



The Barnett Institute

of Chemical and Biological Analysis



Northeastern
UNIVERSITY

THE BARNETT INSTITUTE OF
CHEMICAL AND BIOLOGICAL ANALYSIS

www.barnett.neu.edu

LEADERSHIP



PROF. BARRY L. KARGER, Director, is the James L. Waters Chair of Analytical Chemistry at Northeastern University. He has published over 300 papers and 36 patents in the field of bioanalytical chemistry, with particular emphasis in liquid chromatography, capillary electrophoresis and mass spectrometry. Awards include the American Chemical Society (ACS) Awards in Chromatography (1982); Analytical Chemistry (1990) and Separations Science and Technology (1998). He has also received the Halasz Medal of the Hungarian Chemical Society for Chromatography and Separation Science (2002), the Michael Widmer Award (2004) by the Swiss Chemical Society and Novartis, and the Torbern Bergman Medal (2008) from the Swedish Chemical Society. Dr. Karger was elected an Honorary Member of the Hungarian Academy of Sciences in 2007.

ADVISORY BOARDS

The Barnett Institute is guided by advisory boards drawn from prominent members of the academic and industrial science community, with emphasis on front-line bioanalytical chemistry, instrumentation, and applications.

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Harvard and MIT*

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*Associate Professor of Pathology,
Harvard Medical School;
Massachusetts General Hospital*

FACULTY FELLOWS

Faculty Fellows are professors of academic departments at Northeastern University who have formal agreements and ongoing collaborations with other Institute personnel.

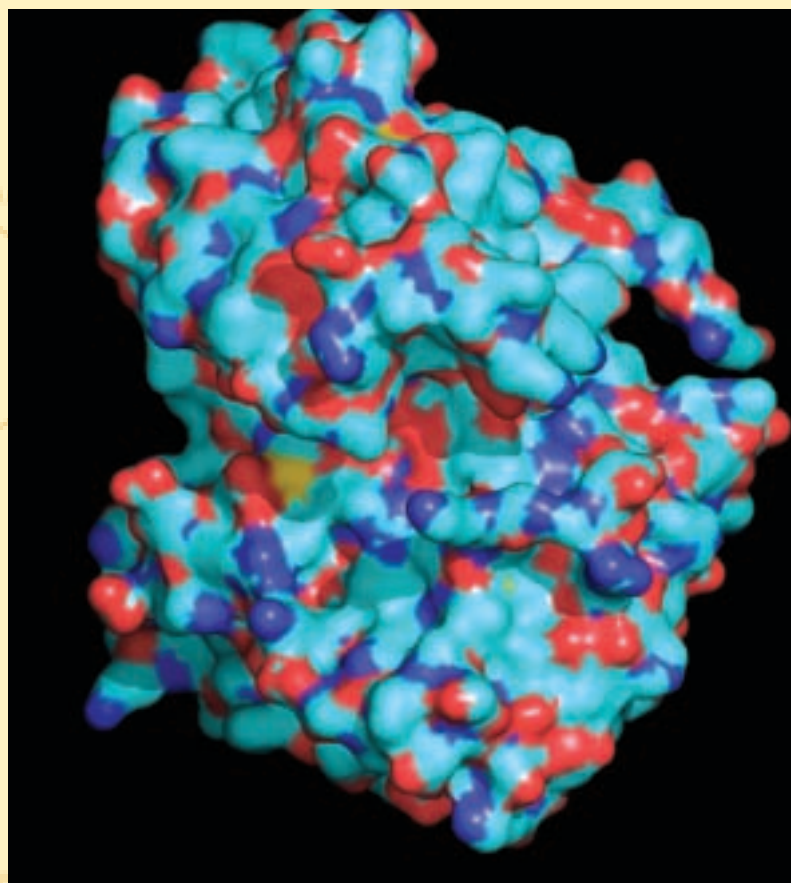


From left, Professors Sunny Zhou, Bill Hancock, Paul Vouros, Barry Karger, Roger Giese, Graham Jones, and John Engen (inset, Bill Giessen).

A CENTER OF EXCELLENCE

in bioanalytical technologies
and their application to problems in the life sciences, with missions to:

- Develop and apply new technologies for basic and clinical biological research;
- Develop and apply new technologies for the characterization of protein therapeutics;
- Train students and visiting scientists for academic, industrial, and medical leadership;
- Collaborate actively with the medical and industrial communities.



BARNETT INSTITUTE CONTRIBUTIONS

Recent

Comprehensive Analysis of Proteins

- Extended Range Proteomic Analysis: high sequence coverage of large proteins, including characterization of glycosylation and phosphorylation.
- Multiple Lectin Affinity Chromatography (MLAC): rapid isolation of glycoproteins, the most biomedically relevant class of proteins.
- CE-MS analysis of protein microheterogeneity.

Clinical Proteomics

- Discovery of biomarkers for breast, cervical, and lung cancer.
- Antibody-based technologies for biomarker discovery and diagnostics.
- Human Proteome Organization (HUPO) Reference Lab.
- Editor in Chief, *Journal of Proteome Research* (ACS).

Additional Contributions

- Protein solution structure and dynamics by hydrogen-deuterium exchange MS.
- Post-translational modifications of proteins and DNA by biochemical tagging and mass spectrometry.
- Microscale LC-MS-NMR for metabolites and natural products.
- Reagents and methods for detection of DNA adducts.
- Environmental Cancer Research Program.

Past Successes

- **Genome Sequencing:** Key technologies used to sequence the human genome: microcapillary gel electrophoresis and linear polymer sieving matrices.
- **HPLC:** Major contributions to the development and acceptance of liquid chromatography, currently a multi-billion dollar industry.
- **Capillary Electrophoresis:** Screening of natural product extracts for new therapeutic compounds using capillary electrophoresis. Detection of rare single nucleotide mutations in DNA pooled from populations.
- **LC-MS:** Electrospray mass spectrometry from a microfluidic device.



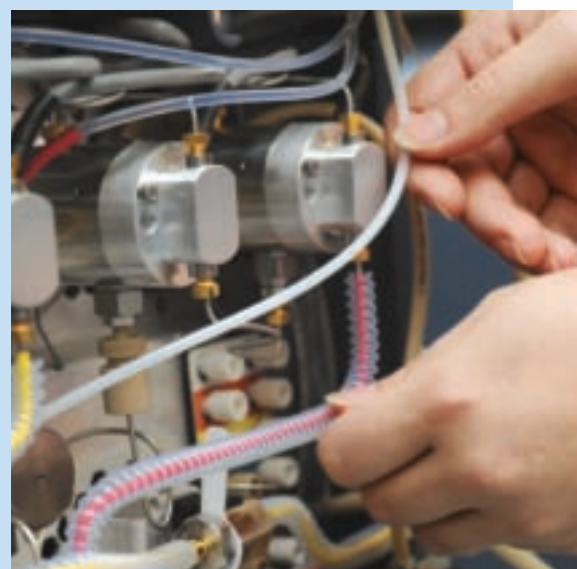
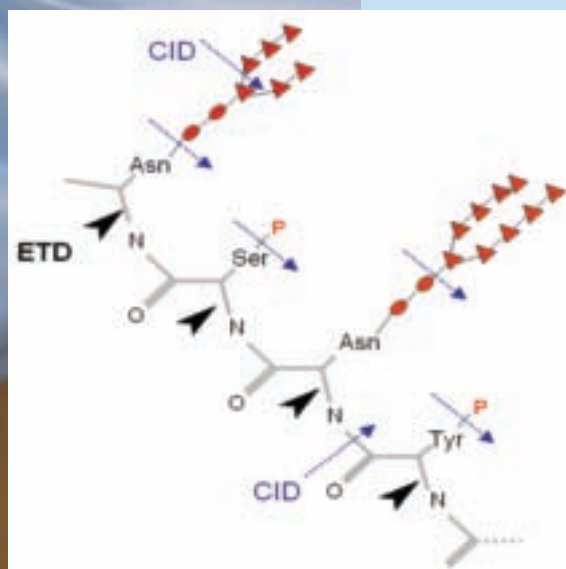


Since its inception in 1973, the Barnett Institute, an endowed research center of excellence, has earned an international reputation through its contributions of significant advancements in bioanalytical technologies (e.g. LC, CE, MS). A current focus is advanced LC/MS methods for comprehensive protein analysis.

Recent achievements have enabled the detailed characterization of previously intractable proteins, such as the 180 kDa membrane receptor EGFR, with near-complete sequence coverage including characterization of phosphorylation and glycosylation. The Institute includes an NCI Tumor Glycome laboratory, with the co-chair of the trans-NIH Alliance of Glycobiologists. Our expertise in sample preparation and data processing extends to analyses of other complex matrices, supporting active projects in proteomic biomarker discovery, metabolomics and natural products.

The Institute maintains a large interdisciplinary staff of 70 scientists in-house, including senior researchers, organized under 8 tenured Faculty Fellows. A network of over 300 loyal alumni with distinguished careers in industry and academia maintain close contact with the Institute.

The Barnett Institute's focus on the development and application of new technologies for the life sciences, collaborating with the Boston medical community and wide industrial partners, has generated over 900 peer-reviewed publications and 70 patents with significant licensing activity. Over the years, 5 companies have been spun out from research in the Institute.



COLLABORATION WITH THE BARNETT INSTITUTE

The Barnett Institute works in collaboration with the biotechnology and pharmaceutical industries and with hospitals and medical centers in basic research and applications. Interacting with the Barnett Institute provides access to advanced instrumentation and expertise in protein or metabolite analysis — from sample collection and storage, through extraction and LC-MS, to data processing and interpretation. Process and final product characterization can be accomplished with the expertise of the Institute. Academic and medical research laboratories can integrate cutting-edge analytical methods with their basic science and clinical investigations.



Active Project Areas

- Comprehensive Analysis of Proteins:
 - Variation in glycosylation, phosphorylation
 - Variation in amino acid sequence
 - Levels of degradation, glycation
 - Disulphide bonding
- Glycoproteomic Analysis
- Pharmacokinetics of Therapeutic Antibodies
- Biomarker Discovery – Clinical Proteomics
- Metabolic Pathway Analysis
- Process Analytical Technology (PAT)
- Protein Solution Structure and Dynamics using Hydrogen-Deuterium Exchange MS
- Bio-organic Chemistry: Synthesis of Prodrugs and Imaging Agents
- DNA Damage Caused by Environmental Effects
- Identification of Metabolites and Natural Products
- Metabolomic Analysis of Blood and Tissue

Instrumentation

Well-equipped laboratories operate over 20 mass spectrometers interfaced to a variety of specialized instrumentation, including:

- Hybrid Linear Ion Trap + Fourier Transform MS (LTQ-FT)
- Linear Ion Trap (LTQ-FT) with Electron Transfer Dissociation (ETD) source
- 'Proteomics Workstation' AB4700 MALDI TOF-TOF MS
- 16 additional mass spectrometers, including:
 - Quadrupole Time-of-Flight MS (Q-TOF)
 - GC-MS
 - Ion Trap MS
 - MALDI-TOF- MS
- 32 LC systems, including 2D-LC, nano-LC, and UPLC systems
- Capillary Electrophoresis
- NMR with microcapillary detection and high-throughput flow-NMR
- A computer cluster for bioinformatic analysis and software development
- Automation

Active Collaborations

Advion
Agilent
Biogen-Idec
BioSystems International
Centocor (J&J)
Cytoc
Dana-Farber Cancer Institute
Eksigent
Fred Hutchinson Cancer Center
GE Healthcare
Genentech
George Mason University
Glycobiology Institute
Harvard Medical School
Harvard School of Public Health
Joslin Clinic
Massachusetts General Hospital
Millenium
Momenta
National Cancer Institute
New Objective
Protasis
Protein Forest
Roswell Cancer Center
Sionex
ThermoFisher
Veterans Administration
Waters Corp.

SENIOR RESEARCH STAFF

The Institute staff includes several research faculty as well as principal and senior research scientists with advanced postdoctoral experience and special skills. The highly collaborative environment brings together an interdisciplinary team of experts in the construction of instrumentation through the intricacies of sample preparation, separations and mass spectrometry, to advanced and emerging bioinformatic and computational methods. Performing analysis in the context of the biological question is emphasized throughout. Ph.D. students from academic departments participate in the research groups together with postdoctoral scholars, visiting scientists, and undergraduate students with strong academic records and interest.



Billy Wu
Research
Associate Professor



Tomas Rejtar
Research
Assistant Professor



Marina Hincapie
Research
Assistant Professor



Thomas Wales
Principal Research
Scientist

ALUMNI

Among our over 300 alumni, many have attained prominent positions in academia and industry, including Presidents and Senior Vice-Presidents of major corporations, and heads of academic, industrial, and government departments all over the world. The Alumni have established an endowed Alumni Graduate Fellowship, awarded each year to an outstanding final year doctoral student.



Marek Minarik is Founder and President of Genomac, a leading genetic analysis company in Prague. **Emanuel Carrilho** is a Professor at the University of São Paulo, currently on sabbatical with Prof. George Whitesides at Harvard University.

ADJUNCT FACULTY



Peter Barrett was co-founder of Celera and is currently Senior Partner for Life Sciences at Atlas Ventures, in Waltham, MA. Peter received his Ph.D. in Chemistry from Northeastern University. He has a broad understanding of the current trends in biotechnology.



Rob Garnick is currently Senior Vice President of Regulatory, Quality, and Compliance at Genentech, having joined the company in 1984. Rob received his Ph.D. in Chemistry from Northeastern University. He has a broad background in the biopharmaceutical field, bringing 18 protein therapeutic products to market.

As Adjunct Faculty, Drs. Barrett and Garnick provide advice and guidance on current practices and trends in the biotechnology industry to students and faculty.



CONFERENCES AND EVENTS

The Institute hosts a number of special workshops and lectures. The Biogenetics2008 conference was organized this year; the ongoing international MSB (HPCE) conferences were established by Institute researchers.

Annual Lectureships

Three prestigious Lectureships have brought a highly distinguished roster of eminent scientists to the Barnett Institute over the years. The Barnett and the Hoehn Lectureships address technical and industrial aspects of bioanalysis. The Saferstein Memorial Lectures highlight scientific and ethical aspects of forensic research.

FACULTY AND ACTIVE RESEARCH AREAS

BARRY L. KARGER

Director

James L. Waters Chair in Analytical Chemistry

- Comprehensive characterization of large proteins using high-resolution LC/MS.
- Trace proteomic analysis using ultra-narrow bore LC/MS.
- Clinical biomarker discovery for cancer.

GRAHAM B. JONES

Associate Director

Chair of Chemistry and Chemical Biology

Special Assistant to the Provost

- Synthetic chemistry at the biology interface.
- Hybrid targeting/chemotherapeutic agents.
- Site-specific imaging agents.

WILLIAM S. HANCOCK

Faculty Fellow

Raymond Bradford Bradstreet Chair in Bioanalytical Chemistry

- Multiple Lectin Affinity Chromatography and the study of the glycoproteome.
- Glycan markers for the early detection of cancer.
- Application of proteomics to the study of protein pharmaceuticals.

PAUL VOUIROS

Faculty Fellow

Professor of Chemistry and Chemical Biology

- Capillary LC-MS methods development for DNA adducts and drug metabolites.
- Ion Mobility Scanning (IMS-MS).
- Integration of HPLC-MS-NMR for drug discovery from natural products.

ROGER W. GIESE

Faculty Fellow

Professor of Chemistry and Biomedical Science

- Charge and electrophore tagging for ultrasensitive mass spectrometry.
- Characterization of genotoxic mixtures by mass spectrometry.
- Electrodialytic gel devices.

BILL C. GIESSEN

Faculty Fellow, co-founder

Professor of Chemistry and Chemical Biology

- Chemometric and agorometric methods.

JOHN R. ENGEN

Faculty Fellow

Associate Professor of Chemistry and Chemical Biology

- Protein conformation and dynamics using H-D exchange MS.

ZHAOHUI SUNNY ZHOU

Faculty Fellow

Associate Professor of Chemistry and Chemical Biology

- Post-translational modifications of proteins and DNA by biochemical tagging and mass spectrometry.
- Medicinal chemistry of protein pharmaceuticals.

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