.) Total Budget: $472,960
5% effort
NIH/NCI
Development of nanoparticulate solution for cancer treatment by breakup of tumor extracellular hydroxyapatite: a new paradigm

3/15/12-6/30/21 R01 EB014308 (Does, M.D.) Total Budget: $3,404,639
5% effort
NIH/NIAMS
Bone fracture risk assessment through bound and pore water MRI

12/1/15-11/30/19 R01 EB019980 (Does, M.D.) Total Budget: $1,768,522
5% effort
NIH/NIBIB
MRI toolbox for rodent brain microstructure imaging

4/01/12-3/31/17 T32 EB014841 (Gore, J.C.) Total Budget: $1,804,896
Mentor – 0% effort
NIH
Institutional predoctoral training program in biomedical imaging science

9/01/13-8/31/15 R21 EB017873 (Zu, Z.) Total Budget: $430,813
5% effort
NIH/NIBIB
MRI of mobile protein and immobile metabolite via magnetization rotation transfer

9/30/13-9/29/15 W81XWH-13-1-0073 (Smith, S.A.) Total Budget: $623,156
Collaborator – 0% effort
Dept. of Defense
7T Magnetization transfer and chemical exchange saturation transfer MRI of cortical gray matter

6/1/09-7/31/15 R01 EB001744 (Does, M.D.) Total Budget: $2,112,267

10% effort
NIH/NIBIB
Sub-voxel tissue characterization with in-vivo MRI

9/22/08-8/31/14 5P50 CA128323 (Gore, J.C.) Total Budget: $6,770,472
5% effort
NIH/NCI (Pilot Project)
Vanderbilt in vivo cellular and molecular imaging center

8/5/09-6/30/14 R01 AR057091 (Damon, B.M.) Total Budget: $1,749,608
5% effort
NIH/NIAMS
Multiparametric classification of muscle damage in inflammatory myopathy

9/30/03-4/30/13 T32 EB001628 (Gore, J.C.) Total Budget: $3,196,280
Mentor – 0% effort
NIH
Postdoctoral training in biomedical MRI and MRS

9/8/05-7/31/11 R01 EB000214 (Gore, J.C.) Total Budget: $1,910,320
15% effort
NIH
Proton relaxation and contrast mechanisms in MRI

9/1/08-12/31/10 R21 NS058787-01A2 (Sriram, S.) Total Budget: $327,610
6.5% effort
NIH
Neuroimaging and neuroprotection of primary oligodendrogliopathy

7/01/04-6/30/10 T32 EB03817 (Gore, J.C.) Total Budget: $1,291,397
Mentor – 0% effort
NIH
Predoctoral training in biomedical imaging

1/10/05-11/30/09 R01 AR050101 (Damon, B.M.) Total Budget: $1,195,920
3% effort
NIH
Biophysical basis of muscle functional MRI

8/27/02-12/31/07 R01 CA90844 (Gore, J.C.) Total Budget: $1,084,070
15% effort
NIH
Improved polymer gels for radiation dosimetry by MRI

**PUBLICATIONS:**

**Refereed Journal Articles**

1. **D.F. Gochberg**, R.P. Kennan, and J.C. Gore. Quantitative studies of magnetization transfer by selective excitation and $T_1$ recovery. *Magnetic Resonance in Medicine*, 38: 224-231, 1997

2. **D.F. Gochberg**, R.P. Kennan, M.J. Maryanski, and J.C. Gore. The role of specific side groups and pH in magnetization transfer in polymer gels. *Journal of Magnetic Resonance*, 131: 191-198, 1998

3. **D.F. Gochberg**, R.P. Kennan, M.D. Robson and J.C. Gore. Quantitative imaging of magnetization transfer using multiple selective pulses. *Magnetic Resonance in Medicine*, 41: 1065-1072, 1999

4. J.C. Gore, A.W. Anderson, M.D. Does, **D.F. Gochberg**, J.M. Joers, R.P. Kennan, E.C. Parsons, and M. Schachter, The relationship of problems in biomedical MRI to the study of porous media, *Magnetic Resonance Imaging* 19 (3-4): 295-300, 2001

5. **D.F. Gochberg**, P.M. Fong, and J.C. Gore. Studies of magnetization transfer and relaxation in irradiated polymer gels—Interpretations of the Effects of MRI-based dosimetry. *Physics in Medicine and Biology*, 46: 799-811, 2001

6. **D.F. Gochberg**, P.M. Fong, and J.C. Gore., A quantitative study of magnetization transfer in MAGIC gels, *Physics in Medicine and Biology*, 48: 277-282, 2003

7. **D.F. Gochberg** and J.C. Gore, Quantitative imaging of magnetization transfer using an inversion recovery sequence, *Magnetic Resonance in Medicine*, 49: 501-505, 2003

8. W. Jr Barros, J.C. Gore, **D.F. Gochberg**. Simultaneous measurement of D and T2 using the distant dipolar field. *Journal of Magnetic Resonance*, 178(1):166-169, 2006.

9. W. Jr Barros, **D.F. Gochberg**. Fast single-gradient simultaneous measurement of D and T-2 in liquids via the distant dipolar field, *Chemical Physics Letters*, 431(1-3): 174-178, 2006

10. W. Jr Barros, **D.F. Gochberg**, Gore JC, Assessing signal enhancement in distant dipolar field-based sequences, *Journal of Magnetic Resonance*, 189: 32-37, 2007

11. **D.F. Gochberg**, J.C. Gore. Quantitative magnetization transfer imaging via selective inversion recovery with short repetition times. *Magnetic Resonance in Medicine*, 57(2): 437-441, 2007

12. X. Ou, **D.F. Gochberg**. MT effects and T1 quantification in single slice spoiled gradient echo imaging. *Magnetic Resonance in Medicine*, 59(4): 835-845, 2008

13. H.M. Whitney, **D.F. Gochberg**, J.C. Gore. Magnetization transfer proportion: a simplified measure of dose response for polymer gel dosimetry; *Physics in Medicine and Biology*, 53: 7107-7124, 2008

14. X. Ou, S.W. Sun, H.F. Liang, S.K. Song, **D.F. Gochberg**. Quantitative magnetization transfer measured pool-size ratio reflects optic nerve myelin content in ex vivo mice; *Magnetic Resonance in Medicine*, 61(2): 364-371, 2009

15. A.N. Dula, **D.F. Gochberg**, M.D. Does, Optimal echo spacing for multi-echo imaging measurements of bi-exponential $T_2$ relaxation, *Journal of Magnetic Resonance*, 196 (2): 149-56, 2009

16. E.A. Louie, **D.F. Gochberg**, M.D. Does, B.M. Damon. Transverse relaxation and magnetization transfer in skeletal muscle: effect of pH. *Magnetic Resonance in Medicine*, 61: 560-569, 2009

17. C.C. Quarles, **D.F. Gochberg**, J.C. Gore. A theoretical framework to model DSC-MRI data acquired in the presence of contrast agent extravasation; *Physics in Medicine and Biology*, 54: 5749-5766, 2009

18. X. Ou, S.W. Sun, H.F. Liang, S.K. Song, **D.F. Gochberg**. The MT pool size ratio and DTI radial diffusivity may reflect the myelination in shiverer and control mice; *NMR in Biomedicine*, 22: 480-487, 2009

19. W. Jr Barros, **D.F. Gochberg**, J.C. Gore. Nuclear magnetic resonance signal dynamics of liquids in the presence of distant dipolar fields, revisited; *Journal of Chemical Physics*, 130: 174506, 2009

20. A.N. Dula, **D.F. Gochberg**, H.L. Valentine, W.M. Valentine, M.D. Does. Multi-exponential T2, magnetization transfer and quantitative histology in white matter tracts of rat spinal cord; *Magnetic Resonance in Medicine*, 63(4): 902-909, 2010

21. R.A. Horch, J.S. Nyman, **D.F. Gochberg**, R.D. Dortch, M.D. Does. Characterization of 1H NMR signal in human cortical bone for magnetic resonance imaging; *Magnetic Resonance in Medicine*, 64(3): 680-687, 2010

22. K. Li, Z. Zu, J. Xu, V.A. Janve, J.C. Gore, M.D. Does, **D.F. Gochberg**. Optimized inversion recovery sequences for quantitative T1 and magnetization transfer imaging; *Magnetic Resonance in Medicine*, 64(2): 491-500, 2010

23. L. M. Meenderink, L.M. Ryzhova, D.M. Donato, **D.F. Gochberg**, I. Kaverina, S.K. Hanks. P130Cas Src-binding and substrate domains have distinct roles in sustaining focal adhesion disassembly and promoting cell migration; *PLoS ONE*, 5(10): e13412, 2010

24. R.A. Horch, K. Wilkens, **D.F. Gochberg**, M.D. Does. RF coil considerations for short T2 MRI; *Magnetic Resonance in Medicine*, 64(6): 1652-7, 2010

25. R.A. Horch, **D.F. Gochberg**, J.S. Nyman, M.D. Does. Non-invasive predictors of human cortical bone mechanical properties: T2-discriminated H1 NMR compared with high resolution x-ray; *PLoS ONE*, 6(1): e16359, 2011

26. Z. Zu, K. Li, V.A. Janve, M.D. Does, **D.F. Gochberg**. Optimizing pulsed-chemical exchange saturation transfer imaging sequences; *Magnetic Resonance in Medicine*, 66(4): 1100-1108, 2011;

27. R.D. Dortch, K. Li, **D.F. Gochberg**, E.B. Welch, A.N. Dula, A.A. Tamhane, J.C. Gore, S.A. Smith. Quantitative magnetization transfer imaging in human brain at 3T via selective inversion recovery; *Magnetic Resonance in Medicine*, 66(5):1346-1352, 2011;

28. J.G. Cobb, J. Xie, K. Li, **D.F. Gochberg**, J.C. Gore. Exchange-mediated contrast agents for spin-lock imaging; *Magnetic Resonance in Medicine*, 67(5): 1427-1433, 2012;

29. Z. Zu, K. Li, V.A. Janve, K. Li, M.D. Does, J.C. Gore, **D.F. Gochberg**. Multi-angle ratiometric approach to measure chemical exchange in amide proton transfer (APT) imaging; *Magnetic Resonance in Medicine*, 68(3): 711-719, 2012;

30. R.A. Horch, **D.F. Gochberg**, J.S. Nyman, M.D. Does. Clinically compatible MRI strategies for discriminating bound and pore water in cortical bone; *Magnetic Resonance in Medicine*, 68(6): 1774-1784, 2012;

31. R.D. Dortch, J. Moore, K. Li, M. Jankiewicz, **D.F. Gochberg**, J.A. Hirtle, J.C. Gore, S.A. Smith. Quantitative magnetization transfer imaging of human brain at 7T; *Neuroimage*, 64:640-649, 2013;

32. **D.F. Gochberg** and Z. Ding, The approach to steady state using homogeneous Cartesian coordinates; *Computational and Mathematical Methods in Medicine*, 2013;

33. Z. Zu, V.A. Janve, J. Xu, M.D. Does, J.C. Gore, **D.F. Gochberg**. A new method for detecting exchanging amide protons using chemical exchange rotation transfer; *Magnetic Resonance in Medicine* , 69(3): 637-647, 2013;

34. V.A. Janve, Z. Zu, S.Y. Yao, K. Li, F.L. Zhang, K.J. Wilson, X. Ou, M.D. Does, S. Subramaniam, **D.F. Gochberg**. The radial diffusivity and magnetization transfer pool size ratio are sensitive markers for demyelination in a rat model of type III multiple sclerosis lesions; *Neuroimage*, 74: 298-305, 2013;

35. D.W.J. Klomp, A.N. Dula, L.R. Arlinghaus, M. Italiaander, R.D. Dortch, Z. Zu, J.M. Williams, **D.F. Gochberg**, P.R. Luijten, J.C. Gore, T.E. Yankeelov, S.A. Smith, Amide proton transfer imaging of the human breast at 7T: development and reproducibility; *NMR in Biomedicine*, 26(10): 1271-1277, 2013.

36. J.G. Cobb, K. Li, J.P. Xie, **D.F. Gochberg**, J.C. Gore. Exchange-mediated contrast in CEST and spin-lock imaging; *Magnetic Resonance Imaging*, 32(1): 28-40, 2014;

37. J. Xu, K. Li, Z. Zu, X. Li, **D.F. Gochberg**, J.C. Gore. Quantitative magnetization transfer imaging of rodent glioma using selective inversion recovery; *NMR in Biomedicine* , 27(3): 253-260, 2014;

38. M. Zaiss, J. Xu, S. Goerke, I.S. Khan, R.J. Singer, J.C. Gore, **D.F. Gochberg**, P. Bachert. Inverse Z-spectrum analysis for spillover-, MT-, and T-1-corrected steady-state pulsed CEST-MRI – application to pH-weighted MRI of acute stroke; *NMR in Biomedicine* , 27(3): 240-252, 2014;

39. J. Xu, M. Zaiss, Z. Zu, H. Li, J.P. Xie, **D.F. Gochberg**, P. Bachert, J.C. Gore. On the origins of chemical exchange saturation transfer (CEST) contrast in tumors at 9.4T; *NMR in Biomedicine* , 27(4): 406-416, 2014;

40. N.D. Bryant, K. Li, M.D. Does, S. Barnes, **D.F. Gochberg**, T.E. Yankeelov, J.H. Park B.M. Damon. Multi-parametric MRI characterization of inflammation in murine skeletal muscle; *NMR in Biomedicine*, 27(6): 716-725, 2014;

41. M.K. Manhard, R.A. Horch, K.D. Harkins, **D.F. Gochberg**, J.S. Nyman, M.D. Does. Validation of quantitative bound- and pore-water imaging in cortical bone; *Magnetic Resonance in Medicine*, 71(6): 2166-2171, 2014;

42. Z. Zu, J.Z. Xu, H. Li, E.Y. Chekmenev, C.C. Quarles, M.D. Does, J.C. Gore, **D.F. Gochberg**. Imaging amide proton transfer and nuclear overhauser enhancement using chemical exchange rotation transfer (CERT); *Magnetic Resonance in Medicine*, 72(2): 471-476, 2014;

43. K. Li, R.D. Dortch, E.B. Welch, N.D. Bryant, A.K.W. Buck, T.F. Towse, **D.F. Gochberg**, M.D. Does, B.M. Damon, J.H. Park. Multi-parametric MRI characterization of healthy human thigh muscles at 3.0 T – relaxation, magnetization transfer, fat/water, and diffusion tensor imaging; *NMR in Biomedicine*, 27(9): 1070-1084, 2014;

44. M. Zaiss, Z. Zu, J Xu, P. Schuenke, **D.F. Gochberg**, J.C. Gore, M.E. Ladd, P. Bachert. A combined analytical solution for chemical exchange saturation transfer and semi-solid magnetization transfer; *NMR in Biomedicine* , 28(2): 217-230, 2015;

45. H. Li, Z. Zu, M. Zaiss, I.S. Khan, R.J. Singer, **D.F. Gochberg**, P. Bachert, J.C. Gore, J. Xu. Imaging of amide proton transfer and nuclear Overhauser enhancement in ischemic stroke with corrections for competing effects; *NMR in Biomedicine* , 28(2): 200-209, 2015;

46. R.A. Baheza, E.B. Welch, **D.F. Gochberg**, M. Sanders, S. Harvey, J.C. Gore, T.E. Yankeelov. Detection of microcalcifications by magnetic susceptibility effects using MR phase image cross-correlation analysis; *Medical Physics* , 42(3): 1436-1452, 2015;

47. K. Li, R.D. Dortch, S.F. Kroop, J.W. Huston, **D.F. Gochberg**, J.H. Park, B.M. Damon. A rapid approach for quantitative magnetization transfer imaging in thigh muscles using the pulsed saturation method; *Magnetic Resonance Imaging*, 33(6): 709-717, 2015;

48. M.K. Manhard, R.A. Horch, **D.F. Gochberg**, J.S. Nyman, M.D. Does. In vivo quantitative MR imaging of bound and pore water in cortical bone; *Radiology*, 277(1): 221-229, 2015;

49. H. Li, K. Li, X. Zhang, Z. Jiang, Z. Zu, M. Zaiss, **D.F. Gochberg**, J.C. Gore, J. Xu. R1 correction in amide proton transfer imaging: indication of the influence of transcytolemmal water exchange on CEST measurements; *NMR in Biomedicine* , 28(12): 1655-1663, 2015;

50. K.D. Harkins, J. Xu, A.N. Dula, K. Li, W.M. Valentine, **D.F. Gochberg**, J.C. Gore, M.D. Does. The microstructural correlates of T1 in white matter; *Magnetic Resonance in Medicine*, 75(3): 1341-1345, 2015;

51. K. Li, H. Li, X. Zhang, A.M. Stokes, X. Jiang, H. Kang, C.C. Quarles, Z. Zu, M. Zaiss, **D.F. Gochberg**, J.C. Gore, J. Xu. Influence of water compartmentation and heterogeneous relaxation on quantitative magnetization transfer imaging in rodent brain tumors; *Magnetic Resonance in Medicine*, 76(2): 635-644, 2015;

52. F. Wang, K. Li, A. Mishra, **D.F. Gochberg**, L.M. Chen, J.C. Gore. Longitudinal assessment of spinal cord injuries in nonhuman primates with quantitative magnetization; *Magnetic Resonance in Medicine*, 75(4): 1684-1696, 2015;

53. N.D. Kelm, K.L. West, R.P. Carson, **D.F. Gochberg**, K.C. Ess, M.D. Does. Evaluation of diffusion kurtosis imaging in ex vivo hypomyelinated mouse brains; *Neuroimage*, 124(A): 612-626, 2016;

54. M.K. Manhard, S. Uppuganti, M. Granke, **D.F. Gochberg**, J.S. Nyman, M.D. Does. MRI-derived bound and pore water concentrations as predictors of fracture resistance. Bone; 87:1–10, 2016. doi: 10.1016/j.bone.2016.03.007.

55. X.Y. Zhang, F. Wang, A. Afzal, J. Xu, J.C. Gore, **D.F. Gochberg**, Z. Zu. A new NOE-mediated MT signal at around −1.6ppm for detecting ischemic stroke in rat brain. Magnetic resonance imaging; 34:1100–1106, 2016. doi: 10.1016/j.mri.2016.05.002.

56. K.L. West, N.D. Kelm, R.P. Carson, **D.F. Gochberg**, K.C. Ess, M.D. Does. Myelin volume fraction imaging with MRI. Neuroimage 2016. doi: 10.1016/j.neuroimage.2016.12.067.

57. B.M. Damon, K. Li, R.D. Dortch, E.B. Welch, J.H. Park, A.K.W. Buck, T.F. Towse, M.D. Does, **D.F. Gochberg**, N.D. Bryant. Quantitative Magnetic Resonance Imaging of Skeletal Muscle Disease. JoVE (Journal of Visualized Experiments) 2016:e52352–e52352. doi: 10.3791/52352.

58. X.Y. Zhang, F. Wang, T. Jin, J. Xu, J. Xie, **D.F. Gochberg**, J.C. Gore, Z. Zu. MR imaging of a novel NOE-mediated magnetization transfer with water in rat brain at 9.4 T. Magn. Reson. Med.; 78:588-597, 2017. doi: 10.1002/mrm.26396.

59. M.K. Manhard, K.D. Harkins, **D.F. Gochberg**, J.S. Nyman, M.D. Does. 30-Second bound and pore water concentration mapping of cortical bone using 2D UTE with optimized half-pulses. Magnet Reson Med; 77:945–950, 2017. doi: 10.1002/mrm.26605.

60. J.C. Gore, Z. Zu, P. Wang, H. Li, J. Xu, R. Dortch, **D.F. Gochberg**. "Molecular" MR imaging at high fields. Magnetic resonance imaging; 38:95–100, 2017. doi: 10.1016/j.mri.2016.12.008.

61. Z. Zu, E.A. Louie, E.C. Lin, X. Jiang, M.D. Does, J.C. Gore, **D.F. Gochberg**. Chemical exchange rotation transfer imaging of intermediate-exchanging amines at 2 ppm; *NMR in Biomedicine*, 9(8): e3756, 2017.

62. X.Y. Zhang, W. Feng, H. Li, J. Xu, **D.F. Gochberg**, J.C. Gore, Z. Zu. Accuracy in the quantification of chemical exchange saturation transfer (CEST) and relayed nuclear Overhauser enhancement (rNOE) saturation transfer effects; *NMR in Biomedicine*, 30(7): e3756, 2017.

63. Z. Zu, H. Li, J. Xu, X. Zhang, M. Zaiss, K. Li, M.D. Does, J.C. Gore, **D.F. Gochberg**. Measurement of APT using a combined CERT-AREX approach with varying duty cycles; *Magnetic Resonance Imaging*, 42: 22-31, 2017.

64. X.Y. Zhang, F. Wang, H. Li, J. Xu, **D.F. Gochberg**, J.C. Gore, Z. Zu. CEST imaging of fast exchanging amine pools with corrections for competing effects; *NMR in Biomedicine*, 30(7): e3715, 2017.

65. X.Y. Zhang, J. Xie, F. Wang, E.C. Lin, J. Xu, **D.F. Gochberg**, J.C. Gore, Z. Zu. Assignment of the molecular origins of CEST signals at 2 ppm in rat brain; *Magn. Reson. Med.*, 78(3), 2017: 10.1002/mrm.26802

66. X.Y. Zhang, F. Wang, J. Xu, **D.F. Gochberg**, J.C. Gore, Z. Zu. Increased CEST specificity for amide and fast-exchanging amine protons using exchange-dependent relaxation rate; *NMR in Biomedicine*, 31(2): e3863, 2018. 10.1002/nbm.3863

67. K.L. West, N.D. Kelm, R.P. Carson, D.C. Alexander, **D.F. Gochberg**, M.D. Does. Experimental studies of g-ratio MRI in ex vivo mouse brain. *Neuroimage* 167: 366-371, 2018. doi: 1 0.1016/j.neuroimage.2017.11.064.

68. **D.F. Gochberg**, M.D. Does, Z. Zu, C.L. Lankford. Towards an analytic solution for pulsed CEST. *NMR in Biomedicine*, 31(5), e3903, 2018. http://doi.org/10.1002/nbm.3903

69. R.D. Dortch, F. Bagnato, **D.F. Gochberg**, J.C. Gore, S.A. Smith. Optimization of selective inversion recovery magnetization transfer imaging for macromolecular content mapping in the human brain. *Magn. Reson. Med.*, 20, 285, 2018: http://doi.org/10.1002/mrm.27174

70. E.C. Lin, H. Li, Z. Zu, E.A. Louie, C.L. Lankford, R.D. Dortch, M.D. Does, J.C. Gore, **D.F. Gochberg**. Chemical exchange rotation transfer (CERT) on human brain at 3 Tesla. *Magn. Reson. Med.*, 80:2609-2617, 2018: http://doi.org/10.1002/mrm.27365

71. M.D. Does, J.L. Olesen, K.D. Harkins, T. Serradas-Duarte, **D.F. Gochberg**, S.N. Jespersen, N. Shemesh. Evaluation of principal component analysis image denoising on multi-exponential MRI relaxometry. *Magn. Reson. Med.*, 81:3503-3514, 2019: http://doi.org/10.1002/mrm.27658

72. Z. Zu, E.C. Lin, E.A. Louie, J. Xu, H. Li, J. Xie, C.L. Lankford, E.Y. Chekmenev, S.D. Swanson, M.D. Does, J.C. Gore, **D.F. Gochberg**. Relayed nuclear Overhauser enhancement sensitivity to

membrane Cho phospholipids. *Magn. Reson. Med.*, 84(4):1961-1976, 2020: http://doi.org/10.1002/mrm.28258

73. Y. Zhao, Z. Zu, Z. Wang, Z. Liu, B. Guo, X. Yan. **D.F. Gochberg**, J. Li. Effectiveness of fat suppression using a water-selective binomial-pulse excitation in chemical exchange saturation transfer (CEST) magnetic resonance imaging. *Magma*. 2020

74. M.J. Cronin, J. Xu, F. Bagnato, **D.F. Gochberg**, J.C. Gore, R.D. Dortch. Rapid whole-brain quantitative magnetization transfer imaging using 3D selective inversion recovery sequences. *Magn. Reson. Imaging*, 68: 66-74, 2020.

75. J. Cui, X.Y. Zhang, J. Xie, **D.F. Gochberg**, Z. Zu. Towards the molecular origin of glutamate CEST (GluCEST) imaging in rat brain. *Magn. Reson. Med.*, 83(4):1405-1417, 2020: http://doi.org/10.1002/mrm.28021. Corrigendum for authorship: *Magn. Reson. Med.*, 85(1):570, 2021: http://doi.org/10.1002/mrm.28451

76. Z. Zu, E.C. Lin, E.A. Louie, X. Jiang, C.L. Lankford, B. Damon, M.D. Does, J.C. Gore, **D.F. Gochberg**. Chemical exchange rotation transfer imaging of phosphocreatine in muscle. *NMR in Biomedicine*, 34(2), e4437, 2021. http://doi.org/10.1002/nbm.4437

77. J. Cui, Y. Zhao, F. Wang, **D.F. Gochberg**, Z. Zu. Contribution of blood to nuclear Overhauser effect at -1.6 ppm. *Magn. Reson. Med.*, 87(1):409-416, 2022: http://doi.org/10.1002/mrm.28973

78. C.L. Lankford, E.A. Louie, Z. Zu, M.D. Does, **D.F. Gochberg**. A hybrid numeric-analytic solution for pulsed CEST. *NMR in Biomedicine*, 35(1), e4610, 2022. http://doi.org/10.1002/nbm.4610

79. J. Zhou, M. Zaiss, L. Knutsson, P.Z. Sun, S.S. Ahn, S. Aime, P. Bachert, J.O. Blakeley, K. Cai, M.A. Chappell, M. Chen. **D.F. Gochberg**, S. Goerke, H.Y. Heo, S. Jiang, T. Jin, S.G. Kim, J. Laterra, D. Paech, M.D. Pagel, J.E. Park, R. Reddy, A. Sakata, S. Sartoretti-Schefer, A.D. Sherry, S.A. Smith, G.J. Stanisz, P.C. Sundgren, O. Togao, M. Vandsburger, Z. Wen, Y. Wen, Y. Wu, Y. Zhang. W. Zhu, Z. Zu, P. van Zijl. Review and consensus recommendations on clinical APT-weighted imaging approaches at 3T: application to brain tumors. *Magn. Reson. Med.*, 88(2):546-474, 2022.

80. Y. Zhao, Z. Zu, J. Xu, J.C. Gore, M.D. Does, J. Li, **D.F. Gochberg**. Mapping pH using stimulated echoes formed via chemical exchange. *Magn. Reson. Imaging*, 92: 100-107, 2022.

81. M. Zaiss, T. Jin, S.G. Kim, **D.F. Gochberg**, Theory of chemical exchange saturation transfer MRI in the context of different magnetic fields, *NMR in Biomedicine*, 35(11), e4789, 2022.

82. T. Ketsiri, S. Uppuganti, K.D. Harkins, **D.F. Gochberg**, J.S. Nyman, M.D. Does, T1 relaxation of bound and pore water in cortical bone, *NMR in Biomedicine*, e4878, 2023.

83. T. Ketsiri, S. Uppuganti, K.D. Harkins, **D.F. Gochberg**, J.S. Nyman, M.D. Does. Finite element analysis of bone mechanical properties using MRI-derived bound and pore water concentration maps. *Comp. Methods in Biomech. And Biomed. Eng.* 26(8), 905-916, 2023.

84. J.S. Nyman, T. Ketsiri, E.A. Louie, K.D. Harkins, M.K. Manhard, **D.F. Gochberg**, D.H. Lee, M.J. Desai, J. Maslow, S.B. Tanner, M.D. Does. Toward the use of MRI measurements of bound and pore water in fracture risk assessment. *Bone*, 176, 116863, 2023.

85. **D.F. Gochberg**. Inverting CEST or $R_{1\rho}$ data to generate solute spectra without *a priori* assumptions. *Magn. Reson. Med.*, Published Ahead of Print, 2025. doi: 10.1002/mrm.70111.

**Book Chapters**

1. **D.F. Gochberg** and M. Lepage. Magnetization transfer and chemical exchange saturation transfer in cancer imaging. In: T.E. Yankeelov, eds. *Quantitative MRI in Cancer*. London: Taylor & Francis Group; 2012;

**Book Reviews**

1. **D.F. Gochberg**. Chemical Exchange Saturation Transfer imaging: Advances and applications by Michael T. McMahon, Assaf A. Gilad, Jeff W. M. Bulte, and Peter C.M. van Zijl Publisher: Pan Stanford Publishing Pte. Ltd., Singapore. Magnetic resonance imaging; 38:233, 2017. doi: 10.1016/j.mri.2017.01.004.

**Patents (Full)**

1. Co-inventor, U.S. Patent Application 13/151,556, "System and method for determining mechanical properties of bone structures". U.S. Patent 8,923,948, 2014 (filed 6/2/11).
2. Inventor, "Magnetic resonance imaging of neuro-electro-magnetic oscillations". Docket No.: 142973-00130

**Patents (Preliminary Only)**

3. Co-inventor, U.S. Patent Application 61/600,309, "Chemical Exchange Rotation Transfer (CERT) imaging".
4. Co-inventor, U.S. Patent Application 63/883,794, "Method to determine solutes exchanging with water by transforming and linear fitting an MRI signal", filed 9/18/2025

**Invited Talks**

| | |
|---|---|
| March 2010 | University of Kentucky<br>Dept of Radiology<br>Symposia on Advanced Medical Imaging |
| March 2010 | University of Kentucky<br>Dept of Radiology<br>The Peter Hardy Research Group |
| December 2011 | University of Pennsylvania<br>Dept of Radiology<br>Center for Magnetic Resonance and Optical Imaging Speaker Series |
| December 2011 | Washington University in St. Louis<br>Mallinckrodt Institute of Radiology<br>Biomedical Magnetic Resonance Speaker Series |
| May 2012 | International Society of Magnetic Resonance in Medicine 20th Scientific Meeting (Melbourne)<br>Plenary Talk (audience of several thousand)<br>Session: Measuring Tissue Microstructure with MRI, "What is Tissue Microstructure & Why Might We Want to Measure It?" |
| May 2012 | Massachusetts General Hospital<br>Martinos Center for Biomedical Imaging<br>BrainMap Seminar Series |
| October 2013 | Vanderbilt University<br>VUIIS Friday Seminar Series |

| | |
|---|---|
| May 2014 | CEST 2014: 4th International Workshop on Chemical Exchange Saturation Transfer (Torino, Italy)<br>"Alternative Approaches to Imaging Exchange" |
| July 2014 | Gordon Research Conference: In Vivo Magnetic Resonance, from Molecules to Humans (Andover, NH)<br>Session Overview<br>"CEST versus spin locking versus MRS" |
| September 2015 | Yale University<br>Magnetic Resonance Research Center<br>"Imaging Magnetization Exchange" |
| October 2015 | 44th SEMRC: Southeastern Magnetic Resonance Conference (Daytona Beach)<br>"Imaging Magnetization Exchange with CEST and CERT" |
| August 2017 | Music City CEST: 6th International Workshop on Chemical Exchange Saturation Transfer (Nashville, TN) |
| August 2019 | Gordon Research Conference: Multi-Modal Approaches and Histopathological Validation in Tissue Microstructure Imaging (Mount Holyoke College, MA)<br>"Magnetization Exchange and Lipid Structure" |
| January 2023 | ISMRM Workshop on Data Sampling and Image Reconstruction (Sedona, AZ)<br>"Modelling of Tissue Microstructure" |