Curriculum Vitae

1. PERSONAL DATA

Name: Qiuhong He, Ph.D.

Home Address: West Lafayette, IN 47906 **Citizenship:** United States of America

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2. RESEARCH OBJECTIVE or PERSONAL PROFILE

Innovative academic scholar in magnetic resonance spectroscopy & imaging and cancer research, and provide MRI service and collaborations in academic settings. 15+ years of teaching experience at the undergraduate and postgraduate levels. Supervised postdoctoral researchers, graduate study and PhD dissertations, undergraduate and high school students for research experience. Published original research findings in scientific journals and internationals scientific conferences, review articles and book chapters. Obtained research grants from NIH, NSF, DoD and private foundations; served as NIH and DoD scientific reviewers to evaluate research proposals. Inventor with U.S. Patents on innovative magnetic resonance spectroscopic imaging methods and a RF coil system for heteronuclear MR imaging and spectroscopy of human breast cancer. Discovered a new phenomenon in NMR physics and pioneered in the development of Electrophoretic NMR (ENMR) methods for studying molecular mixtures and structural characterization of macromolecular interactions.

3. EDUCATION and TRAINING

Dates Attended	Name and Location of Institution	Degree Received and Year	Major Subject

POSTDOCTORAL RESEARCH TRAINING:

Dates Attended	Name and Location of Institution	Name of Program Director and Discipline
1992-95	The Johns Hopkins University School of Medicine, NMR research division, Department of Radiology, Baltimore, Maryland. (JHU Medical School transcript is available upon request)	In vivo NMR of Cancer Advisor: Jerry D. Glickson
1990-92	Princeton University, Department of Chemistry Princeton, New Jersey.	Physical Chemistry/NMR Advisor: Warren S. Warren

GRADUATE:

1986-90	University of North Carolina, Department of Chemistry,	Ph.D., 1990	Physical Chemistry/NMR

Chapel Hill, NC
(The graduate transcript is available upon request)

Ph.D. Thesis: "Electrophoretic Nuclear Magnetic Resonance"
Advisor: Prof. Charles S. Johnson, Jr.

1984-85 Jilin University, Graduate Study Theoretical Chemistry
Institute of Theoretical Chemistry,
Changchun, Jilin, P. R. China
Advisors:
Prof. Aoqing Tang (Founding Chair of the Chinese National Science Foundation, Member of the Chinese National Academy of Science, President of Jilin University)
Prof. Yuansheng Jiang (Member of the Chinese National Academy of Science)
Prof. Jiazhong Sun (Member of the Chinese National Academy of Science)

UNDERGRADUATE:

1980-84 Jilin University, B.S., 1984 Chemistry
Department of Chemistry, Major: Physical Chemistry
Changchun, P. R. China
Graduated with #1 ranking of academic grades among the 200 students of chemistry major (summa cum laude); Champion in English competition of Jilin University
(Official undergraduate Transcript is available upon request)

Undergraduate Thesis Research: "Studies of Metalloporphyrins in relation to activation of small molecules (I)--Effect of Cobalt Porphyrin CoTAPPI on Electroreduction of Oxygen in Organic Solution." (Published in English)
Advisor: Prof. Chubao Huang

Continuous Education

Continued education in science, engineering and biomedicine through university courses, conferences, seminars and webinars, and literature research.

4. PROFESSION EXPERIENCE (INCL. ADMINISTRATIVE AND LEADERSHIP EXPERIENCE)

APPOINTMENTS and POSITIONS

Years	**Name and Location of Institution or Organization**	**Rank/Title**
1995	The Johns Hopkins University School of Medicine, Baltimore, Maryland	Research Associate (Junior Faculty)
1995-2000	Department of Chemistry Institute of Materials Science University of Connecticut Storrs, Connecticut	Assistant Professor
1998-2003	Yale University School of Medicine Magnetic Resonance Center New Haven, Connecticut	Visiting Assistant Professor

2000-2003	Medical Physics and Radiology Departments Memorial Sloan Kettering Cancer Center	Assistant Attending Physicist
2000-2003	Weill Medical College of Cornell University New York, New York	Assistant Professor of Physics in Radiology
2003-2004	University of Pittsburgh, Department of Radiology Pittsburgh, PA	Visiting Assistant Professor
2004-2008	University of Pittsburgh, Department of Radiology Pittsburgh, PA	Assistant Professor (Tenure-stream on 7/1/04)
2008-2012	University of Pittsburgh, Department of Radiology Pittsburgh, PA	Associate Professor
2003-2012	University of Pittsburgh, Department of Bioengineering	Adjunct Faculty
2003-2012	University of Pittsburgh Cancer Institute	Member
2009-2022	National Institutes of Health, Center for Scientific Review Scientific Review Group Study Sections And Special Emphasis Panels	Scientific Reviewer
2010 -	Department of Defense (DoD), U.S. Army Medical Research and Material Command, Congressionally Directed Medical Research Programs (CDMRP)	Scientific Reviewer
2016-2018	Breast Cancer: Basic and Clinical Research, SAGE Publishing	Lead Guest Editor
2019-2022	iCoreMed Technology and Service, LLC	Manuscript Reviewer
2019-2022	University of North Carolina School of Medicine Biomedical Research Imaging Center (BRIC) Center for Animal MRI (CAMRI) Chapel Hill, NC	Staff Scientist and Inventor
2022-	Purdue University College of Human and Health Sciences School of Health Sciences West Lafayette, IN	Associate Professor

MEMBERSHIPS in PROFESSIONAL and SCIENTIFIC SOCIETIES

Organization	**Year**
Active Member, American Association for Cancer Research (AACR)	2003-present
Member, the International Society for Magnetic Resonance in Medicine (ISMRM)	1992-present
Member, Biomedical Engineering Society	2013-present
Member, the American Chemical Society (ACS)	1995 - 2000

AWARDS and HONORS

Distinguished manuscript reviewer for Magnetic Resonance in Medicine (2013)
Chancellor's Research Fellow, the University of Connecticut (1997-98)
Outstanding Student Awards ("Shan Hao" Student Award), Jilin University (1980-81, 1981-82, 1982-83)

PROFESSIONAL ACTIVITIES:

Research Proposal Reviewer:

NIH 2022 Scientific Review Group Member for 2022/10 ZRG1 BST-P (55) R PAR-20-104: Biomedical Technology Development and Dissemination Center (RM1). Mail reviewer (Meeting date: 06/17/2022)

DoD 2017 Breast Cancer Research Program: Scientific Reviewer (CET Panel meeting date: Feb 14-16, 2018)

DoD 2016 Breast Cancer Research Program: Scientific Reviewer (CET Panel meeting date: July 13-15, 2016)

DoD 2016 Breast Cancer Research Program: Ad Hoc Scientific Reviewer (DDP Panel meeting: July 13-15, 2016)

DoD 2015 the Reconstructive Transplant Research Program (RTRP): Teleconference Scientific Reviewer (Panel meeting date: Jan. 6-7, 2016)

DoD 2015 Breast Cancer Research Program: Scientific Reviewer (Panel meeting date: June 17 – 19, 2015)

DoD 2013 Breast Cancer Research Program: Scientific Reviewer (Panel meeting date: March 12 – 14, 2014)

DoD 2013 BCRP Training Program - Teleconference Scientific Reviewer (Panel meeting date: March 9-10, 2014)

NIH Special Emphasis Panel/Scientific Review Group 2013/10 ZCA1 SRLB-J (O1) S for the Cancer Prevention Research Small Grant Program (R03) PAR-11-079: Panelist and scientific reviewer (July 10, 2013)

NIH Clinical and Translational Imaging Applications Study Section, mail scientific reviewer (June 27, 2012)

NIH Special Emphasis Panel on "Academic-Industrial Partnerships for Translation of in vivo Imaging Systems for Cancer Investigations," Study Section Member, June 14, 2012.

NIH Biomedical Imaging Technology Study Section (BMIT-B) member (June 2-3, 2011)

NIH Medical Imaging (MEDI) Scientific Review Group Study Section member (Feb. 7-8, 2011)

NIH Biomedical Imaging Technology (BMIT) Study Section member (Oct 1-2, 2010)

DoD CDMRP Breast Cancer Research Program Concept Award - Online Scientific Reviewer (June-July, 2010)

DoD CDMRP Breast Cancer Research training Program - Scientific Reviewer (April -May, 2010)

NIH S10 High-End Instrument Proposal Reviewer and Study Section Member (Oct. –Nov. 2009)

NIH RC1 proposal reviewer (June, 2009)

University of Connecticut Research Foundation proposal reviewer

Journal Editorial:

2016-2018 Lead Guest Editor, Breast Cancer: Basic and Clinical Research for a special journal collection on "Breast Cancer: Drug resistance and metastasis."

Manuscript Reviewer:

1. Journal of American Chemical Society
2. Journal of Magnetic Resonance
3. Concepts in Magnetic Resonance
4. Journal of Magnetic Resonance Imaging
5. Journal of Computer Assisted Tomography
6. NMR in Biomedicine
7. Magnetic Resonance in Medicine
8. International Journal of Hyperthermia

Professional Conference Scientific Reviewer:

2014 Annual Meeting of Biomedical Engineering Society (BMES)—Scientific reviewer to select REU (Research for Undergraduates) abstracts for BMES presentations (San Antonio, Oct. 22-25, 2014)

21st Annual Meeting & Exhibition of the International Society of Magnetic Resonance in Medicine (Salt Lake City, Utah, USA. April 20-26, 2013)

2009 World Molecular Imaging Congress (June, 2009)

CSMRM & OCSMRM Joint Meeting 2008 and ESMRMB Workshop (Fall, 2008)

5. SCIENTIFIC RESEARCH GRANTS and CONTRACTS:

Grant Number	Grant Title	My Role in Project and Percentage of Effort	Years Inclusive	Source	Funded Amount
Under Review:					
NIH R41 (STTR Phase I - Clinical Trial Required)	Fast Biomarker Imaging for Early Detection of Neoadjuvant Chemotherapy Response in Triple Negative Breast Cancer (TNBC) using pi-SelMQC Methods	Lead-Principal Investigator (Contact PI) (15% effort)	07/01/2022 – 06/30/2023	NIH NCI	$ 399,502 (Total Costs)
DoD Breast Cancer Research Program (Breakthrough Award Levels 1)	Clinical MR Spectroscopic Imaging of Prognostic Biomarkers for Combinational Pembrolizumab-Chemotherapy Treatment of PD-L1+ Triple Negative Breast Cancer	Principal Investigator (Lead PI) (11% effort)	10/01/2022-09/30/2025	DoD Congressionally Directed Medical Research Programs	$450,000 (Direct Costs) $699,750 (Total costs)
NIH R01	Selective Targeting of	Co-Investigator	04/01/2023-	NIH NCI	$3,653,948

(Animal tumor model and spontaneous tumor investigations)	Glioblastoma with Algorithmically Controlled Pulsed Electric Fields	(30% effort) (PI: Michael Sano at North Carolina State University)	03/31/2028		(Total budget)

PEER-REVIEWED & AWARDED:

#1 NCTracs 550KR282113	Towards Broadly Available Molecular Imaging with Parahydrogen Hyperpolarized MRI: A proof-of-concept study mapping reprogramed tumor metabolism in glioblastoma	Co-Investigator (10%) (Multi-PI: Hong Yuan/Thomas Theis)	5/1/2022 – 4/30/2023	NCTraCS CTSA Pilot Grant	$50,000 (Direct Costs)
#2 NIH 1R01 CA109471-01 A1	Fast 3D MR Spectroscopic Imaging of Human Breast Cancer	Principal Investigator (50% effort)	4/1/2005-3/31/2012	NIH NCI	$1,250,000 (Direct Costs) $1,826,034 (Total Costs)
#3 DoD Breast Cancer Synergistic Idea Award (W81XWH-09-1-0555 BC084091)	Fat-1 Gene Therapy as an Adjuvant to Hormonal Treatment of Breast Cancer	PI, 25% (Corresponding PI)	10/01/2009 - 09/30/2012	$267,608 (PI#1--He, Qiuhong) + $235,478 (PI#2—Li, Luyuan)	$762,175
#4 DoD Breast Cancer Concept Award (BC097603)	The Blood Vessel-Associated Breast Cancer Invasion and Metastasis Mediated by Endothelial BDNF Release	PI, 10%	09/15/2010 – 10/14/20112	DoD CDMRP	$75,000 (direct costs)
#5 Friends for an Earlier Breast Cancer Test	Development of Chimeric Biopolymers as Molecular MRI Contrast Agents to Detect Premalignant Breast Lesions, Breast Cancer, and Metastasis	Principal Investigator (10% effort)	3/1/2008 – 3/31/2011	Friends for an Earlier Breast Cancer Test Foundation	$40,000 (direct and indirect costs)
#6 R21 (1 R21 EB001756-01):	"Bacteria-Based MR Molecular Imaging of Tumor Oxygenation."	Principal Investigator	9/15/2003-8/31/2007	NIH NIBIB	$350,000 (Direct Costs) $415,262 (Total Costs)

#7	"*In Vivo* Magnetic Resonance Spectroscopy of Breast Cancer on Clinical Scanners	Principal Investigator	10/1/01-09/30/05	Susan G. Komen Breast Cancer Foundation	$249,823
#8	"*In Vivo* Magnetic Resonance Spectroscopy of Breast Cancer on Clinical Scanners."	Principal Investigator	03/19/01-2003	MSKCC Translational and Integrative Medicine Fund	$100, 000
#9 R21 (1 R21 CA80906-01A1	"*In Vivo* Proton MRS Detection of Malignant Breast Cancer."	Principal Investigator	04/01/00-04/30/04	NIH	$280,000
#10 R21 Research Resources (1 R21 RR12774-01)	"Three-Dimensional Electrophoretic NMR of Mixed Proteins."	Principal Investigator	9/30/97-8/31/03	NIH	$202,992
#11 James A. Shannon Director's Award (1 R55 GM/OD55209-01	"Voltage Induced S4 Conformation Changes by NMR."	Principal Investigator	9/30/97-8/31/02	NIH	$100,000
#12	"Gene Therapy Monitoring by Magnetic Resonance Techniques."	Co-Principal Investigator PI: G. Pizzorno (Yale University)	01/1/00-12/31/01	Susan G. Komen Breast Cancer Foundation	$200,000
#13	"^{1}H MRS Detection of Metabolic Changes and Drug Delivery in Human Breast Cancer (Postdoctoral Fellowship)."	Principal Investigator	10/1/96 - 9/30/03	Susan G. Komen Breast Cancer Foundation	$105,000
#14	"Electrophoretic NMR of Mixed Proteins and Oligonucleotides."	Co-Investigator	(1998-2000).	NSF Summer Research Experience for Undergraduates (REU) Program	$57,000
#15	"Cell Culture Facilities--Magnetic Resonance Spectroscopy and Imaging of Breast Cancer."	Principal Investigator	01/01/99 - 12/30/99	University of Connecticut Research Foundation Equipment Competition	$13,171
#16 ACS-PRF# 32308-G4	"Homonuclear Coherence Correlated Electrophoretic NMR."	Principal Investigator	7/15/97 to 8/30/99	American Chemical Society Petroleum	$20,000

				Research Fund	
#17 MCB-9707550	"Motion Ordered Correlation NMR Spectroscopy for Determining Multiple Protein Conformations in Solution."	Principal Investigator	7/1/97 to 6/30/99	NSF Research Planning Grant	$18,000
#18	"Three-Dimensional Electrophoretic NMR to Characterize the Conformational Heterogeneity of Chemically Altered DNA Duplex."	Principal Investigator	1/1/98-12/31/98	The University of Connecticut Research Foundation	$12,373
#19	"Multi-slice Sel-MQC for Proton Detection of Human Breast Cancer."	Principal Investigator	6/1/97 - 5/30/98	The University of Connecticut Research Foundation:	$9,000
#20	"Gradient and Electrophoresis Accessories and Probes for Bruker DRX 400 NMR Spectrometer."	Principal Investigator	1/1/97 to 12/31/97	The University of Connecticut Research Foundation	$21,500
#21 ACSIN152L-132	"Multislice Selective Multiple Quantum Coherence Transfer Toward Clinical Proton MRS Investigation of Breast Cancer."	Principal Investigator	3/1/96-6/30/97	American Cancer Society Institutional Research Grant	$11,685
#22	"Homonuclear Coherence Correlated Electrophoretic NMR."	Principal Investigator	11/1/95-12/31/96	The University of Connecticut Research Foundation	$13,196

NON-PEER REVIEWED RESEARCH FUNDS:

#23	Startup Funds for equipment and student support	Principal Investigator	8/15/2022-	Purdue University	
#24	Startup Funds	Principal Investigator	09/15/03 – 09/15/06	University of Pittsburgh	$75,000
#25	Start-up equipment funds	Principal Investigator	9/1/1995-8/30/1998	The University of Connecticut	$150,000

4. DETAILS OF OCCUPATION

4.1 ORGANISATIONAL RESPONSIBILITIES

4.1a. SERVICE:

Purdue University, School of Health Sciences

Serving on Undergraduate Curriculum Committee (UCC)

University of North Carolina School of Medicine at Chapel Hill

Serving as a Staff Scientist in MR physics in the Center for Animal MRI (CAMRI) in Biomedical Imaging Research Center (BRIC), University of North Carolina School of Medicine. Involved in the magnetic resonance imaging and spectroscopy service and research, as well as Bruker 9.4T MRI system maintenance and operation. Design MRI protocols for anatomical MRI of embryo specimens and rodent animal models. Successfully programmed Bruker 9.4T (AVII PV 6.0.1 console) and invented the novel phase incrementing Selective Multiple-Quantum Coherence Transfer (pi-SelMQC) methods for in vivo studies of mammary tumors, prostate cancer and lung cancer mouse models. UNC-CH has filed a full patent application on the pi-MRSI methods. We have formed an UNC Start Up company IrNex-Inc to develop MRI software and hardware for pi-MRSI implementation on clinical MRI scanners. Programming the multi-band SWIFT-ZTE pulse sequence for live animal fMRI in collaboration with neuroscience researchers at UNC medical school. Provide MRS (H-1 and C-13) services using 9.4T MRSI system and small animal C-13 RF coils to UNC researchers and colleagues from the North Carolina State University and Pharmaceutical Companies. Characterizing C-13 labeled drug leuprolide acetate in 10% trichloroacetic acid (TCA) aqueous solution using the high-resolution 850MHz NMR spectrometer and 9.4T Bruker MRI scanner in phantoms and in vivo using mouse and rat models in the UNC School of Medicine. We also initiated experiments to detect the C-13 labeled pyruvate preparing for the hyperpolarization experiments.

University of Pittsburgh School of Medicine

Served as the Faculty Coordinator to direct Faculty Research Seminar, Department of Radiology, University of Pittsburgh, 2005 - 2007. Working with the Radiology Chairman to fund the faculty research seminar series for inviting outside speakers. Invited outstanding scientists to give seminars from various academic institutions including Yale, UPPEN, Johns Hopkins School of Medicine, NIH, Weill Medical College of Cornell University, etc. The event has attracted a full house attendance of faculty, research fellows and students from the University of Pittsburgh and Carnegie Mellon University. As part of the resident training program, the Department of Radiology has required the radiology residents to attend this seminar series and kindly provided nutritious lunch to attendees.

Directing Biochemistry Laboratory and cell culture facility in the Magnetic Resonance Research Center, Department of Radiology, University of Pittsburgh, 2003 - 2012. Equipped the laboratory with bacterial culture, biochemistry and genetic engineering, and mammalian cell culture equipment. Ensured compliance with government and institutional regulations. Training laboratory personnel and coordinate with the university training courses of blood-born pathogen training and chemical hygiene training, etc. Certified for rDNA research.

Member, Pilot Imaging Evaluation Committee, Department of Radiology, University of Pittsburgh, 2003-2004. Reviewing institutional investigational proposal for internal funding support to initiative MRI research projects using the MRI scanners in the Magnetic Resonance Research Center.

Directed magnetic resonance spectroscopy and imaging research and cancer biology research using animal models and human subjects. Managing a research group consist of postdoctoral research fellows, graduate students, undergraduate students, high school student volunteers, and laboratory technicians from University of Pittsburgh, Carnegie Mellon University, and summer visiting students from other Universities.

Memorial Sloan-Kettering Cancer Center:

Directing magnetic resonance spectroscopic imaging research and cancer research using human subjects and animal tumor models. Further developed the electrophoretic NMR methods and applications. Working with postdoctoral research fellows and collaborators from Yale University, Memorial Sloan-Kettering Cancer Center, Cornell University Medical School, and Columbia University.

University of Connecticut:

Member, Graduate recruiting committee, Department of Chemistry
Member, Faculty search committee, School of Medicine
Hosted Departmental seminars, Department of Chemistry

Directed a Physical Chemistry Research Laboratory for NMR research with applications in biophysics and biomedical applications; Designed a new physical chemistry research laboratory in the new chemistry building, which has included a tissue culture room and benches for molecular biology experiments. Led a research collaborative team and initiated studies using the Sel-MQC technique to detect human breast cancer on the 2.1T Human MR scanner at Yale MR Center at Yale University School of Medicine, collaborating with Yale physician-scientists. The project was supported by Susan G. Komen Breast Cancer Foundation and NIH R21 grants. Developed innovative Electrophoretic NMR techniques for structure characterization of multi-component proteins and protein conformations in solution NMR.

University of North Carolina at Chapel Hill (Chemistry):

Senior graduate student laboratory manager. Assisted Prof. Charles S. Johnson, Jr. (PI) in laboratory management, including training new graduate students to carry out Electrophoretic NMR research and operate Bruker 250MHz NMR spectrometer.

4.1b. PRINCIPAL INVESTIGATOR (PI) ON RESEARCH PROTOCOLS:

Human subject studies:

IRB Protocol at University of Pittsburgh (#PRO07030201 or previously #0412007): "Magnetic Resonance Spectroscopic Imaging of Human Cancer." (PI: Qiuhong He) Effective Date: 12/1/2004 – 2012

IRB Protocol at Yale University (HIC# 11783): "In Vivo Proton MRS Detection of Breast Cancer." (PI: Qiuhong He, Ph.D. and Carol H. Lee, M.D.) Expiration Date: July. 13, 2003

Animal Research Protocols:

IACUC protocol at University of Pittsburgh (#1104174A, or previously #0708118A or #0404569): "MR Spectroscopy and Imaging of Animal Tumor Models" (PI: Qiuhong He) Effective date: 4/6/2004 – 2012.

IACUC protocol at University of Pittsburgh (#12030309 or previously #0903318B-2): "Molecular Therapy and Imaging of Cancer Using Animal Tumor Models." (PI: Qiuhong He) Effective date: March 25, 2009 – 2012.

DoD ACURO animal care and use protocols for the DoD funded breast cancer research projects using animal tumor models.

4.1c. RESEARCH:

Purdue University, College of Human and Health Sciences, School of Human Sciences

A. Translational human investigation of innovative pi-MRSI in early detection of cancer treatment responses. Human breast cancer and brain tumor patients will be investigated using the whole-body Siemens 3T and GE 3T MRI scanners. We will also study spontaneous tumors in canine oncology patients in veterinary medicine clinics. The novel pi-MRSI methods have been demonstrated in phantoms and mouse tumor models on a Bruker 9.4T MRI scanner for small animal imaging and in vivo spectroscopy.

B. Bacteria based cancer therapy and imaging using animal tumor models. We will investigate the potential of bacterial based cancer therapy to enhance cancer immunotherapy to turn "cold" tumors "hot." Previously, we have genetically engineered attenuated bacteria, which only amplify in tumor tissues, to express anti-cancer proteins and MRI markers. MRI methods will be employed in monitoring longitudinal treatment responses. In a recent collaborative research, we have used machine-learning algorithms to characterize the effectiveness of cancer treatment from previously acquired diffusion-weighted MRI (DWI) images.

University of North Carolina School of Medicine, Biomedical Research Imaging Center (BRIC), Center for Animal MRI (CAMRI)

A. Development of phase-incrementing Magnetic Resonance Spectroscopic Imaging (pi-MRSI) Methods (U.S. Patent pending) on the pre-clinical Bruker 9.4T MRI scanner BioSpec 94/30USR with AVII PV 6.0.1 Console and RRI gradients. The innovative phase-incrementing Magnetic Resonance Spectroscopic Imaging (pi-MRSI) method has been demonstrated to resolve overlapping biomarker images in the presence of read-gradient, with excellent lipid and water suppression. On a Bruker 9.4T MRI spectrometer, the pi-SEE-HSelMQC sequence was implemented. The choline-selective and lactate CH-selective RF pulses were phase incremented by 10° in opposite signs, synchronized with the phase-encoding steps. The lactate and choline images from the Yogurt phantom displayed opposite image offsets without image overlapping. In vivo one-dimensional pi-SEE-HSelMQC CSI images of lactate and choline, acquired from the MDA-MB-231 human breast cancer xenograft in a nude mouse, also had opposite image offsets, shifted away from the spurious residual water signals in the image center. The pi-SEE-HSelMQC method completely suppresses lipid and water with potential clinical applications in disease diagnosis and therapeutic interventions. In vivo 2D pi-SEE-HSelMQC imaging with the frequency-encoding read-gradient was carried out on a PC3 prostate tumor grown in the right flank of nu/nu mouse. The tumor lactate and choline images were detected with opposite image offsets away from the image center, due to -10° and 10° phase increments of the choline selective RF pulse and the last lactate CH selective RF pulse, respectively, in synchronization with the phase encoding steps. The residual water and lipid signals stay at the image center, not overlapping with the resolved lactate and choline images. We have also demonstrated different versions of 3D pi-SEE-SelMQC pulse sequences and provided data for proof-of-concept that 3D pi-MRSI can be accomplished in almost same amount of time as 2D pi-MRSI imaging scans.

B. A novel double echo phase-incrementing soft Selective Multiple Quantum Coherence Transfer (pi-SSelMQC) method was developed to detect full Sel-MQC spectroscopic imaging signals of biomarkers in vivo with excellent water and lipid suppression (U.S. patent pending). For demonstration, the pi-SSelMQC experiments were carried out to map lactate spatial distributions in a yogurt phantom and in vivo in murine 344SQ lung tumors grown subcutaneously on the right thigh of syngeneic 129X1/SvJ male mice. Both ZQ→DQ and DQ→ZQ coherence transfer pathways were detected by synchronizing the phase-encoding gradient steps and RF phase increments of the selective MQ-excitation pulse. The lactate images from the two different MQ-coherence pathways were detected with opposite imaging offsets away from spurious residual signals of unwanted biochemicals, recovering the 50% lost signal in Sel-MQC. Detecting both MQ-coherence pathways using this pulse sequence design, however, may reintroduce lipid and water signals with gradient ratio g1:g2:g3=1: -1:2. To address the issue, I have designed the double-echo pi-SSelMQC sequences employing read-gradients to acquire two separate MQ-coherence transfer echoes. The double-echo pi-SSelMQC permits excellent lipid and water suppression, similar to the original SSel-MQC experiments, yet enabling fast MR spectroscopic imaging of a biomarker with full signal recovery from both ZQ→DQ and DQ→ZQ coherence transfer pathways. The biomarker signals from the two MQ-coherence pathways can be digitally added. The two MQ-transfer echoes are separated permitting insertion of gradient pulses between the two MQ-coherence transfer echoes. To further suppress spurious signals, the last 90° pulse was phase cycled in two steps when number of scans ≥2. We have also demonstrated a version of 3D double echo pi-SSelMQC pulse sequences by applying an additional phase-encoding gradient in the direction of the slice-selective gradient.

C. MRSI of Nicotinamide adenine dinucleotide (NAD+) at 9.4T. In a collaboration with UPENN researchers, I have applied the Sel-MQC CSI technique and detected Nicotinamide adenine dinucleotide (NAD+) in 0.5mM NAD+ in saline solution on the 9.4T Bruker PV6 MRI animal spectrometer using a Doty quadrature volume coil.

In vivo mouse imaging experiments will be conducted on the newly upgraded Bruker PV360 MRI spectrometer (the upgrade is on-going in the progress). In addition, double echo pi-SSelMQC images of NAD+ were obtained using the pulse sequence pi-SSelMQC from 51mM NAD+ in saline in a 15 mL conical tube using a Doty quadrature volume RF coil. The slice-selective 90° excitation pulse was applied at NAD+ proton resonant frequency at 8.21ppm. The second 90° Gaussian frequency-selective pulse was applied at NAD proton at 8.84ppm, which is J-coupled to the NAD+ proton at 8.21ppm. The frequency-selective refocusing 180° pulse was also a Gaussian frequency-selective pulse. The RF phase of the last selective 90° pulse was phase-incremented in 10° in synchronization with the spatial phase-encoding gradient steps to separately acquire the MQ-coherence transfer echoes from the two different MQ-coherence transfer pathways (ZQ→DQ and DQ→ZQ pathways) for full NAD+ signal recovery.

D. Collaborative research to implement multiband SWIFT-ZTE method for live animal fMRI on the Bruker 9.4T pre-clinical MRI spectrometer.

University of Pittsburgh School of Medicine, Department of Radiology, Department of Bioengineering, and University of Pittsburgh Cancer Institute (Principal Investigator).

A. Magnetic resonance spectroscopic imaging (MRSI) of human breast cancer. The project has been funded by NIH R01 and R21 grants and Susan G. Komen Breast Cancer Foundation. We have developed fast MRSI methods for human breast cancer detection in collaboration with Magee Womens' Hospital, University of Pittsburgh Cancer Institute (UPCI), Pathology, Radiology, and Department of Biostatistics. In the University of Pittsburgh Medical Center (UPMC), we have implemented the Sel-MQC methods on a human GE 3T whole-body scanner to detect metabolites, with lipid and water suppression in a single scan in breast tissues. We have constructed transmit/receive breast coils for high-field MRI/MRSI studies of breast cancer (3T and 7T) and heteronuclear breast coil systems. The prototype heteronuclear breast coils (H-1, F-19, C-13, Na-23) was tested on the 7T and 3T MRI Siemens scanners. A fast spiral-SelMQC sequence has been developed to map PUFA distributions in breast tissues *in vivo*, using a rapid spiral k-space sampling scheme. Approximately 160-fold reduction of acquisition time was observed as compared to the corresponding selective multiple-quantum coherence transfer chemical shift imaging (CSI) method with an equivalent number of scans, permitting acquisition of high-resolution human PUFA images in minutes. The reconstructed Spiral-SelMQC PUFA images of human breast tissues achieved a sub-millimeter resolution of 0.54 x 0.54 or 0.63 x 0.63 mm^2/pixel for field of view (FOV) = 14 or 16 cm, respectively. In collaboration with University of Illinois at Chicago, we have designed spectral-spatial selective RF pulses for multi-slice and volume localizations of Sel-MQC to study human breast cancer. Two-dimensional Sel-MQC methods have been implemented on the GE 3T magnet to study polyunsaturated fatty acids and lactate changes in human breast cancer. In addition, we have developed and implemented new members of the Sel-MQC sequence family for simultaneous detection of lactate and choline, or lactate and PUFAs, or lactate, choline and PUFA without spectral baseline distortion. We have also developed *in vivo* selective zero-quantum coherence transfer (Sel-ZQC) sequences permitting measurements of metabolite signals in the ZQ-dimension without inhomogeneous broadening due to magnetic susceptibility dispersion or poor shimming of the static B_0 magnetic field. Compressed sensing Sel-ZQC method has also been developed in collaboration with the Department of Electrical & Computer Engineering, National University of Singapore. Our preliminary study using compressed sampling in the ZQ-dimension of Sel-ZQC has demonstrated feasibility to reduce approximately 70% data acquisition time without degrading Sel-ZQC image quality. Combination of CS-SelZQC and spiral k-space mapping will speed up *in vivo* spectroscopic imaging data acquisition for human subject studies. Our Sel-MQC techniques may be applied to study other types of cancer or other human diseases.

B. Bacterial-based cancer therapy using animal tumor models and treatment monitoring by diffusion-weighted imaging (DWI) and diffusion-tensor imaging (DTI). Genetically modified attenuated *Salmonella typhimurium* and *E. coli* strains to express anti-cancer proteins such as TNF_α or/and methioninase, GFP or RFP optical imaging and magnetic resonance (MR) imaging markers. For instance, some strains of engineered attenuated *Salmonella typhimurium* and *E. coli* strains express MR contrast agent myoglobin for mapping tumor oxygenation. Anti-bacteria monoclonal antibodies were tagged with MR contrast agent Gd(DTPA) for visualization of bacterial infiltration in tumor tissues. After intra-tumoral (*i.t.*) or *i.v.* injection of the engineered bacterial strains expressing

TNF_{α} or/and methioninase, the injected bacteria selectively infected tumor tissues including distant secondary tumors. Rapid tumor tissue destruction was detected non-invasively starting 4th day of bacteria injection and complete tumor tissue destruction was observed non-invasively in 10 days using diffusion-weighted imaging (DWI) and diffusion-tensor imaging (DTI) in mouse models. Massive cancer cell apoptosis was observed accompanied by large number of macrophage infiltration in tumor tissues. The bacteria were not detectable in healthy tissues and normal organs with histological staining. It is likely that the anti-cancer bacteria have suppressed tumors by invoking innate and adaptive immune responses to overcome immune tolerance of cancerous tissues. The project was funded by an NIH R21 grant, the start-up research fund and faculty travel funds from the Department of Radiology, University of Pittsburgh.

C. Fat-1 Gene Therapy as an Adjuvant to Hormonal Treatment of Breast Cancer. We have demonstrated that the fat-1 gene (C. elegans) encoding the n-3 fatty acid desaturase, which converts omega-6 polyunsaturated fatty acids (PUFA) to n-3 PUFA suppress malignant and premalignant breast cancer lesions, as well as tamoxifen-resistant breast cancer. Using C57BL/6 fat-1 transgenic mice with intact immune system, we have observed lung and liver metastasis of murine E0771 breast cancer cells and Lewis Lung Carcinoma (LCC), respectively, in the wild type C57BL/6 mice during an animal-housing pin-worm breakout. There was no metastasis observed in the fat-1 transgenic mice in normal animal housing conditions. (The metastasis observed under the rare experimental conditions is likely caused by the chemical and immunological stimuli during the breakout and the mouse treatment). We have bred double transgenic mice by crossing C57BL/fat-1 mice and MMTV-tva mice to study fat-1 suppression of spontaneous breast cancer induced by RCAS-PyMT tumor virus. In collaboration with Kacey Marra's group, we initiated a project to study adipocyte stem cells expressing fat-1 gene in treatment of breast cancer and other human diseases. The project was funded by the Breast Cancer Research Program, Department of Defense U.S. Army Medical Research and Materiel Command Congressionally Directed Medical Research Programs. H-1 and C-13 MRSI may be employed for *in vivo* monitoring of the biochemical conversion of n-6 to n-3 PUFA in fat-1 mice.

D. Proteomic Electrophoretic NMR for structure characterization of biological signaling processes. We have published the theoretical model of proteomic exchange-ENMR (Ex-ENMR). In the previous years, we have established the multi-dimensional ENMR techniques to study protein mixtures. In the development of three-dimensional Electrophoretic NMR exchange spectroscopy for structural characterization of protein interactions, we have carried out detailed theoretical analysis of electrophoretic exchange NMR spectroscopy for the structural characterization of chemical exchange sites of interacting proteins in solution. The ENMR monitoring atomic rearrangement of interacting biomacromolecules may represent a crucial technical advancement in magnetic resonance to provide critical structural information of biological signaling processes. The Ex-ENMR may be applied to investigate cancer drug targets in proteomic samples. In the ENMR hardware development, we have designed and tested novel ENMR microcoil probes on a Bruker Avance 500 MHz and a Bruker 600 MHz NMR spectrometers in the small animal MRI center in Mellon Institute.

E. Development of Chimeric Biopolymers as Molecular MRI Contrast Agents to Detect Premalignant Breast Lesions, Breast Cancer and Metastasis. In this project, chimeric biopolymers were engineered as MR contrast agents to detect breast cancer cells, the tumor-infiltrating macrophages, and tumor angiogenesis for early breast cancer detection at the premalignant stage. The MMTV-tva/RCAS-PyMT mammary tumor model was established, which develops spontaneous mammary tumors induced by intraductal injection of RCAS-PyMT tumor virus in transgenic FVB/MMTV-tva mice. The project has received seed-funding from FRIENDS FOR AN EARLIER BREAST CANCER TEST foundation.

F. The Blood Vessel-Associated Breast Cancer Invasion and Metastasis Mediated by Endothelial BDNF Release. The objective of this study is to test our hypothesis that tumor invasion and metastasis are partially due to long distant extravascular migrations associated with blood vessel networks. We are investigating: (1) live breast cancer cell migration associated with 3D blood vessel networks mediated by endothelial BDNF expression *in vitro* using time-lapse microscopy and imaging; and (2) blood vessel associated metastasis and invasion of breast cancer *in vivo* using luciferase imaging of live animals and fluorescence time-lapse microscopy of fresh tumor tissues. The

project was supported by the DoD Concept Award, Breast Cancer Research Program, Department of Defense U.S. Army Medical Research and Materiel Command Congressionally Directed Medical Research Programs.

Departments of Medical Physics and Radiology, Memorial Sloan-Kettering Cancer Center | Weill Medical College of Cornell University, New York | Magnetic Resonance Center, Yale University School of Medicine

A. Lactic acid as surrogate marker of Salmonella infection in murine tumors by non-invasive Magnetic Resonance Spectroscopy.

In collaboration with Dr. Giuseppe Pizzorno's laboratory at Yale University School of Medicine, we have investigated mechanisms of the tumor-specific amplification of attenuated *Salmonella typhimurium* using murine Colon 38 tumor models. At the time, the use of gene therapy in the treatment of cancer had been focused on the locoregional administration of gene-vectors because of the limited tumor targeting and selectivity of the available gene delivery systems. Attenuated *Salmonella typhimurium* represented a step in the direction of improved tumor specificity. Auxotrophic mutations have generated a much less virulent strain of bacterium that possesses high tropism for tumor tissues and has the ability to amplify in both aerobic and anaerobic growth conditions. We have applied a magnetic resonance spectroscopy (MRS) technique for non-invasive monitoring of the anti-cancer therapeutic effect of *Salmonella* targeting to the tumor tissues. Lactic acid was used as a surrogate marker of the localized tumor-specific *Salmonella* infection to determine the distribution and proliferation of the attenuated *Salmonella* vector. For *in vivo* detection of lactate, we have applied our Sel-MQC proton NMR technique developed specifically to monitor lactate in tissues containing high endogenous lipid signals. In colon 38 tumors transplanted in C57BL/6 mice following intraperitoneal administration of Salmonella ($5x10^7$ pfu/mouse), we observed a significant reduction (80-90%) in the initial level of lactate (10-12 mM) after 7-8 hours from the administration. This effect was followed by a rapid return of lactate to pre-treatment level within 24 hours after *Salmonella* administration. The *ex vivo* determination of lactate concentration utilizing a classical enzymatic biochemical analysis confirmed the *in vivo* MRS evaluation. The work was supported by Susan G. Komen Breast Cancer Foundation.

B. In vivo characterization of angiogenesis and metabolic changes of endometrial cancer in transgenic murine tumor models by high-resolution magnetic resonance imaging and volume-selective Sel-MQC spectroscopy

In collaboration with Dr. Lora Ellenson's group in Weill Medical College of Cornell University, we have applied the high-resolution magnetic resonance imaging and spectroscopy techniques for *in vivo* investigation of murine endometrial cancer models. Preliminary experiments have been carried out on a Bruker 7T horizontal bore MRI/MRS spectrometer to demonstrate the feasibility of quantitative measurement of tumor vasculature permeability and blood volume by rapid T_1 weighted MRI before and after injection of macromolecular contrast agents. Volume-selective Sel-MQC (Selective Multiple-Quantum Coherence transfer) has been developed and demonstrated for lactate detection in tumor tissues of internal organs (e.g., uterus). A volume-selective composite 90° pulse (30°-τ-30°-τ-30°) was employed in place of the slice-selective 90° pulse in the original Sel-MQC sequence. Tumor tissue lactate level that may be detected in endometrial cancer would provide information of metabolic changes, which would also reflect the tumor angiogenesis and blood flow characteristics during tumorigenesis and cancer therapy. With enhanced spectral resolution and uniform B_1-field distribution, the Vol-SelMQC methods may be applied in both human cancer investigations and animal tumor model studies for localized lactate measurement.

C. Absolute in vivo quantification of lactate in lipid abundant tissues by Sel-MQC.

Tissue lactate as the end-product of glycolytic metabolism is an important biomarker of cellular oxygenation and energy status. *In vivo* detection of lactate by ^1H MR spectroscopy, however, is complicated by the presence of intensive lipid peaks co-resonant at the chemical shift of lactate CH_3 protons (1.3ppm). The Selective Multiple Quantum Coherence transfer (Sel-MQC) spectral editing scheme achieves complete lipid and water suppression in a single scan, permitting efficient *in vivo* lactate detection. Absolute quantification of the

tissue lactate concentration detected by Sel-MQC methods requires measurement of lactate T_1 & T_2 relaxation times and the B_1 field map of the RF coil. However, T_2 relaxation measurements of lactate using the Sel-MQC sequence are confounded by the J-coupling interactions between lactate protons. To address this issue, we have developed the T_2-SelMQC and T_1-SelMQC sequences, which overcome the signal J-modulation effect, facilitating the T_2 and T_1 measurements of lactate with complete lipid and water suppression. The pulse sequences have been demonstrated *in vitro* in phantoms containing lactate/water/oil and *in vivo* in mouse tumor models.

D. Multi-dimensional Electrophoretic NMR for structure characterization of interacting protein and protein conformations in solution.

Despite numerous successes of NMR in structural biology, the simultaneous structure determination of multiple proteins and the studies of protein interactions, especially weak interactions, remain a formidable task. Most NMR investigations of protein mixtures are limited to systems containing a single protein and small molecules with resolvable chemical shifts. Coexisting protein conformations have been identified, for example, for well-characterized small proteins such as basic pancreatic trypsin inhibitor (BPTI); however, severe signal overlap prevented full structural characterization of many detected protein conformations. In previous studies, we have shown experimental evidence that: (1) electrophoretic NMR can resolve overlapping NMR resonances of co-existing proteins in solution without requiring physical separation; (2) The electric current induced heating and convection can be dramatically reduced by capillary array electrophoretic NMR and convection compensated ENMR methods; (3) 3D electrophoretic NMR can separate 2D COSY and HSQC spectra of two molecules in a solution mixture. These results have demonstrated the feasibility of determining structures of proteins and protein conformations co-existing in solution and possibility of structural characterization of interacting proteins and protein conformations. We have continued our efforts to develop three-dimensional ENMR focusing on the ENMR techniques for studying chemical exchange and protein interactions. In collaboration with Dr. Andrew F. Laine's group in Biomedical Engineering Department, Columbia University, we have evaluated the ENMR signal processing method combining spectral denoising and linear prediction. In an independent study, we have found that maximum entropy method (MEM) gives high-resolution ENMR spectra without introducing artifact to distinguish signals from different molecules in the electrophoretic flow dimension, which is crucial in structure mapping of protein conformations and protein interactions.

E. Solvent suppression for biomolecular structural analysis by electroosmosis-enhanced electrophoretic ENMR (EE-ENMR)

Multi-dimensional NMR spectroscopy is an indispensable tool for structural characterization of proteins and DNA molecules in aqueous environment. In these studies, solvent suppression has played an important role. Pre-saturation pulses, binomial sequences, WATERGATE and DPFGSE sequences have been employed, as well as the sequences based on differential diffusion rates between water and macromolecules. We have developed an alternative approach--the electroosmosis-enhanced ENMR (EE-ENMR) technique--to suppress the intensive water resonance. In the previous 2D- and 3D-ENMR experiments, we have shown that electrophoretic interferograms can be obtained for ionic species migrating in DC electric field. In the presence of electroosmosis when methylcellulose coating was not applied to the inner glass surface of the capillaries, the bulk flow of uncharged water molecules has been observed in U-shaped CA-ENMR sample tubes. The coherent motion of water generates a cosinusoidal interferogram with a spectral nulling point of water signal at a specific electric field, when the phase shift of the magnetization is 90° x n, where n is an integer. The multi-dimensional ENMR experiments of proteins carried out at this electric field have an intrinsic water suppression capability, independent of other water suppression mechanisms, for structural characterization of co-existing proteins, protein conformations, and their interactions in solution. Similar to the diffusion-based water suppression methods, ENMR suppression of water does not erase the protein resonances under the water peak. Successful solvent suppression has been achieved in ENMR experiments for 4mM lysozyme solution by optimizing the electric field or gradient pulses. These experiments were carried out on a Varian UNITY-500 spectrometer that was interfaced to a DC electric power supply to produce a maximum voltage output of 1000V.

Department of Chemistry at the University of Connecticut and Magnetic Resonance Center at Yale University School of Medicine

A. Multi-Dimensional Electrophoretic NMR for Simultaneous Structure Determination of Multiple Proteins and Protein Conformations.

Simultaneous structural characterization of multiple proteins and protein interactions, especially weak interactions, remain a formidable task despite numerous successes of NMR in structural biology. Most NMR investigations of protein mixtures are limited to systems containing a single protein and small molecules with resolvable chemical shifts--severe NMR signal overlap prevents full structural characterization of multiple protein conformations. We have developed electrophoretic NMR methods to resolve overlapping NMR resonances of mixed proteins, without their physical separation, based on different electrophoretic mobilities of the protein components. Three-dimension electrophoretic NMR (3D-ENMR) sequences have been developed to obtain the sub-spectra of the ionic mixture components in solution, sorted out in the dimension of electrophoretic flow. In principle, structural parameters (i.e., chemical shifts, J-coupling constants, or NOE correlations) can be measured for simultaneous sequential and stereo-specific assignments of proteins. We have addressed the issue of heat-induced convection for electrophoretic NMR of biomacromolecules in high salt biochemical buffer conditions. We have also developed constant-time multidimensional ENMR, which has removed the line broadening factors due to molecular diffusion and spin relaxation in the dimension of electrophoretic mobility. As a result, the electrophoretic NMR experiments can be performed to investigate proteins and protein conformations in biological buffer solution of high ionic strength. The project has been funded by NIH, NSF, and ACS-PRF.

B. Voltage Induced Conformation Changes of the K^+ Channel S4 Peptides.

Voltage-gated Na^+, K^+, and Ca^{2+} channels contain highly conserved and positively charged S4 segments. The S4 movement during voltage gating is believed to control the activation of ion channels. Two possible models- "sliding helix" (or "helix screw") and "propagating helix" - are proposed to describe the translational movement of S4 and its conformation changes during membrane depolarization. However, no structural evidence is available to support those models. We developed high electric field NMR systems to investigate the structural and functional relationship of S4 voltage sensor during ion channel activation and inactivation. The knowledge gained on the molecular mechanism of ion channel signal transduction will be used to control diseases related to ion channel abnormalities in cardiac excitation-contraction, nerve conduction, muscle contraction, and cancer.

C. Proton Magnetic Resonance Spectroscopic Detection of Metabolic Changes in Human Breast Cancer

The early ^{31}P NMR studies of cancer have shown that magnetic resonance spectroscopy (MRS) is sensitive to tumor physiology and biochemistry. In this project supported by Susan G. Komen Breast Cancer Foundation, we have initiated the development of *in vivo* proton magnetic resonance spectroscopy (MRS) for human breast cancer detection to overcome the shortcoming of the spin echo based MRS methods, which are inadequate for extracranial MRS due to the limited lipid suppression capability. We have developed the Sel-MQC methods on a low field 2.1T human MRI/MRS spectrometer and demonstrated that actively shielded, low-strength commercial magnetic field gradients on a whole-body human MRI scanner is sufficient to suppress water and lipid in a single scan for biomolecule detection in human. We have carried out experiments on breast cancer patients in collaboration with breast cancer clinicians in Yale University School of Medicine. We have also developed multi-slice modules of the Sel-MQC sequences using Hadamard matrix approach to improve spatial resolution in monitoring metabolic changes in human breast cancer. The project has extended *in vivo* proton MRS beyond its limit of examining metabolites inside brain. Proton MRS detection of the intrinsic tumor markers and differentiate malignant from benign breast lesions will improve breast cancer diagnosis and treatment monitoring. The methods can be applied to cancer diagnosis in other extracranial organs, and high-grade brain tumors, which contain high levels of mobile lipid dominating the proton spectral range.

The Johns Hopkins University School of Medicine, Department of Radiology.

Postdoctoral Research, Advisor: Prof. Jerry D. Glickson.

The non-invasive, non-destructive NMR methods can detect biochemical changes *in vivo* in cells, animals, and humans. Metabolic changes and metabolite distributions can be followed by magnetic resonance spectroscopy in physiological conditions. Proton, which has the highest signal sensitivity for NMR detection, would be the choice of the nucleus for observing metabolites non-invasively at low tissue concentration. However, Proton NMR was mostly used for brain tissues that have little mobile lipids. Proton NMR spectra in other organs are dominated by lipid resonances, and the signal overlap prevents the detection of metabolites with low signal intensity. I have conceived and developed the Selective Multiple-Quantum Coherence transfer (Sel-MQC) methods that eliminate lipid and water signals in a single scan, permitting detection and imaging metabolite signals in tumor tissues containing high concentration of mobile fat. With Sel-MQC method, we have achieved the first *in vivo* proton NMR detection of an antineoplastic agent, Iproplatin, in RIF-1 tumors. I have also worked on other projects including *in vivo* ^{1}H NMR measurement of deoxymyoglobin in muscle and isolated heart. In addition, I continued my collaboration with Prof. Warren's group at Princeton University and detected intermolecular multiple-quantum coherence transfer (iMQC) between spins separated in different glass capillary compartments. This experiment provided evidence that the iMQC signal strength is determined by the applied magnetic field gradient that induced the magnetization helix pitch.

Princeton University, Department of Chemistry.
Postdoctoral Research. Advisor: Prof. Warren S. Warren

My experiments of intermolecular multiple quantum coherences (iMQCs) at Princeton University has led to a scientific discovery of the long-distance spin dipolar interactions observed in solution NMR. It was generally accepted that the spin dipolar interactions in small molecules are averaged out due to rapid molecular tumbling in isotropic solutions. In the presence of magnetic field gradients on high-resolution NMR spectrometers, I have observed intermolecular multiple quantum coherences of water and other small molecules derived from long distance spin dipolar interaction in solution. The iMQCs disappeared when multiple-quantum selection gradients were applied along the magic angle direction. I have also carried out the intermolecular multiple-quantum diffusion experiments to confirm the presence of iMQCs. The iMQC may provide a new mechanism of contrast enhancement for magnetic resonance imaging--researchers in other institutions have pursued iMQC medical imaging studies of human brain and breast cancer. In Princeton, I have developed shaped RF pulses to achieve isotropic mixing in total correlation NMR spectroscopy (TOCSY) based on the Average Hamiltonian Theory using simulated annealing optimization algorithm. The TOCSY experiments employing the shaped isotropic mixing pulse was successfully tested on a 500 MHz high-resolution NMR spectrometer.

University of North Carolina, Department of Chemistry, Chapel Hill.
Ph.D. thesis research, Advisor: Prof. Charles S. Johnson, Jr.

My pioneering work on electrophoretic NMR (ENMR) at UNC has established the very first two-dimensional electrophoretic NMR methods and ENMR applications to study small molecules, molecular aggregations, peptides and proteins in mixture solutions. At that time, most people believed that DC electric field pulses applied to any NMR samples in a high resolution NMR spectrometer would disturb magnetic field homogeneity due to interactions between electric field and magnetic field and thus will not generate the high-resolution NMR spectra. Our successful ENMR experiments have shown that the ionic migration of molecules can be measured by high resolution ENMR. My experiments initiated the first experimental demonstration of two-dimensional electrophoretic NMR. The experiments provided evidence that overlapping NMR signals from different molecular aggregations in solution can be resolved in a new dimension of electrophoretic flow. My development of 2D spin-echo ENMR, 2D stimulated echo ENMR, multiple-quantum ENMR (MQ-ENMR), and the 2nd type 2D ENMR has laid the foundation for my subsequent development of multidimensional electrophoretic NMR to study protein mixtures and protein interactions after joining the faculty in other institutions.

4.2 TEACHING EXPERIENCES:

Duke University's Fuqua School of Business, Durham, NC.

• Experiential Learning at Duke Fuqua Business School -- Mentored Study Program (MSP)
Spring 2022 (Coordinator: Fiona Behm – Associate Director, Experiential Learning)

Serving as a mentor for a Duke MBA student, Inbal Mayan, who is participating in the National Nucleate Activator Program as a member of Team IrNex-Inc working on clinical translation and commercialization of the pi-MRSI technology (patent-pending) for early detection of cancer treatment response. The team has four members: Inbal Mayan (the Duke MBA student) and Prajwal Malladi (a Duke Engineering Management student) are business members; Ritujith Jayakrishnan, MD, and a resident at Yale New-Haven Hospital Resident is the clinical member; and myself is the technical member as the inventor of the pi-MRSI technology. In a successful competition, the team was selected into the phase II National Nucleate Activator program, receiving mentoring and coaching from regional, national, and international renounced experts. We are among teams selected into the inaugural cohort of Nucleate RTP's Activator program in Research Triangle Park (RTP), NC.

University of Pittsburgh, School of Pharmacy, Department of Bioengineering, Department of Physics, and Department of Biological Science, and Department of Radiology:

Education:

COURSES TAUGHT:

• Graduate Pharmaceutical Analysis (PHARM 2001): graduate class Lectures (team teaching, 13 and more students, 3 credit) Topic: In vivo Magnetic Resonance Imaging and Spectroscopy
Spring 2009 (Coordinator: Li Song, Ph.D.)
Spring 2010 (Coordinator: Jan Beumer)
Spring 2011 (Coordinator: Jan Beumer)
Spring 2012 (Coordinator: Jan Beumer)

• Graduate Research Course (BioE 3997), Department of Bioengineering, University of Pittsburgh: Taught one PhD graduate student, fall and Spring, 2010 – Fall, 2011.

• Joint Bioengineering and Pathology Graduate Seminar Course (course coordinator: Dr. Kacey Marra; ~15 graduate students): Seminar Lecture, Spring 2007)

• Graduate Research PhD Thesis Study, Department of Physics, University of Pittsburgh: Taught one PhD graduate student, He (Henry) Zhu, who has earned his PhD (2004-2007). Henry has become a research faculty in the John Hopkins University (JHU) School of Medicine after postdoctoral training in JHU and is now on faculty at Vanderbilt University School of Medicine.

• Physics course for Directed Research (PHYS 1903): Taught one undergraduate research student in Fall 2010 and Spring 2011. Spring and fall, 2008.

• Undergraduate Research Course (ECE 1898 Engineering project course). Department of Electrical & Computer Engineering, University of Pittsburgh: Taught one undergraduate research student, Spring 2011.

• Biology course for Directed Research (BIOSC 1903): Taught one undergraduate research student, fall 2009; fall 2008; Spring, 2012.

• Bioengineering course for Directed Research (BIOENG 1002): Taught one research intern student (Fall, 2005).

• Taught NSF REU students in the Department of Physics, University of Pittsburgh (Physics REU program: Summer, 2004, 2005, 2006, 2007, and 2008;

• Taught NSF REU students in the Department of Bioengineering, University of Pittsburgh (BioE REU program): summer 2005 and 2008

Training:

• Lectured in Radiology Resident's Noon Conference/Faculty Research Seminar (July 5, 2004; June 15, 2006)

• Taught UPMC summer high school volunteer students for research experience (2006, 2007, 2008)

• Taught numerous UPCI volunteer students for cancer research experience

Carnegie Mellon University (CMU), Department of Biological Sciences:

Education:

• Research Course (CMU 03-445A), Department of Biological Sciences, Carnegie Mellon University (Coordinator Dr. Maggie Braun): Taught CMU undergraduate students carrying out research projects in my laboratory: One student in fall 2010; Two students in Spring 2011; One student in Fall, 2011.

Memorial Sloan-Kettering Cancer Center, Department of Medical Physics and Radiology:

Training:

• Basic Principles of Magnetic Resonance Imaging (Team teaching for ~25 radiology residents, intensive short course)

The University of Connecticut, Department of Chemistry:

Education:

• Graduate Physical Chemistry (Chem 393, ~40 undergraduate students)

• Physical Chemistry Lab (Chem 256/265, ~40 undergraduate students)

• Graduate Biological Chemistry I&II (Chem 360&361, team teaching on Magnetic Resonance of Biomacromolecules, ~20 students)

• General Chemistry (Chem 127 and Chem 128, ~150 undergraduate students)

• Physics of Earth Materials (G305, Magnetic Resonance Imaging, team teaching, ~25 students)

• Special Topics in Polymer Chemistry: Spectroscopic Techniques for Polymer and Biopolymer Determination (Chem 394, Magnetic Resonance of Biopolymers, ~30 students)

• Chemical Kinetics (Chem 353, ~20 undergraduate students)

4.4 PROMOTION OF JUNIOR RESEARCHERS

THESIS COMMITTEE MEMBERSHIPS:

Co-Chair and Academic advisor, PhD thesis committee for He Zhu, Department of Physics, University of Pittsburgh, 2007.

Member, PhD thesis committee for Sung-Hong Park, Department of Bioengineering, University of Pittsburgh, 2009.

Member, PhD and MS graduate thesis committees of several graduate students, Department of Chemistry, University of Connecticut.

POSTDOCTORAL RESEARCH ASSOCIATES SUPERVISED:

Raghunatha Reddy, PhD in biochemistry, Postdoctoral Research Associate, Magnetic Resonance Research Center, Department of Radiology, University of Pittsburgh, March 21, 2011 – June 30, 2012. Dr. Reddy became an Assistant Professor in Kittur Rani Channamma college of Horticulture, Karnataka, India. (I was the academic advisor, and my research grants had provided 100% research funds, stipend and benefit package for Dr. Reddy's work in my research laboratory.)

Song (Michael) Chen, Ph.D. in physics, Postdoctoral Research Associate, Magnetic Resonance Research Center, Department of Radiology, University of Pittsburgh, Sept. 16, 2009 – Feb. 21, 2011. Dr. Chen became an Assistant Professor in Zhejiang University, Hang Zhou, P.R. China. (I was the academic advisor, and my research grants had provided 100% research funds, stipend and benefit package for Dr. Chen's work in my research laboratory.)

Zheng Jing, M.D., Ph.D., Postdoctoral Research Associate, Magnetic Resonance Research Center, Department of Radiology, University of Pittsburgh, June 1, 2009 – June 30, 2010. (I was the academic advisor, and my research grants provided 100% research funds, stipend and benefit package for Dr. Jing's work in my research group.)

Kaung-Ti Yung, Ph.D., Postdoctoral Research Associate, Magnetic Resonance Research Center, Department of Radiology, University of Pittsburgh, August 1, 2005 – July 31, 2008. (I was the academic advisor, and my research grants provided 100% research funds, stipend and benefit package for Dr. Yung's work in my research group.)

Xiangjin Song, Ph.D., Postdoctoral Research Associate, Magnetic Resonance Research Center, Department of Radiology, University of Pittsburgh, April 1, 2004 – March 31, 2005. (I was the academic advisor, and my research grants had provided 100% research funds, stipend and benefit package for Dr. Song's work in my research group.)

Sunitha B. Thakur, Ph.D. in chemistry, Postdoctoral Research Associate, Memorial Sloan-Kettering Cancer Center, Sept, 2001-2003. She became a faculty member and the Chief Medical Physicist in Memorial Sloan-Kettering Cancer Center. (I was the academic advisor, and my research grants had provided 100% research funds, stipend and benefit package for Dr. Thakur's work in my research group.)

Yan Zhang, Ph.D. in physics, Postdoctoral Research Fellow, Memorial Sloan-Kettering Cancer Center and Department of Chemistry and the Institute of Materials Science, University of Connecticut, June, 2000-Sept., 2001. Dr. Zhang has become a scientific staff at NIH MR imaging center. (I was the academic advisor, and my research grants had provided 100% research funds, stipend and benefit package for Dr. Zhang's work in my research group.)

Manickam Muruganandham, Ph.D., Postdoctoral Research Associate, Memorial Sloan-Kettering Cancer Center,

Sept, Collaborator. (I was the academic advisor for Dr. Muruganandham's collaborative work with my research group, which was published in Magnetic Resonance in Medicine.)

Zheng Xu, Ph.D. Postdoctoral Research Fellow, Department of Chemistry, University of Connecticut, Nov., 1999-Sept., 2000. (I was the academic advisor, and my research grants had provided 100% research funds, stipend and benefit package for Dr. Xu's work in my research group.)

Ercheng Li, Ph.D. Postdoctoral Research Fellow, Department of Chemistry and the Institute of Materials Science, University of Connecticut, Jan., 1999 - Mar., 2000. (I was the academic advisor, and my research grants provided 100% research funds, stipend and benefit package for Dr. Li's work in my research group.)

Jianwei Zhou, Ph.D. Visiting Professor, Department of Chemistry, University of Connecticut, Nov., 1999-2000. (I was the academic advisor, and my research grants provided 100% research funds for his work.)

Pavel Shkarin, Ph.D. Postdoctoral Research Fellow, Department of Chemistry, University of Connecticut, Sept. 21, 1997-99 & July, 2000. (I was the academic advisor, and my research grants provided 100% research funds, stipend and benefit package for Dr. Shkarin's work in my research group.)

Kambiz Shahnazi, Ph.D. Postdoctoral Research Fellow/Collaborator, Department of Chemistry, University of Connecticut and Yale University School of Medicine, Summer, 1999.

Yumin Liu, Ph.D. Postdoctoral Research Fellow and Collaborator, Institute of Materials Science, University of Connecticut, 1995-1998.

Yuri Lvov, Ph.D. Postdoctoral Research Fellow and Collaborator, Department of Chemistry, University of Connecticut, 1998.

Youliang Qiu, Ph.D., Programming Specialist, Department of Chemistry, University of Connecticut, April, 2000. (I was the academic advisor, and my research grants provided 100% research funds, stipend and benefit package for Dr. Qiu's work in my research group.)

GRADUATE AND UNDERGRADUATE STUDENTS SUPERVISED:

He (Henry) Zhu, PhD candidate and graduate student in the Department of Physics, thesis research was carried out in my research group in the MR Research Center, Department of Radiology, University of Pittsburgh. (PhD Thesis Research Advisor: Qiuhong He) Sept, 2004 – July, 2007. Dr. Zhu became a faculty member in the John's Hopkins School of Medicine and then a research assistant professor in Radiology and Radiological Sciences at Vanderbilt University. (I was the research advisor, and my research grants provided 100% research funds, stipend and benefit package for Mr. Zhu's Ph.D. thesis research in my research group.)

Jeffrey Barker, PhD graduate student in the Department of Bioengineering, MR Research Center, Department of Radiology, University of Pittsburgh. Pre-graduate student, July 1 – Aug. 30, 2010. Graduate Study: Sept, 2010 – 2011. (I was the research advisor, and my research grants provided 100% research funds, stipend and benefit package for Mr. Barker's research in my group.)

Emily Hitchcock, Sarah Hodges, Kevin Zuang, Rosy J. Lu, the 2022 summer students in the program of Research Experience for Undergraduates (REU) in Engineering & Aviation Sciences, University of Maryland Eastern Shore Princess Anne, MD. I have provided the scientific project and the diffusion-weighted MRI imaging data acquired previously in my laboratory. Through zoom conference calls, I have remotely supervised the four REU students on MRI imaging techniques and data acquisition methods, as well as our experiments of bacteria based cancer treatment in tumor models. The project results have been submitted to the REU symposium, entitled "Image processing and machine learning for tumor tissue detection using MRI images in bacteria based cancer therapy."

Brian Mattes, an undergraduate student Department of Biological Sciences, University of Pittsburgh. Brian was working with Ian Bayles in tumor growth measurement and tissue fixation to evaluate fat-1 suppression of breast cancer growth. (I was the research advisor, and my research grants provided 100% research funds for Mr. Mattes's research in my group.)

Ian Bayles, CMU undergraduate student major in biology. Ian was taking the undergraduate research course (CMU 03-445A) for credit for 3 semesters on cancer research in my laboratory. The course required at least 12 research hours per week in laboratory experiments. (Course coordinator: Dr. Maggie Braun, Biological Sciences Department at Carnegie Mellon University). Ian carried out animal tumor model studies involving breeding of transgenic mice and tumor growth curve measurements. He also worked with a postdoctoral fellow to perform breast cancer cell migration assays using 96 transwell plates. Summer and fall, 2010 – Summer, 2012. (I was the research advisor, and my research grants provided 100% research funds for Mr. Bayles's research in my group.)

Shira Barnett, an undergraduate student Department of Biological Sciences, University of Pittsburgh. Shira registered for the undergraduate research course (BIOSC1903-100) to carry out laboratory experiments using animal tumor models. She constructed 3D blood vessels in matrix gels to study cancer metastasis. (Spring, 2012) (I was the research advisor, and my research grants provided 100% research funds for Ms. Barnett's research in my group.)

Darren Morris, CMU undergraduate student major in biology. Darren was involved in animal tumor measurement in the project on fat-1 gene suppression of human breast cancer. (Spring & Fall semester, 2011) (I was the research advisor, and my research grants provided 100% research funds for Mr. Morris's research in my group.)

Dolapo Junaid, Bioengineering undergraduate student at University of Pittsburgh. Dolapo took a laboratory research project on MR signal processing for the course requirement (BioEng 1002) in Fall semester of 2011. He applied Maximum Entropy method to analyze Sel-ZQC imaging data and used ImageJ software to analyze MR diffusion-weighted images acquired from mouse tumors treated with engineered attenuated *Salmonella* expressing anti-cancer proteins. (Summer & Fall, 2011) (I was the research advisor, and my research grants provided 100% research funds for Mr. Junaid's research in my group.)

Natasha Lejbman, a second-year undergraduate student major in biology at the University of Pittsburgh. As a student researcher referred to us from University of Pittsburgh Cancer Institute, Natasha joined our research team to work on mouse tumor models using fat-1 gene therapy to suppress breast cancer and metastasis. She attended transgenic animals working with a senior student, cryo-dissected tumor and lung tissue slides, and performed H&E tumor tissue staining. Fall, 2011- Spring, 2012. (I was the research advisor, and my research grants provided 100% research funds for Ms. Lejbman's research in my group.)

Heather Lynn, CMU undergraduate student major in Biology. Heather was supported by Howard Hughes Medical Institute (HHMI) fellowship for her work in our lab on cancer biology. In Spring of 2011, she initiated the project to construct artificial blood vessels *in vitro* to study breast cancer metastasis. Fall, 2009 –Spring, 2011. (I was the research advisor, and my research grants provided 100% research funds for Ms. Lynn's research in my group.)

Jennifer Rudolph, Physics Undergraduate student working on a research course in our lab. She constructed a 7T $^{1}H/^{13}C$ RF coil system for small animal tumor imaging and a Siemens 7T interface box for ^{31}P MRS. She also constructed a ^{1}H mouse tumor coil for Varian 9.4T horizontal bore MRI/MRS spectrometer. (Fall, 2010 - Summer, Spring, 2011) (I was the research advisor, and my research grants provided 100% research funds for Ms. Rudolph's research in my group.)

Joshua D. Brown, Electrical & Computer Engineering undergraduate student taking a research course (ECE 1898) for credit in our lab. He was involved in the construction of ^{1}H breast coil for human breast cancer MRI/MRSI at 7T. (Spring semester - summer, 2011) (I was the research advisor, and my research grants provided 100% research funds for Mr. Brown's research in my group.)

Greg Hogan, Undergraduate student research assistant, Department of Physics, University of Pittsburgh. Computer IT student assistant. Summer and Fall, 2009 – Summer, 2010. (I was the research advisor, and my research grants provided 100% research funds and stipend for Mr. Hogan's research in my group.)

Leon Lin, summer student from North Allegany High School. Leon has constructed a ^{31}P coil for mouse tumor studies at 7T. Summer 2010. (I was the research advisor, and my research grants provided 100% research funds for Mr. Lin's research in my group.)

Heather Leigh Dolan, undergraduate student, Chemical engineering, CMU. MR contrast reagent development. Summer, 2009 – Spring, 2010. (I was the research advisor, and my research grants provided 100% research funds for Ms. Dolan's research in my group.)

Harrison Jackson, UPCI volunteer, CMU graduate of Department of Mechanical Engineering, working on breast coil construction. He has constructed a breast coil housing support for Siemens MRI Scanners in mechanical shop in Magnetic resonance research center. Summer 2009 - 2010. (I was the research advisor, and my research grants provided 100% research funds for Mr. Jackson's research in my group.)

Alexander John Blair, CMU undergraduate student major in Biology. Alex was supported by Howard Hughes Medical Institute (HHMI) fellowship working in our lab on tumor tissue immunofluorescence staining of macrophage activation in tumor specimens induced by bacterial-based therapy. Spring, 2009. Genetic engineering of E. Coli to express MR-reporter labeled SDF-1α peptide for molecular imaging of metastatic tumor cells. Fall, 2009 (as a registered Pitt-CMU Biology research class student) and Spring-fall, 2010 (as a HHMI funded CMU undergraduate student in biological science.) (I was the research advisor, and my research grants provided 100% research funds for Mr. Blair's research in my group.)

Varun Badami, a freshman undergraduate student, University of Pittsburgh, to study biological science and cancer. Varun worked on tissue immunofluorescent staining to study tumor damaging effect of M1 macrophage introduced in the bacterial-based therapy. Fall, 2008. (I was the research advisor, and my research grants provided 100% research funds for Mr. Badami's research in my group.)

Meghana Rajashekar, undergraduate student of University of Pittsburgh major in Biology. In the fall semester, 2008, Maghana took the BIOSC 1903 research course in our lab (10 hr/wk), learning cancer cell culture, animal tumor maintenance, genetic engineering and MR contrast agent construction. Summer - Fall, 2008. (I was the research advisor, and my research grants provided 100% research funds for Ms. Rajashekar's research in my group.)

Joshua Wiener, undergraduate student in CMU. He worked as a volunteer student on cancer tumor models, July, 2008. (I was the research advisor, and my research grants provided 100% research funds for Mr. Wiener's research in my group.)

Thomas F. Hahn, REU undergraduate student, Department of Bioengineering, University of Pittsburgh. Project: Genetic engineering of RACS-PyMT viral plasmid to insert magnetic resonance reporter genes for MR molecular imaging of premalignant lesions and cancer in mammary gland, as well as lung metastasis. Summer, 2008. (I was the research advisor, and my research grants provided 100% research funds and stipend for Mr. Hahn's research in my group.)

Peter W. Chiappini, REU undergraduate student, Department of Bioengineering, University of Pittsburgh. Project: Development of a novel micro-coil ENMR probe with specifically designed gradient coils for two-dimensional electrophoretic mobility correlation spectroscopy. Summer, 2008. (I was the research advisor, and my research grants provided 100% research funds and stipend for Mr. Chiappini's research in my group.)

Peter Wu, June-August, 2008 and summer, 2009 (the Summer NAI high school student volunteer, Pittsburgh). Spring, 2010 (the Honor class undergraduate student in University of Pittsburgh) Project: Immunofluorescent

Tumor tissue staining of tumor-infiltrating anti-cancer Salmonella and recruitment of tumor suppressive macrophages in Lewis lung carcinoma in C57BL/6J mice. (I was the research advisor, and my research grants provided 100% research funds and stipend for Mr. Wu's research in my group.)

Patricia Schantz, Undergraduate student, Department of Physics, University of Pittsburgh, has developed a ^{13}C breast coil for 3T MRI scanner. With a career goal to be a professional medical physicist, Patricia took the special study research class PHYS 1903 (two semesters). Oct., 2007 – Dec. 2008. (I was the research advisor, and my research grants provided 100% research funds for Ms. Schantz's research in my group.)

Gabrielle, Ramus, Undergraduate research assistant working on bacterial-based cancer therapy and imaging, Department of Bioengineering, University of Pittsburgh. May, 2005 – July, 2007. (I was the research advisor, and my research grants provided 100% research funds and stipend for Ms. Ramus's research in my group.)

Brendan P. Clifford, REU undergraduate student, Department of Physics, University of Pittsburgh. Project: Development of ^{13}C Radiofrequency Coil for the Imaging of Breast Tissue at 7T High Magnetic Fields. Summer, 2007. (I was the research advisor, and my research grants provided 100% research funds for Mr. Clifford's research in my group.)

Claire Xu, North Allegheny High School student, Pittsburgh, PA. Project: Genetic engineering of anti-cancer protein drugs in attenuated *Salmonella typhimurium* and *E. coli* strains. July, 2006. (I was the research advisor, and my research grants provided 100% research funds for Miss Xu's research in my group.)

York Chen, summer intern undergraduate student, Washington University, Saint Louis. Project: Genetic engineering of anti-cancer protein drugs in attenuated *salmonella typhimurium* and *E. coli* strains. Summer 2006. (I was the research advisor, and my research grants provided 100% research funds and stipend for Mr. Chen's research in my group.)

Bradley Schorer, REU undergraduate student, Department of Physics, University of Pittsburgh. Project: Microstrip RF coil design and construction for proteomic ENMR of cancer. Summer, 2006. (I was the research advisor, and my research grants provided 100% research funds for Mr. Schorer's research in my group.)

Selina Guo, North Allegheny High School student, Pittsburgh. Project: Building a 7T RF coil for detecting breast cancer using MRI and Tumor tissue staining. Summer, 2006 and 2007. (I was the research advisor, and my research grants provided 100% research funds for Ms. Guo's research in my group.)

Han H. Liu, North Allegheny High School student who became an undergraduate student major in chemistry in University of Pittsburgh. Han has constructed 1.5T, 3T animal RF coils for studying bacterial-based cancer imaging and therapy. In addition, Han has made a 7T ^{1}H volume coil for detecting breast cancer using 7T MRI scanner. Han has also established a SCID mice genotyping protocol to characterize NODC57/fat1 transgenic mice. Summer 2006, 2007, 2008, and 2012. (I was the research advisor, and my research grants provided 100% research funds for Mr. Liu's research in my group.)

Denis Robin, REU undergraduate student working on breast RF coil design and construction, Department of Physics, University of Pittsburgh. Project: Building an RF coil for detecting breast cancer using MRI. Summer, 2005. (I was the research advisor, and my research grants provided 100% research funds and stipend for Mr. Robin's research in my group.)

Jeremy Spater, REU undergraduate student working on micro RF coil design and construction, Department of Physics, University of Pittsburgh. Project: Microcoil electrophoretic NMR for proteomic analysis. Summer, 2005. (I was the research advisor, and my research grants provided 100% research funds for Mr. Spater's research in my group.)

Elliot J. Alyeshmerni, REU undergraduate student, Department of Bioengineering, University of Pittsburgh.

Project: Diagnosis of human brain tumors using point resolved spectroscopy (PRESS) by absolute metabolite quantification. Summer, 2005. (I was the research advisor, and my research grants provided 100% research funds and stipend for Mr. Alyeshmerni's research in my group.)

Vitaly Chibisov, summer undergraduate student from Duke University. Project: Genetic engineering of anti-cancer protein drugs in attenuated *salmonella typhimurium* and *E. coli* strains. Summer 2005 and 2006. (I was the research advisor, and my research grants provided 100% research funds and stipend for Mr. Chibisov's research in my group.)

William Lanham**,** summer undergraduate student, Pennsylvania State University. Project: Construction of RF coils for small animal imaging. Summer, 2005. (I was the research advisor, and my research grants provided 100% research funds for Mr. Lanham's research in my group.)

Eli Wasserman, 1st year graduate student, Bioengineering Department, University of Pittsburgh. Feb. – Jun., 2004. (I was the research advisor, and my research grants provided 100% research funds for Mr. Wasserman's research in my group.)

Lisa Myers, pre-graduate student, Bioengineering Department, University of Pittsburgh. Summer 2005. She discontinued her graduate study due to her diagnosis of breast cancer. (It turned out to be a false positive diagnosis.) (I was the research advisor, and my research grants provided 100% research funds for Ms. Myers's research in my group.)

Hussein Baradia. REU undergraduate student, Department of Physics, University of Pittsburgh. Summer 2004. (I was the research advisor, and my research grants provided 100% research funds for Mr. Baradia's research in my group.)

Nancy Charles, Undergraduate student assistant who has conjugated biotinylated anti-Salmonella antibody with GdDTPA to detect bacteria in T1W-MRI. She earned B.S. degree in the Department of Industrial Engineering, University of Pittsburgh in Dec., 2004. July, 2004-March, 2005. (I was the research advisor, and my research grants provided 100% research funds and stipend for Ms. Charles's research in my group.)

Jason Goldwasser, Summer intern student from University of Maryland, Summer 2004. (I was the research advisor, and my research grants provided 100% research funds for Mr. Goldwasser's research in my group.)

Xiaoguang Zhang, M.S., Graduate student, Department of Electrical and System Engineering, University of Connecticut. (I was the research advisor, and my research grants provided 100% research funds and stipend for Mr. Zhang's research in my group.)

Wei Lin, M.S., Graduate student, Department of Computer Science and Engineering, University of Connecticut. (I was the research advisor, and my research grants provided 100% research funds and stipend for Mr. Lin's research in my group.)

Zhaohui Wei, M.S., Graduate student, Department of Computer Science and Engineering and Mechanical Engineering, University of Connecticut. (I was the research advisor, and my research grants provided 100% research funds and stipend for Mr. Wei's research in my group.)

Haihang Sun, M.S., Graduate Student, Department of Computer Science and Engineering, University of Connecticut. (I was the research advisor, and my research grants provided 100% research funds and stipend for Mr. Sun's research in my group.)

Xinmiao Wei, M. S., Graduate Student, Department of Computer Science and Engineering, University of Connecticut. (I was the research advisor, and my research grants provided 100% research funds and stipend for Mr. Wei's research in my group.)

Jianxin Guo, M.S., Graduate Student, Department of Chemistry, University of Connecticut. (I was the research advisor, and my research grants provided 100% research funds and stipend for Mr. Guo's research in my group.)

Tao Sun, Graduate Student, Department of Chemistry, University of Connecticut. (I was the research advisor, and my research grants provided 100% research funds and stipend for Mr. Sun's research in my group.)

Rao Lei, Graduate Student, Department of Chemistry, University of Connecticut. (I was the research advisor, my research grants provided 100% research funds and stipend for Ms. Lei's research in my group.)

Chunzhi He, Graduate Student, Department of Chemical Engineering, University of Connecticut. (I was the research advisor, and my research grants provided 100% research funds and stipend for Mr. He's research in my group.)

Sherry Tsai, NSF REU Undergraduate Student from Yale University, Department of Chemistry, University of Connecticut. (I was the research advisor, and my research grants provided 100% research funds for Ms. Tsai's research in my group.)

Technicians supervised:

Todd Rapetti, a UPCI volunteer for cancer research. Todd has established an immunochemical staining protocol of iNOS to characterize M1 macrophages in fixed mouse tumor tissues. Fall, 2011 – Summer, 2012. (I was the research advisor, and my research grants provided 100% research funds for Mr. Rapetti's research in my group.)

Keerthi Chadalawada, M.S., Research volunteer (Fall, 2008) and technician (Jan-Feb., 2009 and Jan., 2010 – Aug. 26, 2010) working on PCR genotyping of the transgenic mice and routine animal care. (I was the research advisor, and my research grants provided 100% research funds and stipend for Ms. Chadalawada's work in my group after she became a technician.)

Mine Anil, UPCI volunteer. Mine was involved in tumor tissue staining experiments and genotyping of transgenic mice using PCR and DNA gel electrophoresis, as well as preparing computer data sheets of the transgenic mice and tumor size measurement and growth curves. Fall, 2010. (I was the research advisor, and my research grants provided 100% research funds for Ms. Anil's research in my group.)

Weike Lai, volunteer, Magnetic Resonance Research Center, Department of Radiology, University of Pittsburgh, Sept. 1, 2007 – May, 2008. Cell Culture and Western Blot; RF coil development. (I was the research advisor, and my research grants provided 100% research funds for Mr. Lai's research in my group.)

Huiwen Liu, M.D., Research Specialist, Magnetic Resonance Research Center, Department of Radiology, University of Pittsburgh, Oct. 1, 2005 – Nov., 2006. Bacterial culture and cell culture. (I was the research advisor, and my research grants provided 100% research funds and salary for Ms. Liu's research in my group.)

Xiaoyan Liu, Research Specialist, University of Pittsburgh Cancer Institute, June – August, 2005. Cell culture. (I was the research advisor, and my research grants provided 100% research funds and salary for Ms. Liu's research in my group.)

5. RESEARCH METHODOLOGY

a. Magnetic Resonance Spectroscopic Imaging in Tissues Containing High Level of Mobile Lipids:

1. Single Scan *In Vivo* Lactate Editing with Complete Lipid and Water Suppression by Selective Multiple Quantum Coherence Transfer with application in tumor models (Sel-MQC CSI).

2. In vivo MR Spectroscopic Imaging of Polyunsaturated Fatty Acids (PUFA) in Healthy and Cancerous Breast Tissues by Selective Multiple-Quantum Coherence Transfer (Sel-MQC CSI).

3. In vivo Tumor Lactate Relaxation measurements by Selective Multiple Quantum Coherence (T_1- and T_2-Sel-MQC) Transfer.

4. The Fast Spiral-SelMQC Technique for *In Vivo* MR Spectroscopic Imaging.

5. Compressed Sensing for fast Selective Zero-Quantum Coherence Transfer (CS-SelZQC) Spectroscopic Imaging at high- and Ultrahigh-Field without Susceptibility Artifacts and B_0 inhomogeneous Broadening.

6. Volume and Slice Localizations for Sel-MQC CSI Spectroscopic imaging of Breast Cancer Using Spatial-Spectral Selective RF Pulses.

7. Simultaneous Detection of Overlapping Metabolites and Drugs *in vivo* by Multiple Metabolite Specific Echo Spectroscopy (MMSES CSI).

8. Proton Detection of Choline and Lactate in EMT6 tumors by Spin-Echo-Enhanced Selective Multiple-Quantum Coherence Transfer (SEE-SelMQC CSI).

9. Volume-Selective 1331-SelMQC CSI for *in vivo* Localization of Breast Cancer with Improved B_1 Homogeneity.

10. Three-Dimensional Sel-MQC CSI Mapping of Lactate and PUFAs in Human Breast Tissue at 2.1T by Hadamard Matrix Approach.

11. Double spin-echo enhanced Sel-MQC CSI for simultaneous choline and lactate mapping in fatty tissues.

12. Phase-incrementing MR Spectroscopic imaging (pi-MRSI) for fast imaging of multiple biomarkers in vivo in mouse tumor models

13. Double echo pi-SSelMQC imaging of a biomarker in vivo in tumor models with full signal recovery from multiple quantum coherence transfer pathways

b. Human RF coil design for Breast MRSI at high and ultrahigh field

14. The Butterfly Breast Coils for ^{1}H, ^{13}C, and ^{23}Na Imaging at High-Field MRI (7T and 3T).

15. A Heteronuclear Coil System for MRI/MRS of Human Breast at High Magnetic Field (7T).

c. Electrophoretic NMR Methods

16. High Flow-Resolution for Mobility Estimation in 2D ENMR of Proteins Using Maximum Entropy Method (MEM-ENMR).

17. Constant-Time Multidimensional Electrophoretic NMR

18. Convection Compensated Electrophoretic NMR.

19. Three-Dimensional Electrophoretic NMR Correlation Spectroscopy.

20. Capillary Array Electrophoretic NMR.

21. High-Field Electrophoretic NMR of Protein Mixtures in Solution.

22. Electroosmosis-Enhanced Electrophoretic NMR Spectroscopy (EE-ENMR).

23. Water Suppression in CA-ENMR Spectra of Proteins.

24. Three-Dimensional Electrophoretic Heteronuclear Single-Quantum Coherence Correlation Spectroscopy.

25. Velocity Saturation and Current Clumping in CA-ENMR.

26. Intrinsic Convection-Compensation in Stimulated Echo Electrophoretic NMR.

27. Exchange Multidimensional Electrophoretic NMR (Ex-NMR) in structural characterization of protein interactions in solution mixture of proteins.

28. Multi-Quantum Electrophoretic NMR.

29. One- and Two-Dimensional Stimulated Echo Electrophoretic NMR

30. Two-Dimensional Spin-Echo Electrophoretic NMR

31. Measurement of Mobility Distributions for Vesicles by Electrophoretic NMR.

d. The iMQC Methods and Observation of Long Distance Dipolar Interactions in Solution NMR:

32. Intermolecular multiple-quantum coherences (iMQC) and cross-correlations in solution NMR.

e. Computational design and experimental demonstration of shaped RF Pulses for isotropic mixing using Average Hamiltonian Theory

33. Shaped RF Pulse Design and Optimization in NMR Multilevel Spin Systems: Application to Isotropic Mixing (TOCSY).

f. N-3 PUFA suppression of endocrine-resistant breast cancer and metastasis in mouse models

34. Genetic engineering and expression of n-3 fatty acid desaturase in cell culture and female fat-1 transgenic mice to suppress tamoxifen-resistant breast cancer and lung metastasis. The LLC lung cancer and liver metastasis were also investigated similarly using the male fat-1 mice.

g. Bacterial-based Cancer Therapy

35. Genetic engineered the attenuated *Salmonella Typhimurium* to express anti-cancer protein drugs and induced rapid tumor tissue destruction observed in the longitudinal Diffusion-Weighted MRI (DWI) study and Diffusion Tensor MRI (DTI)

36. Bacterial-Based Magnetic Resonance Contrast Agents by genetic engineering to express myoglobin (Mb) for tumor oxygenation mapping and by making an anti-bacterial antibody conjugated to Gd contrast agent for MR imaging of bacterial tissue distribution.

6. PATENTS AND INVENTION DISCLOSURES:

a. **Qiuhong He, "Methods, systems, and computer readable media for in vivo phase incrementing magnetic resonance spectroscopic imaging (pi-MRSI) for multi-biomarker imaging and for simultaneous imaging of zero quantum→double quantum (ZQ→DQ) and DQ→ZQ coherence pathways."** Full U.S. Patent application filed on 9/20/2021 by University of North Carolina at Chapel Hill (Application #: 17479270). The subject application was published as **US-2022-0091208-A1** on U.S. Patent and Trademark Office website at www.uspto.gov. (Notice of Publication received on March 24, 2022).

b. **Qiuhong He, "MSC-SelMQC method for simultaneous mapping of polyunsaturated fatty acids, lactate and choline in high fat tissues." U.S. Patent 9,915,714 issued on 3/13/2018.** The United States Patent and Trademark Office (USPTO) issued the NOTICE OF ALLOWANCE for patent issuance on 10/31/2017. U.S. Patent filed on 2/2/2016 by University of Pittsburgh (CON application number: 15/013,584). Electronic publication as a patent application on 06/02/2016: Publication No. US-2016-0154077-A1.

c. **Qiuhong He**, **"Selective zero-quantum coherence transfer (Sel-ZQC) method for metabolite imaging in a poorly shimmed magnet field without susceptibility artifact." U.S. Patent 9,733,326 issued on 8/15/2017.** US Patent and Trademark Office has issued "Notice of Allowance" on 5/5/2017 for the application (No. 14/004,624). USPTO's Publication Number for this patent application: US-2014-0296695-A1; Publication Date: 10/02/2014 (on search link: http://www.uspto.gov/patft). Full international PCT patent application (02457/106852.41PCT) submitted by University of Pittsburgh on April 7, 2012. Provisional patent application was entitled, "Selective zero-quantum coherence transfer (Sel-ZQC) method for metabolite imaging in a poorly shimmed magnet field." (University of Pittsburgh Ref. No. 02457, 2010).

d. **Qiuhong He**, **"Simultaneous mapping of multiple chemicals with suppression of unwanted signals via molecular specific coherence (MSC)-SelMQC (selective multiple quantum coherence)." U.S. Patent 9,285,443 issued on 3/15/2016.** Full Patent Application was filed by University of Pittsburgh on April 16, 2011 (U.S. Patent Application No. 12/266,007; International Application No. PCT/US2011/032691). U.S. Provisional Application entitled, "MSC-SelMQC Method for Simultaneous Mapping of Polyunsaturated Fatty Acids, Lactate and Choline in High Fat Tissues," was filed on April 16, 2010. U.S. Serial No. 61/324,796. The invention disclosure, entitled "MR Spectroscopic Imaging of PUFA, Lactate and Choline as Biomarkers in tissues containing High Concentration of Mobile Lipid by Modified Selective Multiple Quantum Coherence Transfer Methods," was filed on March 26, 2009. University of Pittsburgh Ref. No. 01965.

e. **Qiuhong He**, **"Coils for Magnetic Resonance Spectroscopy and Imaging of Human Breast." U.S. Patent 8,731,635 issued on 5/20/2014.** Full Patent Application was filed by University of Pittsburgh on Nov. 6, 2008 (U.S. full patent application No. 12/266,007, 2008). U.S. Provisional Application Serial No. 60/986,253, 2007.

f. **Qiuhong He** and Peter W. Chiappini, "Development of Two-dimensional electrophoretic Mobility Correlation Exchange Spectroscopy (MOC-EXSY) and Instrumentation" July, 2008. (Invention Disclosure)

g. **Qiuhong He**, Kaung-Ti Yung and Jeremy Spater, "Microcoil Electrophoretic NMR Probe for Proteomic Analysis." Provisional patent application (PPA) was filed, 2007.

h. **Qiuhong He**, Vitaly Chibisov, Huiwen Liu, Gabrielle Ramus, "A Genetic Engineering Approach to Induce Infiltration of Magnetically Labeled Therapeutic Bacteria in Metastatic Cancer for Tumor Tissue Destruction in Non-Immunocompromised Host." 2006 (Invention Disclosure)

7. PUBLICATIONS

7.1 LIST OF PUBLICATIONS

A. Original journal papers

No.	Authors/title/journal/volume/page numbers/year
	Felix A. Kyere, Ian Curtin, Oleh Krupa, Carolyn M. McCormick, Mustafa Dere, Sarah Khan, Minjeong Kim, Tzu-Wen Winnie Wang, **Qiuhong He**, Guorong Wu, Yen-Yu Ian Shih, Jason L. Stein, "Whole-Brain Single-Cell Imaging and Analysis of Intact Mouse Brains Using MRI, Tissue Clearing, and Light-sheet Microscopy." J. Vis. Exp. 2022 Aug 1; (186). doi: 10.3791/64096.
1	He Zhu, Denis Rubin, and **Qiuhong He**, "The Fast Spiral-SelMQC Technique for *In Vivo* MR Spectroscopic Imaging of Polyunsaturated Fatty Acids in Human Breast Tissue." *Magn. Reson. Med.* **67**, 8-19 (2012).
2	**Qiuhong He**, Pavel Shkarin, Regina J. Hooley, Donald R. Lannin, Jeffrey C. Weinreb, and Veerle Ilse Julie Bossuyt, "*In vivo* MR Spectroscopic Imaging of Polyunsaturated Fatty Acids (PUFA) in Healthy an Cancerous Breast Tissues by Selective Multiple-Quantum Coherence Transfer (Sel-MQC)—A Prelimina Study." *Magn. Reson. Med.* **58**, 1079-1085 (2007).
3	Sunitha B. Thakur and **Qiuhong He**, "High Flow-Resolution for Mobility Estimation in 2D ENMR of Proteins Using Maximum Entropy Method (MEM-ENMR)." *J. Magn. Reson.* **183**, 32-40 (2006). Doi: 10.1016 / j.jmr.2006.07.009.
4	Manickam Muruganandham, Jason A. Koutcher, Giuseppe Pizzorno, and **Qiuhong He**, "*In vivo* Tumor Lactate Relaxation measurements by Selective Multiple Quantum Coherence (Sel-MQC) Transfer." *Mag. Reson. Med.* **52**, 902-906 (2004)
5	Ercheng Li and **Qiuhong He**, "Constant-Time Multidimensional Electrophoretic NMR." *J. Magn. Reson*. ***156****, 181-186,* 2002.
6	**Qiuhong He** and Zhaohui Wei, "Convection Compensated Electrophoretic NMR." *J. Magn. Reson.* **150,** 126-131 (2001).
7	**Qiuhong He**, Wei Lin, Yumin Liu, and Ercheng Li, "Three-Dimensional Electrophoretic NMR Correlation Spectroscopy." *J. Magn. Reson.* **147**, 361-365 (2000).
8	**Qiuhong He**, Yumin Liu, Haihang Sun, and Ercheng Li, "Capillary Array Electrophoretic NMR of Proteins in Biological Buffer Solutions." *J. Magn. Reson.* **141,** 355-359 (1999).
9	**Qiuhong He**, Yumin Liu, and Terry Nixon, "High-Field Electrophoretic NMR of Protein Mixtures in Solution." *J. Am. Chem. Soc.* **120**, 1341-1342 (1998).
10	Eric O. Aboagye, **Qiuhong He**, Jerry D. Glickson, and Zaver M. Bhujwalla, "Evaluation of Lactate as a ^{1}H NMR Spectroscopy Index for Noninvasive Prediction and Early Detection of Tumor Response to Radiation Therapy: Comparison of RIF-1 and EMT6 Tumor Models." *Radiation Research* **150**, 38- 42 (1998).
11	**Qiuhong He** and Jerry D. Glickson, "Proton Detection of Choline and Lactate in EMT6 tumors by Spin-Echo-Enhanced Selective Multiple-Quantum Coherence Transfer." *J. Magn. Reson., Series B* **111**, 18-25 (1996).
12	**Qiuhong He**, Zaver M. Bhujwalla, Ross J. Maxwell, John R. Griffiths, and Jerry D. Glickson, "Proton Observation of the Antineoplastic Agent Iproplatin *In Vivo* by Selective Multiple Quantum Coherence Transfer (Sel-MQC)," *Mag. Reson. Med.* **33**, 414-16 (1995).

13	Wolfgang Richter, Sanghyuk Lee, Warren S. Warren, and **Qiuhong He**, "Imaging with Intermolecular Multiple-Quantum Coherences in solution NMR," *Science*, **267**, 654-57 (1995).
14	**Qiuhong He**, Dikoma C. Shungu, Peter C. M. van Zijl, Zaver M. Bhujwalla and Jerry D. Glickson, "Single Scan *In Vivo* Lactate Editing with Complete Lipid and Water Suppression by Selective Multiple Quantum Coherence Transfer with Application in Tumors," *J. Magn. Reson., Series B* **106**, 203-11 (1995).
15	**Qiuhong He**, Wolfgang Richter, Sujatha Vathyam and Warren S. Warren, "Intermolecular multiple-quantum coherences and cross-correlations in solution NMR," *J. Chem. Phys.* **98** (9), 6779-6800 (1993).
16	W. S. Warren, **Qiuhong He**, M. McCoy, F. C. Spano, "Reply to the Comment on: Is multiple quantum nuclear magnetic resonance of water real?" *J. Chem. Phys.*, **96**(2), 1659-1661 (1992).
17	**Qiuhong He**, Denise P. Hinton, and Charles S. Johnson, Jr., "Measurement of Mobility Distributions for Vesicles by Electrophoretic NMR," *J. Magn. Reson.* **91**, 654-658 (1991).
18	**Qiuhong He** and Charles S. Johnson, Jr., "Stimulated Echo Electrophoretic NMR," *J. Magn. Reson.* **85**, 181-185 (1989).
19	**Qiuhong He** and Charles S. Johnson, Jr., "Two-Dimensional Electrophoretic NMR for the Measurement of Mobilities and Diffusion in Mixtures," *J. Magn. Reson.*, **81**, 435-439 (1989).
20	Huang Chubao, Wang Maolian, Shi Peihua, **He Qiuhong**, Gao Ping, and Cao Xizhang, "Studies of Metalloporphyrins in relation to activation of small molecules (I)--Effect of Cobalt Porphyrin CoTAPPI on Electroreduction of Oxygen in Organic Solution," *J. Mol. Sci.* (Wuhan, China), **4**, No. 2, 113-120, (1986).

B. Journal Review Articles with original research data:

21	**Qiuhong He**, Ray Z. Xu, Pavel Shkarin, Giuseppe Pizzorno, Carol H. Lee, Douglas L. Rothman, Dikoma C. Shungu, and Hyunsuk Shim, "Magnetic Resonance Spectroscopic Imaging of Tumor Metabolic Markers for Cancer Diagnosis, Metabolic Phenotyping, and Characterization of Tumor Microenvironment." *Disease Markers* **19** (2-3), 69-94 (2004).
22	Charles S. Johnson, Jr. and **Qiuhong He**, "Electrophoretic NMR," *Adv. Magn. Reson.* **13**, Chap. 6, 131-159 (1989). (The original MQ-ENMR methods and data were reported here.)

C. Book chapters with original data:

1. **Qiuhong He**, Sunitha B. Thakur, and Jeremy Spater, "Electrophoretic NMR of Protein Mixtures and its Applications in Proteomics." *Spectral Techniques in Proteomics.* Ed. Daniel S. Sem. CRC Press, Taylor & Francis Group, New York. Chapter 12, Page 223-251, 2007.

2. **Qiuhong He** and Xiangjin Song, "Electrophoretic NMR in Proteomics: Toward Structural Characterization of Biological Signaling Processes." Book Chapter in *Seperation Methods in Proteomics*. Ed. Gary B. Smejkal and Alexander Lazarev. 489-504 (2005).

3. Zaver M. Bhujwalla, Dikoma C. Shungu, **Qiuhong He**, Janna P. Wehrle and Jerry D. Glickson, "MR

studies of Tumours: Relationship between Blood Flow, Metabolism and Physiology," *NMR in Physiology and Medicine*, Ed. R. J. Gillies, Academic Press, Chapter 19, 311-28 (1994).

D. REFEREED PROCEEDING PAPERS:

1. **Qiuhong He**, Hong Yuan, and Yen-Yu Ian Shih, "In vivo phase-incrementing SEE-HSelMQC method to resolve tumor biomarker images by synchronizing RF phase increments and phase-encoding steps." *Proc. Intl. Soc. Mag. Reson. Med. (2022). (Invited for Oral & Digital Poster Presentation in the PowerPitch using Gather.town virtual platform, May 7-12, 2022)*

2. **Qiuhong He,** "Intermolecular and Intramolecular Coherence Transfer of Glutamate in Saline Solution in Two-Dimensional Selective Zero Quantum Coherence Transfer (Sel-ZQC) Experiments at 9.4T." *Proceeding of the 62st Experimental Nuclear Magnetic Resonance Conference (ENC).* March 29 - 31, 2021. (Virtual ENC Conference)

3. **Qiuhong He,** Hong Yuan, and Yen-Yu Ian Shih, "In vivo Phase-Incrementing MRSI (pi-MRSI) for Multi-Biomarker Imaging with Applications to Human MDA-MB-231 Breast Cancer Xenograft Mouse Model." *Proceeding of the 61st Experimental Nuclear Magnetic Resonance Conference (ENC).* March 8 - 13, 2020. Hilton Inner Harbor, Baltimore, Maryland.

4. **Qiuhong He**, Hong Yuan, and Yen-Yu Ian Shih, "Simultaneous Detection of ZQ→DQ and DQ→ZQ Pathways in Phase-Incrementing SSel-MQC (pi-SSelMQC) with Application to Recover Lost Tumor Marker Signals." *Proceeding of the 61st Experimental Nuclear Magnetic Resonance Conference (ENC).* March 8 - 13, 2020. Hilton Inner Harbor, Baltimore, Maryland.

5. **Qiuhong He**, Ying Sun, Jeffrey W. Barker, and Song Chen, "Compressed Sensing in Selective Zero-Quantum Coherence Transfer (CS-SelZQC) Spectroscopic Imaging at Ultrahigh-Field without Susceptibility Artifacts and B_0 inhomogeneous Broadening." Proceeding of 53rd Experimental Nuclear Magnetic Resonance Conference (ENC), Miami, Florida. April 15 – 20, 2012.

6. Chen, S. and **He, Q.**, "Selective Zero-Quantum Coherence Transfer (Sel-ZQC) Method for High-Resolution Metabolite Imaging at Ultrahigh Field without Inhomogeneous Broadening and Susceptibility Artifacts." *Proc. Intl. Soc. Mag. Reson. Med.* **19**, 3455 (2011).

7. **Qiuhong He**, Gregery Hogan and Zheng Jing, "MSC-SelMQC Method for Simultaneous Mapping of Polyunsaturated Fatty Acids, Lactate and Choline in High Fat Tissues." Proceeding of 51th Experimental Nuclear Magnetic Resonance Conference, Datona Beach, Florida, FL. April 18 – 23, 2010.

8. **He, Q, "**Simultaneous MSC-SelMQC Mapping of Polyunsaturated Fatty Acids (PUFA), Lactate and Choline in Tissues Containing High Concentration of Mobile Lipid." *Proc. Intl. Soc. Mag. Reson. Med*. (2010).

9. **Qiuhong He**, Tricia N. Schantz, Brendan P. Clifford and Tiejun Zhao, "The Butterfly Breast Coils for ^{23}Na Imaging at High-Field MRI (7T and 3T)." Proceeding of 50th Experimental Nuclear Magnetic Resonance Conference, Asilomar Conference Center, Pacific Grove, CA. March 29- April 3, 2009.

10. **Qiuhong He**, Keerthi Chadalawada and Kaung-ti Yung, "MR Spectroscopic Imaging of PUFA and Lactate in High Lipid Environment by Selective Multiple Quantum Coherence Transfer." Proceeding of 50th Experimental Nuclear Magnetic Resonance Conference, Asilomar Conference Center, Pacific Grove, CA. March 29- April 3, 2009.

11. **Qiuhong He**, Jiani Hu and Kaung-ti Yung, "Simultaneous MR Spectroscopic Imaging of PUFA and Choline in Tissues Containing High Content of Fat by the Modified SEE-SelMQC Method." Proceeding of

50th Experimental Nuclear Magnetic Resonance Conference, Asilomar Conference Center, Pacific Grove, CA. March 29- April 3, 2009.

12. **Qiuhong He**, Jiani Hu and Kaung-ti Yung, "Double spin-echo enhanced Sel-MQC for simultaneous choline and lactate mapping in fatty tissues." Proceeding of 50th Experimental Nuclear Magnetic Resonance Conference, Asilomar Conference Center, Pacific Grove, CA. March 29- April 3, 2009.

13. Dong Wei, Jie Li, Wei Jia, **Qiuhong He**, Yifan Dai, Allan Z. Zhao, "Endogenous production of n-3 PUFAs affords protective effects against high-fat diet induced obesity, insulin resistance, and hypercholesterolemia." The 68th Scientific Sessions of Annual American Diabetes Association Meeting, San Francisco, CA. June 9, 2008.

14. **Qiuhong He**; Jie Li; Dong Wei; Wei Jia; Yifan Dai ; Allan Zhao, "MRI Reveals a Dramatic Visceral Fat Reduction in Male Fat-1 Transgenic Mice on High Fat Diet." Proc. 49th Experimental Nuclear Magnetic Resonance Conference (ENC), March 9 - 14, 2008.

15. Yuanwei Jin, Jose M.F. Moura, and Yi Jiang, Michael Wahl, and **Qiuhong He,** "Breast Cancer Detection by Time Reversal Imaging." Proceeding of the 5th IEEE International Symposium on Biomedical Imaging: From Nano to Macro, 2008. (ISBI 2008). Paris, France, May 14-17, 2008.

16. **Qiuhong He**; Han H. Liu; Brendan P. Clifford; Salina D. Gao, "A Heteronuclear Coil System for MRI/MRS of Human Breast at High Magnetic Field (7T)." Proc. 49th Experimental Nuclear Magnetic Resonance Conference (ENC), Asilomar Conference Center, 800 Asilomar Blvd. Pacific Grove, California. March 9 - 14, 2008.

17. **Q. He,** V. Chibisov, G. Ramus, H. Liu, K.T. Yung and H. Zhu, "Longitudinal Diffusion-Weighted MRI Study of the Tumor Tissue Destruction Process Induced by Novel Attenuated *Salmonella Typhimurium* Expressing Protein Drugs." *Proc. Intl. Soc. Mag. Reson. Med*. (2007)

18. K-T. Yung, G. Ramus, V. Chibisov, and **Q. He**, "In vivo MR diffusion tensor study of bacteria infiltration in murine tumor." *Proc. Intl. Soc. Mag. Reson. Med*. (2007).

19. H. Zhu, D. Rubin, **Q. He**, "Fast MRSI of Human Breast using Spiral Sel-MQC.**"** *Proc. Intl. Soc. Mag. Reson. Med*. 14, 3051 (2006)

20. K-T. Yung, X. Song, G. Ramus, V. Chibisov, **Q. He**, "In vivo MR Diffusion Investigation of Murine Tumors with Bacteria Infiltration." *Proc. Intl. Soc. Mag. Reson. Med*. (2006)

21. D. Rubin, **Q. He**, "Developing an RF Coil for MRI and MRS of Human Breast Tissue." *Proc. Intl. Soc. Mag. Reson. Med*. (2006).

22. **Q. He**, X. J. Zhou, "Simultaneous Detection of Choline and Other Metabolites using SEE-SelMQC for Spectroscopic Imaging of Human Breast Cancer, "*Proc. Intl. Soc. Mag. Reson. Med*. (2006)

23. **Q. He** and N. Charles, *"*Bacterial-Based Magnetic Resonance Contrast Agents," *Proc. Intl. Soc. Mag. Reson. Med*. (2005).

24. **Q. He** and X. J. Zhou, *"*Volume and Multi-Slice Localizations Using Spatial-Spectral Selective RF Pulses for Selective Multiple-Quantum (Sel-MQC) Spectroscopic Imaging of Human Cancer," *Proc. Intl. Soc. Mag. Reson. Med*. (2005).

25. **Q. He**, J. Mao, J. P. Dyke, H. M. Gach, X. Xiangling Mao, D. C. Shungu, "A Customized Quadrature Transmit/Receive Breast Coil for Selective Multiple-Quantum (Sel-MQC) Spectroscopic Imaging," *Proc.*

Intl. Soc. Mag. Reson. Med. 2043 (2004).

26. **Q. He**, C. H. French-Lee, X. Mao, D. C. Shungu, G. Goelman, "Three-Dimensional Sel-MQC Mapping of Lactate and PUFAs in Human Breast Tissue at 2.1T by Hadamard Matrix Approach," *Proc. Intl. Soc. Mag. Reson. Med*. 2298 (2004).

27. **Q. He**, P. Shkarin, and C. H. Lee-French, "Mapping of Unsaturated Lipid in Human Breast Cancer Using Sel-MQC." *Proc. Intl. Soc. Mag. Reson. Med.* 289 (2003).

28. S. B. Thakur and **Q. He**, "Spectral-Selective Volume Localized Selective Multiple Quantum Spectroscopy." *Proc. Intl. Soc. Mag. Reson. Med*. 1141 (2003).

29. M. Muruganandham, J. A. Koutcher, and **Qiuhong He**, "T_2 Relaxation measurements of Lactate in Abundant Lipid Environment by Selective Multiple Quantum Coherence Transfer (Sel-MQC)." *Proc. Intl. Soc. Mag. Reson. Med.* **10** 2284 (2002).

30. R.Z. Xu, J. J. Leffert, S. Sodi, I. King, J. Pawelek, E. Adam, **Qiuhong He**, and G. Pizzorno, "Magnetic Resonance Spectroscopy (MRS) Detection of Lactic Acid for Salmonella Localization in Tumors." *Proc. Intl. Soc. Mag. Reson. Med.* **10** 2168 (2002).

31. Pavel Shkarin and **Qiuhong He**, "Lactate Detection in Human Breast Cancer on a 2.1T MR System." *Proc. Intl. Soc. Mag. Reson. Med*. (2001).

32. Pavel Shkarin and **Qiuhong He**, "Lactate Observation in the Abundance of Lipid on Whole Body 2.1T Scanner." *Proc. Intl. Soc. Mag. Reson. Med*. **2**, 1089 (1999).

33. **Qiuhong He**, Richard P. Kennan, Gadi Goelman, Jerry G. Glickson, Lei Rao, and Jianxin Guo, "Toward Multi-Slice Detection of Metabolites in Breast Cancer Patients by Hadamard Selective Multiple Quantum Coherence Transfer (HIS-SelMQC)." *Proc. Intl. Soc. Mag. Reson. Med*. **3**, 1447 (1997).

34. Eric O. Aboagy, **Qiuhong He**, Jerry D. Glickson, and Zaver M. Bhujwalla, "Response of EMT6 Mammary Adenocarcinoma to Radiation Therapy Detected by ^{1}H MRS." *Proc. Intl. Soc. Mag. Reson. Med*. **2**, 1076 (1997).

35. **Qiuhong He**, Zaver M. Bhujwalla, Ross J. Maxwell, and Jerry D. Glickson, "Proton Observation of the Antineoplastic Agent Iproplatin *in vivo* by Selective Multiple-Quantum Coherence Transfer (Sel-MQC)." *Proceedings of the International Society for Magnetic Resonance in Medicine* (1994).

36. **Qiuhong He** and Jerry D. Glickson, "Single Scan Multiple Metabolites Detection in Fatty Tissues by SEE-SelMQC." *Proc. Intl. Soc. Mag. Reson. Med*. (1994).

37. **Q. He**, P. C. M. van Zijl, D. C. Shungu, Z. M. Bhujwalla, and J. D. Glickson, "Single Scan In Vivo Lactate Editing by Selective Multiple Quantum Coherence Transfer." *Proc. Intl. Soc. Mag. Reson. Med*. **1**, 420 (1993).

38. Z. M. Bhujwalla, D. C. Shungu, **Q. He**, J. P. Wehrle, and J. D. Glickson, "Blood Flow Mediated Changes in Tumor Choline Compounds Detected in vivo by Localized ^{1}H NMR Spectroscopy." *Proc. Intl. Soc. Mag. Reson. Med*. **2**, 986 (1993).

E. INVITED PROCEEDING PAPERS:

1**. Qiuhong He** and Pavel Shkarin, "Proton Magnetic Resonance Spectroscopy and Imaging of Human

Breast Cancer by Selective Multiple Quantum Coherence Transfer." *Proceedings of the IEEE 25th Annual Northeast Bioengineering Conference*, 102-103 (1999).

2. **Qiuhong He**, Wei Lin, Yumin Liu, Ercheng Li, "Three-Dimensional Electrophoretic NMR Correlation Spectroscopy for Simultaneous Structure Determination of Co-Existing Protein Conformations." *Proceedings of the IEEE 26th Annual Northeast Bioengineering Conference* (2000).

3. **Qiuhong He**, Zhaohui Wei, "Convection Compensated Electrophoretic NMR (CC-ENMR) for Structure Characterization of Mixed Proteins in Biological Buffer Solutions." *Proceedings of the IEEE 26th Annual Northeast Bioengineering Conference* (2000).

4. Ercheng Li, **Qiuhong He**, "Constant Time ENMR (CT-ENMR) for Structure Characterization of Multiple Proteins in Solutions." *Proceedings of the IEEE 26th Annual Northeast Bioengineering Conference* (2000).

F. **TECHNICAL ARTICLES IN PUBLIC CIRCULATION**:

1. Qiuhong He, "Homonuclear Coherence Correlated Electrophoretic NMR." 43rd Annual Report on Research under the Sponsorship of the Petroleum Research Funds, page 323 (1998).

G. OTHER PUBLICATIONS:

a. PUBLISHED ABSTRACTS AND PRESENTATIONS:
(Capitalized names designate the people who presented the posters or talks)

a.1. Professional Conferences:

Invited Talks:

1. **QIUHONG HE,** "Simultaneous Detection of ZQ→DQ and DQ→ZQ Pathways in Phase-Incrementing SSel-MQC (pi-SSelMQC) with Application to Recover Lost Tumor Marker Signals." The 61st Experimental Nuclear Magnetic Resonance Conference (ENC). March 8 - 13, 2020. Hilton Inner Harbor, Baltimore, Maryland. (Oral & Poster)

2. **QIUHONG HE**, "MR Spectroscopic Imaging of PUFA and Lactate in High Lipid Environment by Selective Multiple Quantum Coherence Transfer." 50th Experimental Nuclear Magnetic Resonance Conference, Asilomar Conference Center, Pacific Grove, CA. March 29- April 3, 2009.

3. **QIUHONG HE**, "Magnetic Resonance Studies of Rapid Tumor Tissue Destruction Induced by Attenuated *Salmonella Typhimurium* Expressing Anti-Cancer Proteins." CSMRM & OCSMRM Joint Meeting 2008 and ESMRMB Workshop, Shenzhen, P. R. China. Dec. 12-13, 2008.

4. **QIUHONG HE**, "Rapid Tumor Tissue Destruction by Attenuated *Salmonella Typhimurium* Expressing Anti-Cancer Proteins." The 2nd Huzhou Forum on Biotechnology Development in China, Huzhou, China, on Sept. 26-28, 2008.

5. Yuanwei Jin, JOSE M.F. MOURA, and Yi Jiang, Michael Wahl, and **QIUHONG HE,** "Breast Cancer Detection by Time Reversal Imaging." Proceeding of the 5th IEEE International Symposium on Biomedical Imaging (ISBI) (2008). Paris, France, May 14-17, 2008.

6. **QIUHONG HE**, "Magnetic Resonance Studies of Tumor Tissue Damage Induced by Attenuated

Salmonella Typhimurium Expressing Anti-Cancer Proteins." The 4TH OCMRA Annual Meeting. Rockefeller University, New York City, New York. Feb. 2, 2008.

7. **QIUHONG HE,** "Bacterial-Based Magnetic Resonance Imaging for Cancer Diagnosis and Therapy." 2nd Grantee Conference of NIBIB, National Institutes of Health, August 7-8, 2005. Washington, D. C.

8. **QIUHONG HE** and Nancy Charles, "A Salmonella-Conjugated Contrast Agent for MR Molecular Imaging of Cancer." Oral presentation, 46th Experimental Nuclear Magnetic Resonance Conference, April 10 – 15, 2005. Providence, Rhode Island.

9. **QIUHONG HE** and Xiaohong J. Zhou, "Volume and Multi-Slice Localizations Using Spatial-Spectral Selective RF Pulses for Selective Multiple-Quantum (Sel-MQC) Spectroscopic Imaging of Human Cancer." Oral Presentation, International Society of Magnetic Resonance in Medicine (ISMRM), 13th Scientific Meeting in Miami, Florida. May 7 – 13, 2005.

10. **QIUHONG HE** and Xiangjin Song, "Exchange Multidimensional Electrophoretic NMR (Ex-NMR) in mapping protein interactions." Oral presentation, 15th meeting of International Society of Magnetic Resonance (ISMAR), Ponte Vedra Beach, Florida, Oct. 24-28, 2004.

11. **QIUHONG HE**, "Multi-dimensional Electrophoretic NMR for Structural Characterization of Co-existing Proteins in Solution," Invited lecture, Oversea Chinese Magnetic Resonance Association (OCMRA), the First Annual Meeting, October 11, 2003. Columbia University, New York, NY

12. **QIUHONG HE**, Pavel Shkarin, and Carol H. Lee-French, "Mapping of Unsaturated Lipid in Human Breast Cancer by Sel-MQC Spectroscopic Imaging." The Annual Conference of International Society of Magnetic Resonance in Medicine (ISMRM), 2003.

13. PAVEL SHKARIN, **QIUHONG HE***, Carol H. Lee, Thomas B. Price, and Douglas L. Rothman, "Localized Lactate Mapping in Human Breast Cancer on 2.1T." Invited talk and poster presentations in the Experimental Nuclear Magnetic Resonance Conference (ENC), 2001.

14. **QIUHONG HE**, Wei Lin, Yumin Liu, Ercheng Li, "Three-Dimensional Electrophoretic NMR Correlation Spectroscopy (3D EP-COSY)." 41st Experimental Nuclear Magnetic Resonance Conference, Asilomar Conference Center, Pacific Grove, California, April 9-14, 2000.

15. **QIUHONG HE**, Wei Lin, Yumin Liu, Ercheng Li, "Three-Dimensional Electrophoretic NMR Correlation Spectroscopy for Simultaneous Structure Determination of Co-Existing Protein Conformations." *Proceedings of the IEEE 26th Annual Northeast Bioengineering Conference* (2000).

16. **QIUHONG HE**, Zhaohui Wei, "Convection Compensated Electrophoretic NMR (CC-ENMR) for Structure Characterization of Mixed Proteins in Biological Buffer Solutions." *Proceedings of the IEEE 26th Annual Northeast Bioengineering Conference* (2000).

17. **QIUHONG HE** and Pavel Shkarin, "Proton Magnetic Resonance Spectroscopy and Imaging of Human Breast Cancer by Selective Multiple Quantum Coherence Transfer." IEEE 25th Annual Northeast Bioengineering Conference, April 8-9, 1999. University of Hartford, West Hartford, Connecticut.

18. **QIUHONG HE** and Pavel Shkarin, "Proton MRS Detection of Metabolic Changes and Drug Delivery in Human Breast Cancer." 1997 National Grant Recipient Conference, The Susan G. Komen Breast Cancer Foundation. Dallas, Texas. Oct. 19-21, 1997.

19. **QIUHONG HE**, Zaver M. Bhujwalla, Ross J. Maxwell, and Jerry D. Glickson, "Proton Observation of the Antineoplastic Agent Iproplatin *in vivo* by Selective Multiple-Quantum Coherence Transfer (Sel-

MQC)." Second Meeting of Society of Magnetic Resonance, San Francisco, California. Aug. 6-12, 1994.

20. **QIUHONG HE**, Zaver M. Bhujwalla, Ross J. Maxwell, and Jerry D. Glickson, "*In Vivo* Detection of the Antineoplastic Agent Iproplatin by Proton Multiple Quantum Spectroscopy," Symposium on *In Vivo* Magnetic Resonance Spectroscopy VII, Monterey, California, April 9-10, 1994.

21. **QIUHONG HE**, Peter C. M. van Zijl, Dikoma C. Shungu, Zaver M. Bhujwalla and Jerry D. Glickson, "Single Scan *In Vivo* Lactate Editing by Selective Multiple Quantum Coherence Transfer," SMRM Twelfth Annual Scientific Meeting, August 14-20, 1993, New York.

22. Z. M. BHUJWALLA, D. C. Shungu, **QIUHONG HE**, J. P. Wehrle and J. D. Glickson, "Blood Flow Modifier Mediated Changes in Tumour Choline Compounds Detected in vivo by Localized ^{1}H NMR Spectroscopy," SMRM Twelfth Annual Scientific Meeting, August 14-20, 1993, New York.

23. **QIUHONG HE**, Peter C. M. van Zijl, Dikoma C. Shungu and Jerry D. Glickson, "Single Scan *In Vivo* Lactate Editing with Complete Lipid and Water Suppression by Selective Multiple Quantum Coherence Transfer," Symposium on In Vivo Magnetic Resonance Spectroscopy, St. Louis, Missouri, March 13-14, 1993.

24. S. MAYR, **QIUHONG HE** and W. S. Warren, "Pulse Shape Optimization in NMR Multilevel Spin Systems: Application to Isotropic Mixing (TOCSY)," 34th Experimental Nuclear Magnetic Resonance Conference, St. Louis, Missouri, March 14-18, 1993.

25. DENISE P. HINTON, Stephen J. Gibbs, **QIUHONG HE**, and Charles S. Johnson, Jr., "Advances in ENMR with applications to phospholipid vesicles," 32th Experimental Nuclear Magnetic Resonance Spectroscopy Conference, Invited Poster Presentation Session, St. Louis, Missouri, April 7-11, 1991.

26. CHARLES S. JOHNSON, JR. and **QIUHONG HE**, "Electrophoretic Nuclear Magnetic Resonance," The Waugh Symposium on High Resolution NMR in Solids, M. I. T., Boston, January 19-21, 1989.

Poster Presentations:

0. EMILY HITCHCOCK, SARAH HODGES, KEVIN ZUANG, ROSY J. LU, Yuanwei Jin, **Qiuhong He**, and Enyue Lu, "Image Processing and Machine Learning for Tumor Tissue Detection Using MRI Images in Bacteria Based Cancer Therapy," REU symposium August, 2022 (submitted)

1. **QIUHONG HE,** "Intermolecular and Intramolecular Coherence Transfer of Glutamate in Saline Solution in Two-Dimensional Selective Zero Quantum Coherence Transfer (Sel-ZQC) Experiments at 9.4T." The 62st (Virtual) Experimental Nuclear Magnetic Resonance Conference (ENC). March 29 - 31, 2021. (e-Poster)

2. **QIUHONG HE,** Hong Yuan, and Yen-Yu Ian Shih, "In vivo Phase-Incrementing MRSI (pi-MRSI) for Multi-Biomarker Imaging with Applications to Human MDA-MB-231 Breast Cancer Xenograft Mouse Model." The 61st Experimental Nuclear Magnetic Resonance Conference (ENC). March 8 - 13, 2020. Hilton Inner Harbor, Baltimore, Maryland. (Poster)

3. **QIUHONG HE,** Hong Yuan, and Yen-Yu Ian Shih, "Simultaneous Detection of ZQ→DQ and DQ→ZQ Pathways in Phase-Incrementing SSel-MQC (pi-SSelMQC) with Application to Recover Lost Tumor Marker Signals." The 61st Experimental Nuclear Magnetic Resonance Conference (ENC). March 8 - 13, 2020. Hilton Inner Harbor, Baltimore, Maryland. (Oral & Poster)

4. **QIUHONG HE,** Vitaly Chibisov, Gabrielle Ramus, Huiwen Liu, Kaung-Ti Yung, Peter Wu, Weike Lai, Xiang-jin Song, and Han H. Liu, "Loss of Cancer Immune Privilege in Bacterial-based Therapy." NCI Microbial Based Cancer Therapy Conference, Natcher Conference Center, NIH Bldg 45, Bethesda, MD. July 11-12, 2017. (Poster)

5. **QIUHONG HE**, "Multiple-Quantum MR Spectroscopic Imaging of Disease Markers in Tissues Containing High Fat Content." 2016 BMES/FDA Frontiers in Medical Devices Conference "Innovations in Modeling and Simulation: Patient-Centered Healthcare." College Park, MD. May 23-25, 2016. (Poster)

6. Raghunatha Reddy R. L, Ian Bayles, Yi Lu, Jing Zheng, Keerthi Chadalawada, Song Chen, Jeffrey W. Barker, Yifan Dai, Luyuan Li, and **QIUHONG HE,** "Expression of n-3 fatty acid desaturase suppresses tamoxifen-resistant breast cancer *in vitro* and in fat-1 transgenic mice." Eleventh Annual AACR International Conference on Frontiers in Cancer Prevention Research, October 16 - 19, 2012, Anaheim, California, USA. (Poster)

7. **QIUHONG HE**, Ying Sun, Jeffrey Barker, Song Chen, "CS-SelZQC for Zero-Quantum Magnetic Resonance Spectroscopic Imaging of Extracranial Tissues without B_0 Inhomogeneous Broadening and Susceptibility Artifacts." The Biomedical Engineering Society (BMES) Annual Meeting, October 24-27, 2012. Atlanta, Georgia, USA. (Poster)

8. Raghunatha Reddy, IAN BAYLES and **QIUHONG HE,** "Fat-1 suppression of tamoxifen-resistant breast cancer." University of Pittsburgh Cancer Institute Science Retreat, Pittsburgh, PA 15213. June 21-22, 2012. (Poster)

9. **QIUHONG HE**, Ying Sun, Jeffrey W. Barker, and Song Chen, "Compressed Sensing in Selective Zero-Quantum Coherence Transfer (CS-SelZQC) Spectroscopic Imaging at Ultrahigh-Field without Susceptibility Artifacts and B_0 inhomogeneous Broadening," 53nd Experimental Nuclear Magnetic Resonance Conference (ENC), Miami. Florida. April 15-20, 2012. (Poster)

10. **QIUHONG HE,** Ian Bayles, Raghunatha Reddy, Jeffrey Barker, Song Chen, Yi Lu, Zheng Jing, Keerthi Chadalawada, Yifan Dai, Luyuan Li, "Fat-1 Gene Therapy as an Adjuvant to Tamoxifen Treatment of Breast Cancer," the sixth Era of Hope conference sponsored by the Department of Defense (DOD) Breast Cancer Research Program (BCRP), Orlando, Florida. August 2-5, 2011. (Poster)

11. **QIUHONG HE,** Ian Bayles, Jeffrey Barker, Song Chen, Yi Lu, Zheng Jing, Keerthi Chadalawada, Yifan Dai, Luyuan Li , Raghunatha Reddy, "Fat-1 gene suppression of breast cancer growth in mice." the 102nd American Association for Cancer Research *(*AACR) Annual Meeting, Orlando, Florida. April 2-6, 2011. (Poster)

12. Song Chen, Jeffrey W. Barker and **QIUHONG HE**, "Selective Zero-Quantum Coherence Transfer (Sel-ZQC) Method for Metabolite Imaging in a Poorly Shimmed Magnet Field." 52nd Experimental Nuclear Magnetic Resonance Conference (ENC), Asilomar Conference Center, Pacific Grove, CA. April 10 - April 15, 2011. (Poster)

13. Song Chen and **QIUHONG HE**, "Selective Zero-Quantum Coherence Transfer (Sel-ZQC) Method for High-Resolution Metabolite Imaging at Ultrahigh Field without Inhomogeneous Broadening and Susceptibility Artifacts." 19th Joint Annual Meeting of ISMRM-ESMRMB, Montréal, Québec, Canada. May 7-13, 2011. (e-poster)

14. Zheng Jing, Yi Lu, Yifan Dai, Luyuan Li and **QIUHONG HE**, "Fat-1 gene suppression of human breast cancer growth," 22nd Annual UPCI Scientific Retreat, Soldiers and Sailors Memorial Hall and Museum, University of Pittsburgh, June 17-18, 2010. (poster)

15. **QIUHONG HE, "**Simultaneous MSC-SelMQC Mapping of Polyunsaturated Fatty Acids (PUFA), Lactate and Choline in Tissues Containing High Concentration of Mobile Lipid." 18th Joint Annual Meeting of ISMRM-ESMRMB, Stockholm, Sweden, May 1-7, 2010 (e-Poster)

16. **QIUHONG HE**, Gregery Hogan, and Zheng Jing, "MSC-SelMQC Method for Simultaneous Mapping of Polyunsaturated Fatty Acids, Lactate and Choline in High Fat Tissues." 51th Experimental Nuclear Magnetic Resonance Conference, Hilton Daytona Beach Oceanfront Resort, Daytona Beach, Florida. April 18 - 23, 2010.

17. Peter Wu, Vitaly Chibisov, Gabrielle Ramus, Huiwen Liu, Xiangjin Song, Kaung-Ti Yung, Henry Zhu and **QIUHONG HE,** "The effect of macrophage on bacterial-induced tumor tissue damage." American Association for Cancer Research (AACR) 100th Annual Meeting, Denver, Colorado. April 18-22, 2009.

18. **QIUHONG HE**, Jiani Hu and Kaung-ti Yung, "Simultaneous MR Spectroscopic Imaging of PUFA and Choline in Tissues Containing High Content of Fat by the Modified SEE-SelMQC Method." 50th Experimental Nuclear Magnetic Resonance Conference, March 29- April 3, 2009. Asilomar Conference Center, Pacific Grove, CA.

19. **QIUHONG He,** Jiani Hu and Kaung-ti Yung, "Double spin-echo enhanced Sel-MQC for simultaneous choline and lactate mapping in fatty tissues." 50th Experimental Nuclear Magnetic Resonance Conference, March 29- April 3, 2009. Asilomar Conference Center, Pacific Grove, CA.

20. **QIUHONG HE,** Tricia N. Schantz, Brendan P. Clifford, and Tiejun Zhao, "The Butterfly Breast Coils for ^{23}Na Imaging at High-Field MRI (7T and 3T)." 50th Experimental Nuclear Magnetic Resonance Conference, March 29- April 3, 2009. Asilomar Conference Center, Pacific Grove, CA.

21. KAUNG-TI YUNG, Gabrielle Ramus, Vitaly Chibisov, Huiwen Liu, Weike Lai, He Zhu, Han H. Liu and **QIUHONG HE**, "MR Diffusion investigation of murine tumors infiltrated by genetically-engineered bacteria." Paul C. Lauterbur Memorial Symposium, Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign, Urbana, Illinois. March 27th, 2008.

22. **QIUHONG HE**; Han H. Liu; Brendan P. Clifford; Salina D. Gao, "A Heteronuclear Coil System for MRI/MRS of Human Breast at High Magnetic Field (7T)." 49th Experimental Nuclear Magnetic Resonance Conference (ENC), Asilomar Conference Center, 800 Asilomar Blvd. Pacific Grove, California. March 9 - 14, 2008.

23. **QIUHONG HE**; Jie Li; Dong Wei; Wei Jia; Yifan Dai ; Allan Zhao, "MRI Reveals a Dramatic Visceral Fat Reduction in Male Fat-1 Transgenic Mice on High Fat Diet." 49th Experimental Nuclear Magnetic Resonance Conference (ENC), Asilomar Conference Center, 800 Asilomar Blvd. Pacific Grove, California. March 9 - 14, 2008.

24. **QIUHONG HE**, Vitaly Chibisov, Gabrielle Ramus, Huiwen Liu, Kaung-Ti Yung and He Zhu, "Longitudinal Diffusion-Weighted MRI Study of Rapid Tumor Tissue Destruction Induced by Attenuated *Salmonella Typhimurium* Carrying Anti-Cancer Protein Drugs." University of Pittsburgh Cancer Institute Science Retreat, June 18-19, 2007.

25. Kaung-Ti Yung, Gabrielle Ramus, Vitaly Chibisov, and **QIUHONG HE**, "Diffusion tensor imaging distinguishes regions of tissue modification in *Salmonella* (TNFα) treated murine tumor." University of Pittsburgh Cancer Institute Science Retreat, June 18-19, 2007.

26. **QIUHONG HE**, Vitaly Chibisov, Gabrielle Ramus, Huiwen Liu, Kaung-Ti Yung, He Zhu, "The attenuated salmonella typhimurium strains expressing anti-cancer proteins have overcome host immune

barrier to infiltrate tumor tissues and induce massive cancer cell death." American Association for Cancer Research (AACR), April 14-18, 2007, Los Angeles, California.

27. **QIUHONG HE**; Vitaly Chibisov; Gabrielle Ramus; Huiwen Liu; Kaung-Ti Yung; He Zhu, "Diffusion-Weighted MRI Reveals the Rapid Tumor Tissue Destruction by Attenuated Salmonella Typhimurium Carrying Anti-Cancer Protein Drugs." 48th Experimental Nuclear Magnetic Resonance Conference (ENC), Poster #239. Daytona Beach, Florida, April 22 - 27, 2007

28. Kaung-Ti Yung, Gabrielle Ramus, Vitaly Chibisov, and **QIUHONG HE**, "*In vivo* MR diffusion tensor study of tumor tissue destruction due to bacteria invasion." 48th Experimental Nuclear Magnetic Resonance Conference (ENC), Daytona Beach, Florida, April 22 - 27, 2007

29. **QIUHONG HE,** Vitaly Chibisov, Gabrielle Ramus, Huiwen Liu, Kaung-Ti Yung, and He Zhu, "Longitudinal Diffusion-Weighted MRI Study of the Tumor Tissue Destruction Process Induced by Novel Attenuated Salmonella Typhimurium Expressing Protein Drugs." Joint Annual Meeting ISMRM-ESMRMB, Berlin, Germany, May 19 – 25, 2007.

30. KAUNG-TI YUNG, Gabrielle Ramus, Vitaly Chibisov, and **QIUHONG HE**, "In vivo MR diffusion tensor study of bacteria infiltration in murine tumor." Joint Annual Meeting ISMRM-ESMRMB, Berlin, Germany, May 19 – 25, 2007.

31. Huiwen Liu, Wanda Wang, Vitaly Chibisov, Gabrielle Ramus, **QIUHONG HE**, "Bacteria-induced Macrophage Activation in Metastatic Lewis Lung Carcinoma in mice." 18th Annual UPCI Scientific Retreat, University of Pittsburgh Cancer Institute, Johnstown, PA, June 22-23, 2006.

32. GABRIELLE RAMUS, Huiwen Liu, Vitaly Chibisov and **QIUHONG HE**, "The Role of Protein Drugs in Bacterial infiltration and Tissue Damage in Metastatic Lewis Lung Carcinoma." 2006 Science Retreat, University of Pittsburgh Cancer Institute, Johnstown, PA, June 22, 2006.

33. Kaung-Ti Yung, Gabrielle Ramus, Vitaly Chibisov, Huiwen Liu, and **QIUHONG HE**, "I*n vivo* MR Diffusion Investigation of Murine Tumors with Bacteria Infiltration." 2006 Science Retreat, University of Pittsburgh Cancer Institute, Johnstown, PA, June 22, 2006.

34. Denis Rubin and **QIUHONG HE**, "A Comparison of Parallel Cosine (PCOS) and Parallel Solenoidal (PSOL) Coils as RF Transmit and Receive Device for High-Field Magnetic Resonance Imaging and Spectroscopy of Human Breast Cancer." 2006 Science Retreat, University of Pittsburgh Cancer Institute, Johnstown, PA, June 22, 2006.

35. **QIUHONG HE** and Xiaohong J. Zhou, "SEE-SelMQC Detection of Multiple Metabolites on a GE 3T Human Scanner for Spectroscopic Imaging of Human Breast Cancer." 2006 Science Retreat, University of Pittsburgh Cancer Institute, Johnstown, PA, June 22, 2006.

36. He Zhu, Denis Rubin, Jules Sumkins, and **QIUHONG HE**, "Spiral Sel-MQC: Fast In Vivo MRSI of the Distribution of the Polyunsaturated Fatty Acids in Breast Tissues." 2006 Science Retreat, University of Pittsburgh Cancer Institute, Johnstown, PA, June 22, 2006.

37. Denis Rubin and **QIUHONG HE**, "A Comparison of Parallel Cosine (PCOS) and Parallel Solenoidal (PSOL) Coils as RF Transmit and Receive Device for High-Field Magnetic Resonance Imaging and Spectroscopy of Human Breast Cancer." 47th Experimental Nuclear Magnetic Resonance Conference, April 23 – 28, 2006 Asilomar Conference Center, Pacific Grove, CA.

38. He Zhu, Denis Rubin and **QIUHONG HE**, "Fast Spiral-SelMQC to Map Spatial Distributions of Polyunsaturated Fatty Acids (PUFA) in Human Breast." 47th Experimental Nuclear Magnetic Resonance Conference, April 23-28, 2006 Asilomar Conference Center, Pacific Grove, CA.

39. Kaung-Ti Yung, Gabrielle Ramus, Huiwen Liu, Vitaly Chibisov, Xiangjin Song, and **QIUHONG HE**, "*In vivo* MR Diffusion Study of Bacteria-Carrying Solid Tumor in Mice." 47th Experimental Nuclear Magnetic Resonance Conference, April 23-28, 2006 Asilomar Conference Center, Pacific Grove, CA.

40. **QIUHONG HE** and Xiaohong J. Zhou, "SEE-SelMQC Detection of Multiple Metabolites on a GE 3T Human Scanner for Spectroscopic Imaging of Human Breast Cancer." 47th Experimental Nuclear Magnetic Resonance Conference, April 23-28, 2006 Asilomar Conference Center, Pacific Grove, CA.

41. HE ZHU, Denis Rubin, **QIUHONG HE**, "Fast MRSI of Human Breast using Spiral Sel-MQC.**"** International Society of Magnetic Resonance in Medicine (ISMRM), 13th Scientific Meeting in Miami, Florida. May 6 – 12, 2006.

42. K-T. YUNG, Xiangjin Song, Gabrielle Ramus, Vitaly Chibisov, **QIUHONG HE**, "In vivo MR Diffusion Investigation of Murine Tumors with Bacteria Infiltration." International Society of Magnetic Resonance in Medicine (ISMRM), 13th Scientific Meeting in Miami, Florida. May 6 – 12, 2006.

43. Denis Rubin, **QIUHONG HE**, "Developing an RF Coil for MRI and MRS of Human Breast Tissue." International Society of Magnetic Resonance in Medicine (ISMRM), 13th Scientific Meeting in Miami, Florida. May 6 – 12, 2006.

44. **QIUHONG HE** and Xiaohong J. Zhou, "Simultaneous Detection of Choline and Other Metabolites using SEE-SelMQC for Spectroscopic Imaging of Human Breast Cancer," International Society of Magnetic Resonance in Medicine (ISMRM), 13th Scientific Meeting in Miami, Florida. May 6 – 12, 2006.

45. **QIUHONG HE**, Nancy Charles, Xiangjin Song, Xiaoyan Liu, Demetrius Kokkinakis, William Lanham, Gabrielle Ramus, Vitaly Chibisov, Elliot J. Alyeshmerni, and Jianping Song, "Bacterial-Based Magnetic Resonance Contrast Agents." University of Pittsburgh Cancer Institute, June 9, 2005.

46. **QIUHONG HE**, Nancy Charles, Xiangjin Song, and Jianping Song, "Bacterial-Based Magnetic Resonance Contrast Agents." International Society of Magnetic Resonance in Medicine (ISMRM), 13th Scientific Meeting in Miami, Florida. May 7 – 13, 2005.

47. **QIUHONG HE** and Xiaohong J. Zhou, "Volume and Slice Localizations for Sel-MQC Spectroscopic imaging of Breast Cancer Using Spatial-Spectral Selective RF Pulses." 46th Experimental Nuclear Magnetic Resonance Conference (ENC), April 10 – 15, 2005. Providence, Rhode Island.

48. **QIUHONG HE**, Regina Hooley, Carol H. Lee, Donald Lannin, Jeffery Weinreb, and Veerle Bossuyt, "*In vivo* MR Spectroscopic Imaging of Polyunsaturated Fatty Acids (PUFA) for Early Detection of Human Breast Cancer," American Association for Cancer Research (AACR) 95th Annual Meeting, March 27 – 30, 2004.

49. **QIUHONG HE**, Jintong Mao, Jonathan P. Dyke, H. Michael Gach, Xiangling Mao, Dikoma C. Shungu, "A Customized Quadrature Transmit/Receive Breast Coil for Selective Multiple-Quantum (Sel-MQC) Spectroscopic Imaging of Breast Cancer Lactate on a 3T Clinical MR System," 45th Experimental Nuclear Magnetic Resonance Conference, April 18 – 23, 2004 Asilomar Conference Center, Pacific Grove, CA

50. **QIUHONG HE**, Regina Hooley, Carol H. Lee, Donald Lannin, Jeffery Weinreb, and Veerle Bossuyt, "*In Vivo* MR Spectroscopic Imaging of Polyunsaturated Fatty Acids (PUFAs) of Human Breast Cancer."

45th Experimental Nuclear Magnetic Resonance Conference, April 18 – 23, 2004 Asilomar Conference Center, Pacific Grove, CA

51. SUNITHA B. THAKUR and **QIUHONG HE**, "Spectral-Selective Volume Localized Selective Multiple Quantum Spectroscopy." International Society of Magnetic Resonance in Medicine (ISMRM), Toronto, Canada, 2003.

52. SUNITHA B. THAKUR and **QIUHONG HE**, "Maximum Entropy for Flow Resolution Enhancement in Electrophoretic NMR." The 44th Experimental Nuclear Magnetic Resonance Conference (ENC), 2003.

53. SUNITHA B. THAKUR and **QIUHONG HE**, "Spectral-Selective Volume Localized Selective Multiple-Quantum Spectroscopy (SV-SelMQC)." The 44th Experimental Nuclear Magnetic Resonance Conference (ENC), 2003.

54. R.Z. Xu, J. J. Leffert, S. Sodi, I. King, J. Pawelek, E. Adam, **QIUHONG HE**, and G. Pizzorno, "Magnetic Resonance Spectroscopy (MRS) Detection of Lactic Acid for Salmonella Localization in Tumors." International Society of Magnetic Resonance in Medicine (ISMRM), Honolulu, USA, May 20-24, 2002. Poster

55. M. MURUGANANDHAM, J. A. Koutcher, and **QIUHONG HE**, "T_2 Relaxation measurements of Lactate in Abundant Lipid Environment by Selective Multiple Quantum Coherence Transfer (Sel-MQC)." International Society of Magnetic Resonance in Medicine (ISMRM), Honolulu, USA, May 20-24, 2002. Poster

56. PAVEL SHKARIN and **QIUHONG HE**, "Removing Lipid MQ-Coherences in Localized SSel-MQC for Lactate Detection at Low Magnetic Field." Poster M/T 120. The 43rd Experimental Nuclear Magnetic Resonance Conference (ENC). April 14-19, 2002. Asilomar Conference Center, California.

57. Manickam Muruganandham, Jason Koutcher, and **QIUHONG HE**, "T_2 Mapping of Lactate in Lipid-Rich Environment by Selective Multiple Quantum Coherence Transfer (Sel-MQC). Poster W/Th P120. The 43rd Experimental Nuclear Magnetic Resonance Conference (ENC). April 14-19, 2002. Asilomar Conference Center, California.

58. SUNITHA B. THAKUR and **QIUHONG HE**, "Volume-Selective Sel-MQC for Lactate Editing in Lipid-Rich Environment." Poster W/Th P117. The 43rd Experimental Nuclear Magnetic Resonance Conference (ENC). April 14-19, 2002. Asilomar Conference Center, California.

59. SUNITHA B. THAKUR and **QIUHONG HE**, "Flow–Resolution Enhancement in Electrophoretic NMR Using Denoising and Linear Prediction." Poster W/Th P263. The 43rd Experimental Nuclear Magnetic Resonance Conference (ENC). April 14-19, 2002. Asilomar Conference Center, California.

60. SUNITHA B. THAKUR and **QIUHONG HE**, "Solvent Suppression for Biomacromolecular Structural Analysis by Electroosmosis-Enhanced Electrophoretic NMR (EEENMR). Poster W/Th P267. The 43rd Experimental Nuclear Magnetic Resonance Conference (ENC). April 14-19, 2002. Asilomar Conference Center, California.

61. PAVEL SHKARIN and **QIUHONG HE***, "Lactate Detection in Human Breast Cancer on a 2.1T MR System." International Society of Magnetic Resonance in Medicine (ISMRM), Glasgow, Scotland, UK, 2001. Poster

62. PAVEL SHKARIN, **QIUHONG HE***, Carol H. Lee, Thomas B. Price, and Douglas L. Rothman, "Localized Lactate Mapping in Human Breast Cancer on 2.1T." Invited talk and poster presentations in the Experimental Nuclear Magnetic Resonance Conference (ENC), 2001.

63. Ercheng Li, **QIUHONG HE***, Yan Zhang, "Three-Dimensional Electrophoretic Heteronuclear Single Quantum Correlation Spectroscopy (3D EP-HSQC)." Poster presentation in the Experimental Nuclear Magnetic Resonance Conference (ENC), 2001.

64. **QIUHONG HE** and Zhaohui Wei, "Convection Compensated Electrophoretic NMR (CC-ENMR)." 41st Experimental Nuclear Magnetic Resonance Conference, Asilomar Conference Center, Pacific Grove, California, April 9-14, 2000. Poster M/T PA 056.

65. **QIUHONG HE**, Wei Lin, Yumin Liu and Ercheng Li, "Three-Dimensional Electrophoretic NMR Correlation Spectroscopy (3D EP-COSY)." 41st Experimental Nuclear Magnetic Resonance Conference, Asilomar Conference Center, Pacific Grove, California, April 9-14, 2000. Poster M/T PA 057.

66. Ercheng Li and **QIUHONG HE**, "Constant Time ENMR (CT-ENMR)." 41st Experimental Nuclear Magnetic Resonance Conference, Asilomar Conference Center, Pacific Grove, California, April 9-14, 2000. Poster M/T PA 058.

67. **QIUHONG, HE**, Yumin Liu, Ercheng Li, "Capillary Array Electrophoretic NMR and Convection Compensation." 1999 Magnetic Resonance Gordon Research Conference. New England College, New Hampshire. June 27 - Jule 2, 1999. Poster discussion and session presentation.

68. PAVEL SHKARIN and **QIUHONG HE**, "Lactate Observation in the Abundance of Lipid on Whole Body 2.1T Scanner." Seventh Scientific Meeting and Exhibition, International Society for Magnetic Resonance in Medicine (ISMRM). May 22-28, 1999. Philadelphia, Pennsylvania, USA. (Poster T 1089)

69. **QIUHONG HE** and Yuri Lvov, "In Situ Surface Charge Charaterization by Capillary Array Electrophoretic NMR." 40th Experimental Nuclear Magnetic Resonance Conference (ENC). February 28 - March 5, 1999. Orlando, Florida. (Poster W&Th P137)

70. PAVEL SHKARIN and **QIUHONG HE**, "Robust Lactate Editing in Abundant Lipid on a Whole Body MRI Scanner at 2.1T: A Phantom Verification." 40th Experimental Nuclear Magnetic Resonance Conference (ENC). February 28 - March 5, 1999. Orlando, Florida. (Poster M&T P167)

71. **QIUHONG HE**, Yumin Liu, Haihang Sun, and Terry Nixon, "Multi-Dimensional Electrophoretic NMR of Protein Mixtures in Biological Buffers of High Ionic Strength." Oct. 4-7, 1998. Structure-Based Functional Genomics. Golden Inn Resort, Avalon, NJ. (Poster)

72. PAVEL SHKARIN and **QIUHONG HE**, "Proton Magnetic Resonance Spectroscopy and Imaging of Metabolites in Human Breast Cancer on 2.1T Whole Body Clinical Scanner." 1998 National Grant Recipient Conference, The Susan G. Komen Breast Cancer Foundation. Dallas, Texas. Oct. 19-21, 1998. (Poster)

73. **QIUHONG HE** and Yumin Liu, "High Resolution Capillary Electrophoretic NMR--Resolving Multiple Protein Components in Mixtures." March 22-27, 1998. The 39th Experimental Nuclear Magnetic Resonance Conference (ENC). Asilomar Conference Center, Pacific Grove, CA (Poster)

74. **QIUHONG, HE**, Yumin Liu, Terry Nixon,"High Field Electrophoretic NMR of Proteins." 1997 Magnetic Resonance Gordon Research Conference. New England College, New Hampshire. June 22 - 27, 1997. Poster discussion and session presentation.

75. **QIUHONG HE**, Richard P. Kennan, Gadi Goelman, Jerry D. Glickson, Dennis B. Leeper, and Lei Rao, "Hadamard Selective Multiple Quantum Coherence Transfer for Multi-Slice Detection of Metabolites in

Breast Cancer." Fifth Annual Meeting and Exhibition of International Society of Magnetic Resonance in Medicine, Vancouver, B. C., Canada. April 12-18, 1997. Poster 1447.

76. Eric O. ABOAGYE, **QIUHONG HE**, Jerry D. Glickson, Zaver M. Bhujwalla, "Response of EMT6 Mammary Adenocarcinoma to Radiation Therapy Detected by ^{1}H MRS." Fifth Annual Meeting and Exhibition of International Society of Magnetic Resonance in Medicine, Vancouver, B. C., Canada. April 12-18, 1997. Poster 1076.

77. **QIUHONG HE**, Richard P. Kennan, Gadi Goelman, Jerry D. Glickson, Dennis B. Leeper, and Lei Rao, "Hadamard Selective Multiple Quantum Coherence Transfer for Multi-Slice Detection of Metabolites in Breast Cancer." 38th Experimental Nuclear Magnetic Resonance Conference (ENC), Orlando, Florida. March 23 - 27, 1997. Poster 42.

78. **QIUHONG HE**, Xinmiao Wei, and Jianxin Guo, and Yumin Liu, "Multi-Dimensional Electrophoretic NMR of Multiple Proteins in Mixtures." 38th Experimental Nuclear Magnetic Resonance Conference (ENC), Orlando, Florida. March 23 - 27, 1997. Poster 212.

79. **QIUHONG HE** and Jerry D. Glickson, "Single Scan Multiple Metabolites Detection in Fatty Tissues by SEE-SelMQC." Second Meeting of Society of Magnetic Resonance, San Francisco, California. Aug. 6-12, 1994. Poster 1324.

80. **QIUHONG HE**, Zaver M. Bhujwalla, Ross J. Maxwell, and Jerry D. Glickson, "Proton Observation of Antineoplastic Agent Iproplatin *In Vivo* with Selective Multiple Quantum Coherence Transfer," 35th Experimental Nuclear Magnetic Resonance Spectroscopy Conference, April 10-15, 1994. The Asilomar Conference Center, Pacific Grove, California. Poster section, M11.

81. **QIUHONG HE** and Jerry D. Glickson, "Multiple Molecular Specific Echo Spectroscopy," 35th Experimental Nuclear Magnetic Resonance Spectroscopy Conference, April 10-15, 1994. The Asilomar Conference Center, Pacific Grove, California. Poster section, M12.

82. **QIUHONG HE**, S. Mayr, M. McCoy, N. Murali, W. S. Warren, "Applications of Shaped Pulses for Coupled Spins," 32th Experimental Nuclear Magnetic Resonance Spectroscopy Conference, St. Louis, Missouri, April 7-11, 1991. Poster section, P44.

83. D. Goswami, S. Mayr, **QIUHONG HE**, M. McCoy, W. S. WARREN, "From C.W. NMR to F.T. NMR to V.W. NMR," 32th Experimental Nuclear Magnetic Resonance Spectroscopy Conference, St. Louis, Missouri, April 7-11, 1991. Poster section, P264.

84. **QIUHONG HE** and Charles S. Johnson, Jr., "Electrophoretic NMR," 30th Experimental Nuclear Magnetic Resonance Spectroscopy Conference, Asilomar Conference Center, Pacific Grove, California, April 2-6, 1989. Poster section, W

a.2. Research seminars and invited lectureships:

Research Institutions and Universities:

1. QIUHONG HE, "Polyunsaturated Fatty Acids (PUFA) as MRSI Detection Markers of Human Breast Cancer and n-3 PUFA suppression of tamoxifen-resistant mammary tumors in fat-1 transgenic mice." MRI Seminar, BIOS 334, California State University, Los Angeles, CA 90032. October 19, 2012.

2. QIUHONG HE, "Multi-Dimensional Electrophoretic NMR for Structural Characterization of Protein Mixtures and Protein Interactions." Department of Structural Biology, University of Pittsburgh, Pittsburgh, PA 15213. Oct. 13, 2011.

3. QIUHONG HE, "Magnetic Resonance Studies of Rapid Tumor Tissue Destruction by Bacterial-Based Cancer Therapy." Department of Radiology, University of Pennsylvania, Philidelphia, PA. July 21, 2009.

4. QIUHONG HE, "A Novel Device for Breast Cancer Detection," Presentation to the Commercialization Advisory Committee, University of Pittsburgh, Pittsburgh, June 24, 2009.

5. QIUHONG HE, "Magnetic Resonance Investigations of Rapid Tumor Tissue Destruction by Bacterial-Based Cancer Therapy." Department of Physics, The Chinese University of Hong Kong, Hong Kong, P. R. China. Dec. 11, 2008.

6. QIUHONG HE, "Rapid Tumor Tissue Destruction by Attenuated *Salmonella Typhimurium* Expressing Anti-Cancer Proteins." School of Basic Medicine, Jilin University, Changchun, P. R. China. Sept. 23, 2008.

7. Qiuhong He, Han H. Liu, Brendan P. Clifford, Salina D. Gao, Denis Rubin and Tricia Schantz, "A Novel Device for Breast Cancer Detection," Science2008, University of Pittsburgh, Pittsburgh, Oct. 2, 2008.

8. QIUHONG HE, "Magnetic Resonance Studies of Rapid Tumor Tissue Destruction Induced by Attenuated *Salmonella Typhimurium* Expressing Anti-Cancer Proteins." Departmental Seminar, Department of Bioengineering, University of Illinois at Chicago, Chicago, IL, April 25, 2008.

9. QIUHONG HE, "Bacterial-based Cancer Imaging and Therapy." The Pittsburgh NMR Center for Biomedical Research, Carnegie Mellon University, Pittsburgh, PA. Feb. 25, 2008 (NIH P41 site-visit meeting)

10. QIUHONG HE, "Magnetic Resonance Spectroscopy and Imaging in Breast Cancer Diagnosis and Treatment." Special Seminar, Department of Electrical and Computer Engineering, Carnegie Mellon University, Pittsburgh, PA. September 25, 2007.

11. QIUHONG HE, "Bacterial-Based Cancer Therapy and Imaging." The Pittsburgh NMR Center for Biomedical Research, Carnegie Mellon University, Pittsburgh, PA. July 19, 2007.

12. QIUHONG HE, "Electrophoretic NMR of Protein Mixtures and its Proteomic Applications." Department of Radiology, Magnetic Resonance Research Center, University of Pittsburgh, PA 15213. Aug. 13, 2007.

13. QIUHONG HE, "Magnetic Resonance Spectroscopy and Imaging in Cancer Diagnosis and Therapy." Departmental Seminar, Department of Bioengineering, Pennsylvania State University, University Park, PA. March 23, 2007.

14. QIUHONG HE, "Bacterial-Based Cancer Therapy and Imaging." Departmental Research Seminar, Department of Radiology, University of Pittsburgh, Pittsburgh, PA. June 15, 2006

15. QIUHONG HE, "Bacterial-Based MR Molecular Imaging of Tumor Oxygenation." The Pittsburgh NMR Center for Biomedical Research, Carnegie Mellon University, Pittsburgh, PA. July 19, 2005.

16. QIUHONG HE, "Magnetic Resonance Spectroscopic Imaging for Cancer Diagnosis, Metabolic Phenotyping, and Characterization of Tumor Oxygenation." Departmental Research Seminar, Department of Radiology, University of Pittsburgh, Pittsburgh, PA. July 5, 2004

17. QIUHONG HE, "MR Spectroscopic Imaging to Improve the Diagnostic Specificity of Extracranial Cancers." General Electric Seminar, Milwaukee, Wisconsin. Mar. 1, 2004.

18. QIUHONG HE, "Multi-dimensional Electrophoretic NMR for Structural Characterization of Co-existing Proteins in Solution," Seminar, Department of Chemistry, Marquette University, Milwaukee, Wisconsin. Nov. 21, 2003.

19. QIUHONG HE, "*In Vivo* Magnetic Resonance Spectroscopy and Imaging of Tumor Metabolic Markers." Institute Seminar, Winship Cancer Institute, Emory University School of Medicine. Jan. 31, 2003.

20. QIUHONG HE, "Proton Magnetic Resonance Spectroscopy and Imaging of Human Breast Cancer." Departmental Seminar, Department of Physiology & Biophysics, Albert Einstein College of Medicine, New York. April 11, 2002.

21. QIUHONG HE, "Proton Magnetic Resonance Spectroscopy and Imaging of Human Breast Cancer." Department of Radiology, University of Pennsylvania, Philadelphia. Mar. 13, 2002.

22. QIUHONG HE, "Proton Magnetic Resonance Spectroscopy and Imaging of Human Breast Cancer." Center for Magnetic Resonance, Albert Einstein College of Medicine, New York. Jan. 3, 2002.

23. QIUHONG HE, "Three-dimensional Electrophoretic NMR for Structural Characterization of Co-existing Protein Conformations in Solution." Universitaet Karlsruhe, Institut Fuer Physikalische Chemie, Lehrstuhl fuer Physikalische Chemie mikroskopischer Systeme, D-76128 Karlsruhe, Germany. May 2, 2001.

24. QIUHONG HE, "Three-dimensional Electrophoretic NMR for Structural Characterization of Co-existing Protein Conformations in Solution." Oxford University, Oxford Center for Molecular Sciences, New Chemistry Laboratory, South Parks Road, Oxford OX1 3QH, UK. April 31, 2001.

25. QIUHONG HE, "Three-Dimensional Electrophoretic NMR for Structural Characterization of Co-Existing Protein Conformations in Solution."Pharmacology Seminar Series, School of Pharmacy, the University of Connecticut, Storrs, Connecticut. Nov 16, 2000.

26. QIUHONG HE, "High-Resolution Electrophoretic NMR-Toward Simultaneous Structure Determination of Multiple Proteins in Solution." College Seminar, College of Chemistry, Peking University, Peking, P. R. China. Aug. 23, 1999.

27. QIUHONG HE, "High-Resolution Electrophoretic NMR-Toward Simultaneous Structure Determination of Multiple Proteins in Solution." Institute Seminar, Wuhan Institute of Physics and Mathematics, the Chinese Academy of Science, Wuhan, P. R. China. Aug. 18, 1999.

28. QIUHONG HE, "High-Resolution Electrophoretic NMR-Toward Simultaneous Structure Determination of Multiple Proteins in Solution." Institute Seminar, Institute of Theoretical Chemistry, Jilin University, Changchun, P. R. China. Aug. 13, 1999.

29. QIUHONG HE, "High-Resolution Electrophoretic NMR-Toward Simultaneous Structure Determination of Multiple Proteins in Solution." Departmental Colloquium, Department of Physics, the Chinese University of Hong Kong, Hong Kong, July 30, 1999.

30. QIUHONG HE, "Toward Simultaneous Structure Determination of Multiple Proteins in Solution-Multi Dimensional Electrophoretic NMR." Departmental Seminar. Department of Chemistry, the Scripps Research Institute, 10550 North Terrey Pines Road, La Jolla, California 92037. Mar. 26, 1999.

31. QIUHONG HE, "Proton Magnetic Resonance Spectroscopy and Imaging of Human Breast Cancer." Departmental Seminar, Electrical and System Engineering, University of Connecticut, Oct. 30, 1998.

32. QIUHONG HE, "*In Vivo* Proton MRS for Early Diagnosis of Human Breast Cancer and Electrophoretic NMR for Simultaneous Structural Determination of Multiple Proteins in Solution." Nov. 3, 1997. Departmental Seminar. Department of Chemistry, Lebanon Valley College, Pennsylvania.

33. QIUHONG HE, "NMR in Studying Molecular Mixtures--Electrophoretic NMR, Proton NMR *in vivo* and Intermolecular Coherence Transfer in Isotropic Solutions." BioNMR Seminar Series, Department of Chemistry and Department of Molecular Biophysics and Biochemistry, Yale University, Nov. 22, 1996.

34. QIUHONG HE, "NMR in Cancer Research." New Faculty Seminar, the University of Connecticut, Fall, 1995.

35. QIUHONG HE, "NMR in Studying Molecular Mixtures--Electrophoretic NMR, Proton NMR *in vivo* and Intermolecular Coherence Transfer in Isotropic Solutions." Departmental Seminar. Department of Chemistry, University of Connecticut, Fall, 1995.

26. QIUHONG HE, "NMR in Studying Molecular Mixtures--Electrophoretic NMR, Proton NMR *in vivo* and Intermolecular Coherence Transfer in Isotropic Solutions." Departmental Seminar. Department of Chemistry, University of Michigan, Spring Semester, 1995.

37. QIUHONG HE, "NMR in Studying Molecular Mixtures--Electrophoretic NMR, Proton NMR *in vivo* and Intermolecular Coherence Transfer in Isotropic Solutions." Departmental Seminar. Radiology Department, University of Pennsylvania, Spring Semester, 1995.

38. QIUHONG HE, "NMR in Studying Molecular Mixtures--Electrophoretic NMR, Proton NMR *in vivo* and Intermolecular Coherence Transfer in Isotropic Solutions." Departmental Seminar. Department of Chemistry, Purdue University, Spring Semester, 1995.

39. QIUHONG HE, "NMR in Studying Molecular Mixtures--Electrophoretic NMR, Proton NMR *in vivo* and Intermolecular Coherence Transfer in Isotropic Solutions." Departmental Seminar. Department of Chemistry, Northern Illinois University, Spring Semester, 1995.

40. QIUHONG HE, "NMR in Studying Molecular Mixtures--Electrophoretic NMR, Proton NMR *in vivo* and Intermolecular Coherence Transfer in Isotropic Solutions." Departmental Seminar. Department of Chemistry, Boston University, January, 1995.

41. QIUHONG HE, "Electrophoretic NMR." Seminar in NMR research division, Radiology Department, the Johns Hopkins University School of Medicine, October, 1992.

42. QIUHONG HE, "Multiple Quantum NMR," University of North Carolina, Department Seminar, November 15, 1988.