OMB No. 0925-0001 and 0925-0002 (Rev. 03/2020 Approved Through 02/28/2023)

BIOGRAPHICAL SKETCH

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NAME: Yost, Richard A.

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

POSITION TITLE:

University Professor and Head, Analytical Chemistry Director, NIH Metabolomics Consortium Coordinating Center (M3C)

Director, Southeast Center for Integrated Metabolomics (SECIM) Professor, Pathology, Immunology, and Laboratory Medicine

Professor, School of Natural Resources and Environment Professor of Pathology, University of Utah

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

| INSTITUTION AND LOCATION | DEGREE(if applicable) | Completion DateMM/YYYY | FIELD OF STUDY |
| --- | --- | --- | --- |
| University of Arizona, Tucson, AZ | B.S. | 12/1974 | Chemistry |
| Michigan State University, East Lansing, MI | Ph.D. | 8/1979 | Analytical Chemistry |

# A. Personal Statement

My extensive experience in metabolomics and imaging mass spectrometry, as well as in research administration and academic leadership, as detailed below, make me particularly well suited continue to contribute to this project.

Research in my group is focused on analytical mass spectrometry, particularly tandem mass spectrometry (MS/MS), making our group one of the most widely cited of any research program in analytical chemistry. Our current research efforts focus on innovations in imaging mass spectrometry and ion mobility instrumentation and techniques, and the application of these innovations in areas such as clinical and metabolomic analysis. Our group’s research has reflected a unique balance between fundamental studies, instrumentation development, and applications in analytical chemistry. Several instruments conceived and developed by me and my group are widely used as commercial instruments (with well over $1 billion in instrument sales each year), including the triple quadrupole mass spectrometer, the ion trap tandem mass spectrometer, and the laser microprobe tandem mass spectrometer. We have also been pioneers in imaging biomolecules in intact tissue, quantitative MALDI tandem mass spectrometry, and ion mobility/mass spectrometry (IMS and FAIMS).

I have supervised the research of over 120 graduate students over the past 40 years, graduating nearly 100 PhDs and 18 MSs; my current group includes 12 PhD candidates. Research in the group has led to over 230 publications and 25 patents. I have served as PI or Co-PI on over 100 grants or contracts, totaling over $60M of funding. My research has been recognized with the highest award in my discipline, the 1993 *ASMS Award for Distinguished Contribution in Mass Spectrometry*, as well as the 2018 *MSACL Distinguished Contribution Award in Clinical Mass Spectrometry* and the 2021 *Pittsburgh Analytical Chemistry Award*.

I have extensive experience in leadership and governance in academics. I serve as Head of Analytical Chemistry, one of the most highly rated academic programs on the UF campus (consistently ranked in the top 10 nationwide). I have also served as Associate Dean for Research. I have served on the UF Board of Trustees and on the state of Florida Board of Governors (Regents). I have served three times on the Board of Directors of the American Society for Mass Spectrometry (ASMS), and currently serve as Past President of ASMS.

Although my faculty appointment is in the College of Liberal Arts & Sciences, I have been heavily involved in collaborative research around campus, including with the Colleges of Medicine, Agriculture and Life Sciences, Pharmacy, Veterinary Medicine, and Engineering. I direct both the NIH Metabolomics Consortium Coordinating Center (M3C) and the Southeast Center for Integrated Metabolomics (SECIM); I serve on the Executive Committee of UF’s CTSI (Clinical and Translational Sciences Institute) since it was founded, as well as on the CTSI’s Translational Technologies and Resources Advisory Committee. I am a Senior Member of the UF Health Cancer Center, a founding member of the UF Maples Center for Forensic Science, a member of the UF Emerging Pathogens Institute, served as a fellow and advisory board member of the UF Institute for Science and Health Policy, and was a Visiting Pathologist at the University of Utah in 2012.

# B. Positions and Honors

**Positions and Employment**

1979-1983 Assistant Professor, Department of Chemistry, University of Florida

1983-1989 Associate Professor, Department of Chemistry, University of Florida

1989- Professor, Department of Chemistry, University of Florida

1994-2000, 2006- Head, Analytical Chemistry Division, University of Florida

1999- Founding Member, William R. Maples Forensic Science Center, University of Florida

2001 Associate Dean for Research, College of Liberal Arts & Sciences, University of Florida

2001- Senior Member, UF Heath Cancer Center, University of Florida

2005- Professor, School of Natural Resources and the Environment, University of Florida

2007- Member, Emerging Pathogens Institute, University of Florida

2007-2008 Chair, Faculty Senate, University of Florida

2007-2008 Member, Board of Trustees, University of Florida

2010-2012 Chair, Advisory Council of Faculty Senates, State University System of Florida

2010-2012 Member, Board of Governors (Regents), State University System of Florida

2012 Visiting Pathologist, University of Utah, ARUP (Sabbatical)

2013- Director, Southeast Center for Integrated Metabolomics: SECIM

2013- Professor of Pathology, University of Utah and ARUP

2014- Professor of Pathology, Immunology, and Laboratory Medicine, University of Florida

2018- Director, NIH Metabolomics Consortium Coordinating Center: M3C

**Other Experience and Professional Memberships**

1974- Member, American Chemical Society

1976- Member, American Society for Mass Spectrometry

1997-1999 Secretary, American Society for Mass Spectrometry

1998- Founding Member, International Mass Spectrometry Society

1989-1997 Editorial Board, *The Journal of the American Society for Mass Spectrometry*

1990- Founding Member, North American Chapter of the International Chemometrics Society

1990-1993 Member, NIH Biomedical Engineering and Technology Study Section

1993-1996 Member, NIH Metallobiochemistry Study Section

1995-1997 Member, NASA Advanced Environmental Monitoring Review Panel

1995-2003 Scientific Advisory and Review Board, Lawrence Livermore National Laboratory

1996-present Editorial Board, *International Journal of Mass Spectrometry*

2008-2010 Treasurer, American Society for Mass Spectrometry

2010 Guest Editor, *International Journal of Mass Spectrometry*

2016-2018 Vice President for Programs, American Society for Mass Spectrometry

2018-2020 President, American Society for Mass Spectrometry

2020-2022 Past President, American Society for Mass Spectrometry

#### **Honors**

1975-1979 NSF Graduate Fellowship

1993 ASMS Award for Distinguished Contribution to Mass Spectrometry

2010-2014 Robin and Jean Gibson Professor, College of Liberal Arts & Sciences

2015-2018 Colonel Allen R. and Margaret G. Crow Professor

2018- University Professor

2018 MSACL Distinguished Contribution Award in Clinical Mass Spectrometry

2019 Distinguished Eagle Scout Award

2019 Florida Academy of Sciences Medalist

2019 Florida Inventors Hall of Fame

2019 CPSA Distinguished Analytical Scientist Award

2021 Pittsburgh Analytical Chemistry Award

# C. Contributions to Science

I) During my PhD studies working with Professor Chris Enke at Michigan State University from 1975-1979, I conceived of, developed, and demonstrated the analytical capabilities of the *triple quadrupole mass spectrometer*. I wrote research proposals to NSF and ONR to fund that project, and was funded by ONR. That instrument revolutionized analytical mass spectrometry, and is now the most common mass spectrometer in the world, with sales of over $1 billion per year. That research was recognized in 1993 with the *ASMS John Fenn Award for Distinguished Contribution to Mass Spectrometry* as well as induction into the *Florida Inventors Hall of Fame* in 2019. The triple quadrupole MS/MS instrument is today the gold standard for quantitative analysis in metabolomics, clinical analysis, and a variety of other application areas.

1. U.S. Patent No. 4,234,791, "Tandem Quadrupole Mass Spectrometer for Selected Ion Fragmentation Studies and Low‑Energy Collision‑Induced Dissociation Therefor," C.G. Enke, **R.A. Yost**, and J.D. Morrison, November 18, 1980.

2. "Triple Quadrupole Mass Spectrometry for Direct Mixture Analysis and Structure Elucidation," **R.A. Yost** and C.G. Enke, *Anal. Chem.,* 51, 1251A‑1264A (1979).

3. "Structural Elucidation of Drug Metabolites by Triple Quadrupole Mass Spectrometry," R.J. Perchalski, **R.A. Yost**, and B.J. Wilder, *Anal. Chem.,* 54, 1466‑1471 (1982).

4. "Tandem Mass Spectrometry for Trace Analysis," J.V. Johnson and **R.A. Yost**, *Anal. Chem.*, 57, 758A‑768A (1985).

II) My research group was central to the development of *ion trap instrumentation and techniques for tandem mass spectrometry*. The concept of “tandem-in-time” MS/MS as opposed to the classic “tandem-in-space” MS/MS ushered in a new generation of analytical instruments, including today’s highly successful Orbitrap MS/MS instruments which are our workhorses for global metabolomics.

1. "Tandem-in-Space and Tandem-in-Time Mass Spectrometry (MS/MS): Triple Quadrupoles and Quadrupole Ion Traps," J.V. Johnson, **R.A. Yost**, P.E. Kelley, and D.C. Bradford, *Anal. Chem.*, 62, 2162-2172 (1990). <http://dx.doi.org/10.1021/ac00219a003>
2. "MS/MS Parent Scans on a Quadrupole Ion Trap Mass Spectrometer by Simultaneous Resonant Excitation of Multiple Ions," J.V. Johnson, R.E. Pedder, and **R.A. Yost**, *Int. J. Mass Spectrom. Ion Proc.,* 106, 197-212 (1991). [http://dx.doi.org/10.1016/0168-1176(91)85019-I](http://dx.doi.org/10.1016/0168-1176%2891%2985019-I)
3. "Fundamental Studies of Ion Injection and Trapping of Electrosprayed Ions in a Quadrupole Ion Trap," S.T. Quarmby and **R.A. Yost**, *Int. J. Mass Spectrom*., 190-191, 81-102 (1999). [http://dx.doi.org/10.1016/S1387-3806(98)14268-9](http://dx.doi.org/10.1016/S1387-3806%2898%2914268-9)

III) My group conceived of and developed the *first laser microprobe (MALDI) tandem mass spectrometer for imaging mass spectrometry*, a key development for the rapidly growing application of imaging mass spectrometry to localize targeted and untargeted small molecules in biological tissue. We were the first lab to demonstrate quantitative imaging mass spectrometry, using isotopically labelled internal standards.

1. "Determination of Regional Distribution of Drugs in Brain-tissue by Triple Quadrupole Mass-spectrometry,” R.J. Perchalski, **R.A. Yost**, E.J. Hammond, and B.J. Wilder, *Epilepsia*, 24, 112 (1983).
2. “Detection of Pharmaceutical Compounds in Tissue by Matrix-Assisted Laser Desorption/Ionization (MALDI) and Laser Desorption/Chemical Ionization (LD/CI) MS/MS with a Quadrupole Ion Trap,” F.J. Troendle, C.D. Reddick, and **R.A. Yost**, *J. Am. Soc. Mass Spectrom.,* 10, 1315-1321 (1999). [http://dx.doi.org/10.1016/S1044-0305(99)00103-8](http://dx.doi.org/10.1016/S1044-0305%2899%2900103-8)
3. “Imaging of Small Molecules in Tissue Sections with a New Intermediate-pressure MALDI Linear Ion Trap Mass Spectrometer,” T.J. Garrett, M.C. Prieto-Conaway, V. Kovtoun, H. Bui, N. Izgarian, G. Stafford, and **R.A. Yost**, *Int. J. Mass Spectrom*, 260, 166-176, (2006).

 <http://dx.doi.org/10.1016/j.ijms.2006.09.019>

1. “Tissue-specific analysis of lipid species in Drosophila during overnutrition by UHPLC-MS/MS and MALDI-MSI”, B.F. Tuthill II, L.A. Searcy, R.A. Yost and L.P. Musselman, J. Lipid Res., published online (January 2020). <http://dx.do/10.1194/jlr.RA119000198>

IV) We have been pioneers in the development and application of *ion mobility/mass spectrometry (IMS/MS) for metabolomic and clinical analysis*. This has included both classic drift-tune IMS and high-field ion mobility (FAIMS) for which much of the instrumental development occurred in our lab. We have demonstrated the power of these techniques to analyze complex biological samples, often more rapidly and/or more comprehensively than possible with LC/MS alone. Of particular note has been the isomeric and epimeric separation of steroids and the potential for a development of a rapid (less than 1 minute) clinical analysis for Vitamin D that is epimer-specific. We are also actively exploring the potential of standalone FAIMS and IMS for clinical analysis outside the laboratory, particularly for breath analysis.

1. “Spherical FAIMS: Comparison of Curved Electrode Geometries”, M. Prieto and **R.A. Yost**, *Int. J. Ion Mobil. Spectrom.* 14, 61-69 (2011). <http://dx.doi.org/10.1007/s12127-011-0073-x>
2. “Solvent Vapor Effects in Planar High-Field Asymmetric Waveform Ion Mobility Spectrometry: Solvent Trends and Temperature Effects”, L.C. Rorrer III and **R.A. Yost**, *Int. J. Mass Spectrom.* 378, 336-346 (2015) <http://dx.doi.org/10.1016/j.ijms.2014.10.007>
3. “Current Progress in Metabolomics Using Ion Mobility-Mass Spectrometry”, A.J. Levy, N.R. Oranzi, A. Ahmadireskety, R.H.J. Kemperman, M.S. Wei, and R.A. Yost, *Trends Anal. Chem*., 116, 274-281 (2019). <https://doi.org/10.1016/j.trac.2019.05.001>
4. “Behavior of Transition Metal Salts during the Electrospray Ionization Process”, J. Boock, R.A. Yost, *Int. J. Mass Spectrom.,* 446, 116217 (2019). <https://doi.org/10.1016/j.ijms.2019.116217>
5. “Rapid Quantitation of 25-hydroxyvitamin D2 and D3 in human serum using liquid chromatography-drift tube ion mobility-mass spectrometry”, N.R. Oranzi, J. Lei, R.H.J. Kemperman, C.D. Chouinard, B. Holmquist, J.J. Garrett, and R.A. Yost, *Anal. Chem*., 91, 13555-13561 (2019). DOI: <https://doi.org/10.1021/acs.analchem.9b02683>

V) The primary thrust of my group’s research for the past few years has been the development and application of *innovative mass spectrometric methodologies for global and targeted metabolomics, lipidomics, clinical analysis, and biomarker detection*. Specific areas of application have included liver disease (NAFLD, NASH, and cirrhosis), traumatic brain injury, diabetes, melanoma, and breath analysis for disease detection and monitoring drug use. This research is focused on defining novel tools including instrumentation, methodologies, and software that will drive metabolomics and clinical analysis over the next decade and beyond. This research was recently recognized with the 2018 *MSACL Award for Distinguished Contribution to Clinical Mass Spectrometry* and the 2019 *Florida Academy of Science Medal* and the 2019 *CPSA Distinguished Analytical Scientist Award.*

1. “Metabolomic Analysis of Oxidative and Glycolytic Skeletal Muscles by Matrix-Assisted Laser Desorption/Ionization Mass Spectrometric Imaging (MSI)”, Y-.H. Tsai, T.J. Garrett, C.S. Carter, and **R.A. Yost**, *J. Amer. Soc. Mass Spectrom*. 26, 915-923 (2015). <http://dx.doi.org/10.1007/s13361-015-1133-y>
2. “Improved experimental data processing for UHPLC–HRMS/MS lipidomics applied to nonalcoholic fatty liver disease”, R.E. Patterson, A.S. Kirpich, J.P. Koelmel, S. Kalavalapalli, A.M. Morse, K. Cusi, N.E. Sunny, L.M. McIntyre, T.J. Garrett, **R.A. Yost**, *Metabolomics*, 13, 142-155 (2017). <https://doi.org/10.1007/s1130>
3. “LipidMatch: an automated workflow for rule-based lipid identification using untargeted high-resolution tandem mass spectrometry data”, J.P. Koelmel, N.M. Kroeger, C.Z. Ulmer, J.A. Bowden, R.E. Patterson, J.A. Cochran, C.W.W. Beecher, T.J. Garrett, **R.A. Yost**, *BMC Bioinformatics*, 18(1), 331 (2017). <https://doi.org/10.1186/s12859-017-1744-3>
4. “Ultrahigh Performance Liquid Chromatography-High Resolution Mass Spectrometry Metabolomics and Lipidomics Study of Stool from Transgenic Parkinson’s Disease Mice Following Immunotherapy”, E.L. Gill, J.P. Koelmel, L. Meke, R.A. Yost, T.J. Garrett, M.S. Okun, V. Vedam-Mai, *J. Proteom. Res.*, 19, 1, 424-431 (2020). <https://pubs.acs.org/doi/10.1021/acs.jproteome.9b00605>

**Partial list of published work -** <https://www.ncbi.nlm.nih.gov/myncbi/richard.yost.1/bibliography/public/>

**D. Additional Information: Research Support and/or Scholastic Performance**

SELECTED ONGOING PROJECTS

 U2C DK119889 (Yost, PI) 8/17/2018 – 6/30/2022 NIH Common Fund

 “Metabolomics Consortium Coordinating Center (M3C)”

*I serve as Director of the nationwide consortium coordinating center and stakeholder engagement and promotion program for NIH’s common fund metabolomics*.

Cooperative Research Agreement (Yost, PI) 8/16/2014 - 9/15/2023 Agilent Scientific

"Developments in Ion Mobility and Mass Spectrometry for Clinical, Lipidomics, and Metabolomics Applications"

*The major goals of this project are instrumental and method development for small-molecule applications of ion mobility and tandem mass spectrometry.*

Cooperative Research Agreement (Yost, PI) 6/15/2014 – 12/15/2020 Wellspring

“Clinical Applications of Mass Spectrometry”

*The major goals of this project are innovative mass spectrometric and mobility-based methods for rapid clinical analyses.*

SELECTED COMPLETED PROJECTS

 U24 DK097209 (Yost, PI) 9/11/2013 – 8/31/2020 NIH Common Fund

 “Southeast Resource Center for Integrated Metabolomics (SECIM)”

*I serve as Director of this regional metabolomics center as well as directing the advanced mass spectrometry core*.

141143-R315 (Yost, PI) 9/16/2016 – 12/18/2017 Partnership for Clean Competition

“Ion Mobility-Mass Spectrometry for Improved Analysis of Exogenous Anabolic Steroids”

*The major goals of this project are innovative mobility-based methods for resolving isomeric steroids including those potentially used as performance-enhancing substances.*