

Case Center for Proteomics
&
Cleveland Foundation Center for Proteomics
Annual Report
2005-2006

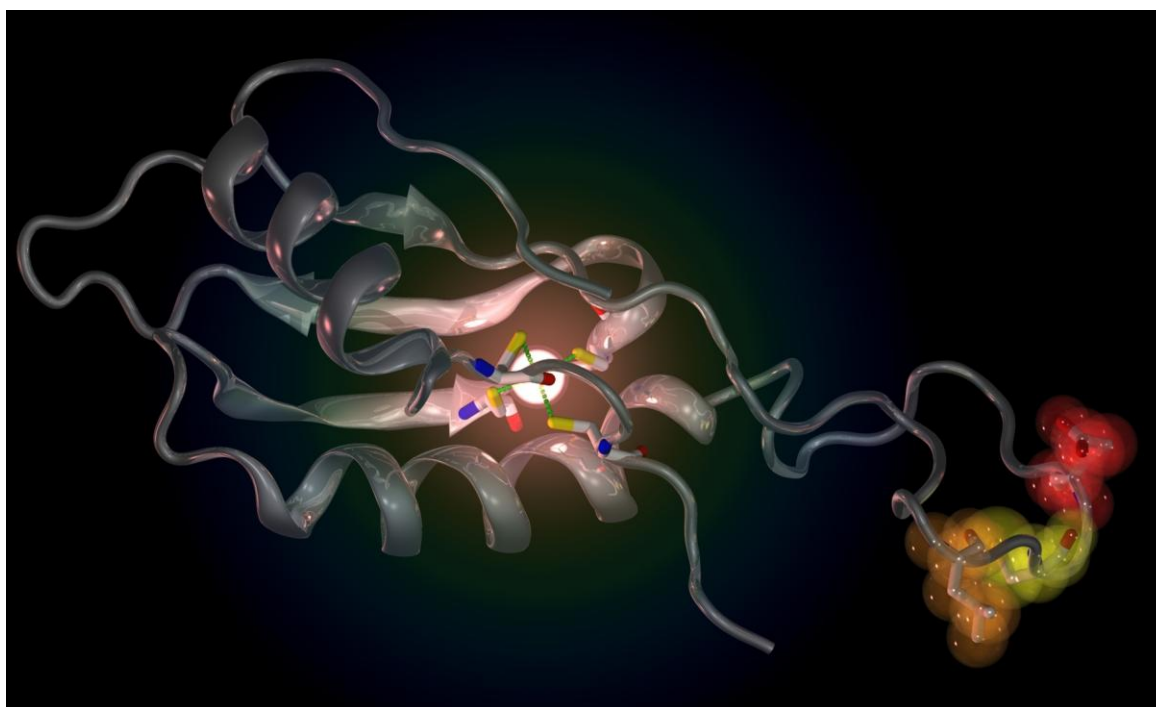


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Center First Year Overview: Report from the Director

The Center for Proteomics and Cleveland Foundation Center for Proteomics in the School of Medicine was established with a primary goal of strengthening Cleveland's presence in modern proteomics and mass spectrometry research to make the region a leader in the field. Dr. Mark Chance assumed the position of Director in July, 2005. This report highlights the major accomplishments of the Center in its first year and outlines some of the immediate objectives to be accomplished in the future.

One of the primary goals of the CPC is to develop an infrastructure of sophisticated equipment that facilitates and maximizes shared equipment usage, as well as to offer a wide array of proteomics services including 2D gel and mass spectrometry analyses. These goals have been accomplished in the first year of operation. Seven mass spectrometry instruments have been installed and are fully operational, including several very high resolution and high sensitivity instruments, such as the Thermo-Finnegan Fourier-Transform-LTQ mass spectrometer. These facilities are documented in the report. The Center has the capacity to process hundreds of samples monthly on a number of instruments. In addition, a quantitative 2-D gel proteomics program has provided rapid identification of protein expression changes in normal versus diseased tissues for animal models and human samples. The official opening of the Center was February 1, 2006, over the course of the first year 45 PIs have used the Center from 23 Departments and Divisions of the Medical school and hospital. A list of Departments using the Center, with distributions by number of PIs and by charge back fees collected is provided in the report. These users have interacted with the Center in a variety of ways, some projects have involved simple "drop-off" service, others have included close collaboration with Center faculty and staff in the design and execution of experiments resulting in the securing of new funding from federal agencies, a third class of interactions involve "independent use" of Center facilities. In this case users are trained in the use of Center instruments and conduct and analyze their own experiments.

The Center has continually expanded its staff over the first year, currently 42 students, Post-Docs, research staff and faculty work in the Center. These personnel also include faculty and staff of the Center for Synchrotron Biosciences located at Brookhaven National laboratory, Upton, NY (A separate report for this Center is also available). This expansion of staff has included considerable faculty recruitment in the first year. Dr. Masaru Miyagi joined the Center as a primary faculty appointment in April, 2006; he is an expert in quantitative proteomics and analytical chemistry and has a secondary appointment in the Pharmacology Department and an additional appointment in Ophthalmology. Dr. Miyagi's research on macular degeneration is progressing rapidly in the short time he has been at Case. He is also developing novel technologies to provide quantitative analysis of proteins in biological samples. Dr. Reuben Gobezie joined the Center as of July 1 2006, his primary appointment is in Orthopedics, and his secondary is in Proteomics. Dr. Gobezie is an expert in musculoskeletal proteomics and has discovered a number for biomarkers relevant to osteoarthritis progression that will be developed by the Center into patient care diagnostics in collaboration with University Hospital physicians. Drs. Keiji Takamoto and Wuxian Shi have also joined the Center as Assistant Professors in Proteomics. Dr. Takamoto's expertise is in protein chemistry and computational biology. He has recently completed software that provides a novel analysis of protein gel images providing much greater depth of information about differences in protein expression; the University has applied for a patent on this technology. Dr. Shi's expertise is in structural biology of infectious disease; recently she collaborated with the Division of Infectious Diseases in submitting a major program grant to the NIH to develop novel AIDS vaccines. These faculty members are executing the Center's goals to advance the frontiers in terms of proteomics technology as well as bring new discoveries into the clinic as rapidly as possible.

The Center has also become an important resource for training and dissemination of information on Proteomics technologies and approaches. The Center started a Thursday seminar series in September 2005 and 33 seminars were held through May, 2006 with an average attendance of 30-40 people. The presentations ranged from research talks from Center staff to scientific presentations from instrument vendors, as well as presentations by Case faculty and nationally recognized outside speakers. The Center has also held an open house attended by 190 people from the case

community. In addition, the inaugural proteomics symposium was attended by 160 people and followed by a celebratory reception in the Wolstein building. A list of the seminars and the symposium agenda is included in the report.

The Center's outreach activities include a website detailing services, publications, facilities, contact information and seminars (<http://casemed.case.edu/proteomics/index.html>). The Center faculty and staff also have been actively publishing their work; 25 publications are reported from 2005-2006. They have also been quite active in presenting posters and talks at national meetings and giving invited lectures around the country. All these activities are documented in the report.

The Center has been actively pursuing grant funding in its first year; this includes grants transferred by Dr. Chance from New York along with new grants awarded to the Center in the first year. A major award includes the transfer of Dr. Chance's large program grant that is used to run the Center for Synchrotron Biosciences at Brookhaven laboratories, the amounts transferred to Case, including a recent supplement will total \$3.2 million over three years. Other major awards include sub-contracts as part of the National Protein Structure Initiative (Structural Genomics) and as part of an NIH funded program to study alcohol effects and cardiomyopathy; these total over \$2.2 million over five years. An award from the Cleveland Foundation totaling \$1.5 million was received to promote faculty recruitment; these funds were essential in attracting Dr. Miyagi and Dr. Gobezie. Overall, the Center has attracted \$10 million in new funding in its first year of operation. The goal is to secure an additional \$25 million in new funding over the next 4 years.

Part of this funding goal will be achieved by active efforts to commercialize biotechnology discoveries made in the Center. Towards this end, the Center's faculty established NEO Proteomics Inc. in January, 2006 and has located this company in the Bioenterprise incubator space. The goals of this company are to develop and commercialize new proteomics technologies as well as develop strategic partnerships with academic and industrial partners to develop novel biomarkers in the areas of colon cancer, osteoarthritis and diabetic complications. The company will submit several small business grants to the NIH in these areas by August 2006 and is in negotiations with several biotechnology companies to develop strategic partnerships. The new company is intended to provide a successful model of academic-commercial interaction and commercial development that will form a strong foundation for the development of the University's West Quad Biotech project.

The Center has endeavored to actively manage its strategic goals and tactical approaches through a process of regular planning and review. The Center has a regular staff meeting every Tuesday morning to review instrument and IT structure and function; this is followed by rotating staff presentations of works in progress. The Center holds bi-monthly faculty meetings to allocate necessary departmental tasks and review progress. The Center has an internal advisory committee that met twice over the first year, agendas and minutes of those meetings are included in the report. In addition, the Center Director attends the regular School of Medicine Academic Chair and Basic Science Chair meetings and meets regularly with the Dean of the School of Medicine. The Center's overall goals for its first three years and the specific progress towards attaining those goals are provided in the report.

Overall, the Center, in its first year is now operating smoothly and has become a potent research force within the University. In the second year, the Center will focus on continuing its faculty recruitment and program development, including hiring faculty in Bioinformatics and developing a new course in Proteomics. In addition, we will shortly launch a marketing campaign to promote use of center resources among our University Hospital colleagues to promote research that can provide novel biomarkers for diagnosis of disease.

Center for Proteomics Faculty, Staff, Students, and Advisory Committee Members

Advisory Committee

- Vernon Anderson, Ph.D. Professor, Department of Chemistry & Biochemistry
- Henri Brunengraber, MD, Ph.D. Chairman & Professor, Department of Nutrition
- Mike Kinter, Ph.D. Associate Staff in Cell Biology, CCF & Associate Professor, Physiology and Biophysics, Case
- Tom McCormick, Ph.D. Assistant Professor, Dermatology
- Krzysztof Palczewski, Ph.D., Chairman of Pharmacology & John H. Hord Professor
- Witold Surewicz, Ph.D., Professor, Physiology & Biophysics
- Assem Ziady, Ph.D., Assistant Professor, Pediatric Pulmunology

Center Members at Case Western Reserve School of Medicine

Faculty

Mark Chance, Ph.D. Director, Professor
Masaru Miyagi, Ph.D., Assistant Professor
Keiji Takamoto, Ph.D., Assistant Professor
Reuben Gobezie, M.D., Assistant Professor
Janna Kiselar, Ph.D., Instructor
Joan Schenkel, M.S., Instructor

Research Associates

Jinsook Chang, Ph.D.,
Serguei Ilchenko, Ph.D.
Shuqing Liu, Ph.D.
Amisha Kamal, Ph.D.
Kelli Peterson, M.S.
Ming-Zhong Sun, Ph.D.
Benlian Wang, Ph.D., Senior Research Associate
Huicheng Wang, M.S.

Post Doctoral Scholars

Gurkan Bebek, Ph. D.
Sekhar Kadiyala, Ph.D.
Elizabeth Yohannes, Ph.D.
Xiaojing Zheng, Ph.D.

Research Assistants

Katy Lundberg, M.S. Research Assistant
Hong Zhao, M.S. Research Assistant

Graduate Students

Dasha Hajkova, M.S.
Rod Nibbe, M.S.
Vikram Palamalai, M.B.B.S
George Lominadze, Medical Student at Case

Office Support

Audrey Williams, B.S., IT Support
 Beverly Montgomery, Department Assistant 3
 Shannon Swiatkowski, M.S., Department Assistant 2

Summer Interns

Hope Connolly, Summer on Cuyahoga
 Amit Mahadevia, Summer on Cuyahoga
 Jason Chance, Orange High School
 Peter Fellows, Orange High School

Case Center for Synchrotron Bioscience**Faculty**

Wuxian Shi, Ph.D., Assistant Professor
 Sayan Gupta, Ph.D., Instructor

Research Associates

Babu Manjasetty, Ph.D., Senior Research Associate
 Michael Sullivan, Senior Research Associate
 Don Abel, Research Associate
 Sandeep Rekhi, Ph. D., Research Associate
 John Toomey, Research Associate

Postdoctoral Scholars

Jen Bohon, Ph.D.

Faculty/ Staff Summary & Recruitment Progress

	Faculty Members	Research Staff Members	Post Docs	Research Support	Admin Support	Graduate Students	Summer Students	
Currently On Payroll	8	11	5	1	3	4	4	
Increase by end of Summer 2006	1 Bioinformatics	2	1 (Dr. Gobezie)	1	0	1 BSTP Program		
Totals	9	13	6	2	3	5	4	42

The Center has begun a nationwide search for a Director of Bioinformatics. We have several candidates who meet our requirements and three were interviewed in July and August. One was invited for a second visit. And will come back in September, 2006.

**Case Center for Proteomics
Advisory Board Meeting Minutes
October 11, 2005**

ATTENDEES: Dr. Mark Chance, Dr. Henri Brunengraber, Dr. Aaron Weinberg, Dr. Kris Palczewski, Dr. Assem Ziady, Dr. Thomas McCormick, Dr. Vernon Anderson, Dr. Witold Surewicz.

NOT IN ATTENDANCE: Dr. Michael Kinter

GUESTS: Dr. Gordon Xu, Dr. Janna Kiselar, Dr. Ming-Zhong Sun, Dr. Shuqing Liu, Dr. Sergei Iltchenko, Joan Schenkel, Bill Herringer

Motion to nominate Dr. Aaron Weinberg as Chair accepted and passed.

Introduction of the staff of the Case Center for Proteomics and Mass Spectrometry.

The Progress of the Center is to be viewed much in the same light as a Start up company/Venture Capital investment company.

Brookhaven Center for Synchrotron Biosciences is a very integral element to the Case Center.

There is a hierarchy of machinery to be included at the Center:

- Robust, very easy to operate
- Machinery requiring more training, but still usable by interdepartmental staff
- FT LTQ Very high end machinery to be operated by Center staff only

Personnel

14 total in the Center as of today. Hiring updates are included in the handouts. Possibility to hire lab techs to process upfront prep for experiments – Leave PhDs to run the machines and analyze data a suggested next step in the hiring process.

Space

An eventual move the West Quad is planned; a 2008 date has been suggested; fact or fiction? Major question is how to accommodate the growth of the core until then and beyond. Should the core have to stay in the BRB for a lengthier period of time?

The question begging to be asked is “Why not start affiliating with private companies today?” 5 different companies started at the Cleveland Clinic in exactly this fashion.

A proposal to the Dean will be submitted to the Dean in the next 10 days (N.B. – submitted 10/13/05) to start a company within Proteomics Center.

Training and Outreach

- Student Research
- Workshops
- Courses
- Websites (building out)
- Conferences (May 2006 – Inaugural)
- Community Programs (on hold)

Funding

Through specific funding, a additional new name adopted for the Center is The Cleveland Foundation Center for Proteomics (\$1.5M to recruit faculty).
>15M pending/awarded including the Foundation grant

Center Grants – Major Priority

Wright Center

Center for Excellence in Genomic Science (NHGRI)

Clinical Proteomics Technology Assessment Consortia (NCI)

Renewal of Biomedical Technology Center Grant

Issues

Announcing the Opening of the Center – probably January 2006

Access fees to the lab

- discounts for major users?

\$50/hr flat fee?

- will there be discounts
- strictly machine time/not analysis
- Cancer Center works similarly

Preparation of samples, whose responsibility?

Lab Technician – Roles and responsibilities <how many?>

Policies and procedures documentation

Additional faculty recruitment

-

Separate Analytical Room?

- A few benches for offline analysis separate from instrumentation
- Center or Web Access data availability

Cluster Issue? 50 CPU cluster held in budget, 7 terrabyte server ordered

- Had a meeting with Apple guys regarding setting up computer clusters for high level analysis

Case building a Super Computer Center, which should include the clusters which will aid in small molecule processing.

After the meeting, members went on a tour of the facilities.

Case Center for Proteomics
Advisory Board Meeting Minutes
June 5, 2006- 3:30-5:00

Attendees: Dr. Mark Chance, Dr. Aaron Weinberg (Chair), Dr. Henri Brunengraber, , Dr. Kris Palczewski, Dr. Assem Ziady, Dr. Thomas McCormick, Dr. Vernon Anderson, Dr. Michael Kinter

GUESTS: Dr. Janna Kiselar, Dr. Keiji Takamoto, Dr. Masaru Miyagi, Joan Schenkel,

A status report on the progress made by the Center in meeting its yearly milestones was given by Dr. Mark Chance. (Milestone Report attached). Dr. Brunengraber asked about the status of our imaging program and Dr. Chance noted that the center would likely move up implementation of this goal to year 2.

Dr. Chance reviewed with the committee a Preliminary Annual Report. This report includes information on: types of center users, number of PIs, number of samples, service fees generated, current and pending grant support, faculty and staff hiring, instrumentation, community outreach and computer facilities.

Dr. Masaru Miyagi gave a brief presentation on his research and future development of isotope labeling technologies.

Dr. Takamoto gave a brief presentation on his development of novel 2 D-Gel proteomics approaches.

Major Issues Discussed:

Dr. Palczewski acknowledged the substantial progress the center has made in a short time. Current Case Center for Proteomics service fees and user fees were discussed in comparison with other proteomics and mass spec facilities across the country. It was agreed that our prices are very much in line with other facilities. Dr. Palczewski suggested having PIs reserve instruments for a 24 hour period and then be charged for the first 8 hours in order to provide a 67% discount for large users of the center. This will be implemented on trial basis until the next meeting.

An issue of some PIs not wanting to pay for their results was raised. Dr. Weinberg suggested we have a policy that enables the center to refuse to complete experiments that center members feel will fail due to inadequate/inappropriate preparation of samples. It was also stated by Dr. Kinter that PIs should have to pay when they are not pleased with their results but that his center sometimes gives those people a discount. Dr. Chance stated that he wants the fee for such users to be significant enough to discourage them from attempting to analyze inappropriately prepared samples and/or unfeasible experiments. The committee agreed that discounts in such cases should be determined by Dr. Chance on a case by case basis.

The committee felt the center is developing well and meeting its milestones ahead of schedule and agreed to meet again in early November.

Center Goals 2005-2008

Legend: Completed, ~~Deferred/Cancelled~~, New/Changed, Planned

Year 1-2005-2006

- **Recruit Scientific Director**
- **Establish Centralized Laboratory of 5000 sq. ft.**
- **Relocate Q-TOF, Finnegan LTQ, & MALDI instruments.**
- ~~Purchase & Install Bruker or ABI MALDI TOF/TOF and~~ **Finnegan FTICR-MS with capillary LC capability.**
- **Combine with Director's Ion-Trap instruments for a total of 7 instruments in the first year.**
- Establish multi-dimensional, quantitative LC-MS with nanospray capability as a Medical School service.
- **Complete automation of all instruments for 24/7 operation (Q-star pulsar exception)**
- **Transfer Biomedical Technology Center Grant from AECOM to Case.**
- **Organize collaborations with existing centers and Case faculty; submit joint applications or applications with Center as a core facility.**
- **Organize 1st Annual Case Proteomics Workshop.**
- **Establish Center advisory board**
- **Recruit laboratory director and 3 additional staff**
- **Establish criteria for faculty membership in the proteomics center, make initial appointments.**
- **Identify potential foundations for support initiatives**
- External Funding of Center \$2.4 million/yr.

Year 2-2006-2007

- ~~Purchase and install 1 additional ion trap instruments with coupled LC and 1 additional MALDI TOF/TOF instrument for a total of 9 instruments in year 2.~~
- **Purchase & install Biomec-FX robotic liquid handling system.**
- Organize graduate group in systems biology.
- Participate in submission of Molecular Biophysics Training grant application.
- Establish deuterium exchange and hydroxyl radical mapping as Medical School service functions with robotic liquid handling.
- **Explore new collaborations with existing centers and Case faculty; submit joint applications or applications with Center as a core facility.**
- ~~2nd Annual Case Proteomics Workshop.~~ Continue successful seminar program, expand website
- Submit Program Project or Center Grant focused on proteomics research at CWRU-Diabetes
- **Recruit Proteomics Faculty member to Medical School**
- **Submit Shared Instrumentation grant for additional instrument (s)**
- **Recruit 3 additional laboratory staff members**
- Establish proteomics course

Year 3-2007-2008.

- ~~Move center to West Campus.~~
- Expand laboratory space to 10-20,000 sq. ft.
- Explore new collaborations with existing centers and Case faculty; submit joint applications or applications with Center as a core facility.
- Implement additional robotic liquid handling system.
- **Implement automated 2-D gel electrophoresis system with robotic sample picking. Provide as service to Medical School investigators.**
- Implement MALDI imaging program. Provide as service to Medical School investigators.
- 3rd Annual Case Proteomics Workshop.
- Submit Shared Instrumentation grant for additional instrument (s)
- Recruit additional Proteomics Faculty member to Medical School
- Establish systems biology undergraduate program with Physics and BME.
- Recruit 3 additional laboratory staff members for a total of 10
- Achieve 25% recovery of center budget through service fees.

Case Center for Proteomics Types of Research

Center Research-Research that is conducted and charged to grants where Center for Proteomics Member is PI

Collaborative Research- Research conducted with other departments. Research is considered collaborative when:

- there is an agreement to submit a collaborative grant
- a collaborative staff member has been identified
- a fraction of staff members salary will be paid by grant or pending grant
- we will be author on publications
- the grant will provide on-going financial support to Center
- the collaborative grants pays for use of center facilities

Service- Research conducted by Center according to specifications on Sample Submission Form. PI pays for this service.

Independent Research- Research conducted by **non-center staff** using Case Center for Proteomics facilities.

Number of PIs by Department as of 6/1/06

Case Center for Proteomics Users	Service	Collaborative	Independent	
Biochemistry	4		2	
Biological Sciences		1		
Biology		1		
Biomedical Engineering	1			
Clinical and Molecular Endocrinology	1			
Endocrinology	1			
Dermatology		2	1	
General Medicine			1	
Genetics	1			
Hematology/Oncology	1	1		
Infectious Disease		1		
Molecular Biology and Microbiology	1			
Neuroscience				
Nutrition	1			
Ophthalmology	1		1	
Otolaryngology		1		
Pathology	2	1		
Pediatrics	2	1	1	
Pharmacology	2	2		
Physiology and Biophysics	2			
Radiology	1		2	
RNA Molecular Biology	1		1	
Proteomics			1	
Outside Case Community		5		
	22	16	10	48

Number of Samples Processed as of 6/1/06

Instrument and Service	Number of Samples
<i>2D Gel Services</i>	
single labeled gel	5
double labeled gel	3
triple labeled gel	63
preparative gel	8
protein concentration analysis	122
gel scanning	23
cell pellet processing	2
sample cleanup	94
1-D Electrophoresis	1
<i>MS Services</i>	
Q-Star	24
Deca XP	238
FT-MS	104
LTQ	195
Maldi-Tof	146
Misc LC-MS	72
Total MS:	779

Instruments Usage Analysis as of June 1, 2006

1. proTOF- The instrument is not working properly. It has been deemed defective. The Center is being sent a new instrument at it should be fully operational by the end of June.
2. FT/LTQ, Deca XP, LTQ, Q Star XL, Q Star Pulsar (under utilized) are all fully operational and running samples on a regular basis.
3. 2-D GIGE System is working well and running samples

Service Fees Generated

Users Listed by Department	Service Fees Generated as of June 1, 2006	
Biochemistry	\$3,675	2.9%
Biology	\$13,695	10.8%
Biomedical Engineering	\$180	0.1%
Clinical and Molecular Endocrinology	\$1,225	1.0%
Dermatology	\$14,000	11.0%
Endocrinology	\$11,700	9.2%
General Medicine	\$550	0.4%
Genetics	\$300	0.2%
Hematology/Oncology	\$4,350	3.4%
Infectious Disease	\$500	0.4%
Molecular Biology and Microbiology	\$1,237	1.0%
Nutrition	\$637	0.5%
Ophthalmology	\$550	0.4%
Otolaryngology	\$7,500	5.9%
Pathology	\$2,790	0.0%
Pediatrics	\$410	0.3%
Pharmacology	\$1,575	1.2%
Physiology and Biophysics	\$3,640	2.9%
Proteomics	\$54,490	42.9%
Radiology	\$420	0.3%
RNA Biology	\$3,525	2.8%
	\$126,949	

Resources & Environment of Case Center for Proteomics

See <http://casemed.case.edu/proteomics/index.html> for full center description

Laboratories: The Proteomics Center will be fully available for this project. This laboratory is comprised of 5000 sq. feet of laser, spectroscopy, spectrometry, cell culture, and biochemistry laboratory space on the 9th floor of the BRB Building.

Biochemistry facilities: HPLC and FPLC chromatography apparatus, microfuges, regulated water baths, gel dryer, vacuum pump, high voltage power supplies, sequencing gel units, protein and DNA electrophoresis apparatus, refrigerators, freezer, analytical balances, pH meter, micropipets, radiation safety equipment, glassware, pipettes, -70°C freezers, and cold rooms.

Major Mass Spectrometry Equipment: Dr. Chance's laboratory has a full complement of mass spectrometry and proteomics facilities available including:

1. Thermo-Finnegan Fourier Transform LTQ mass spectrometer with 2 ppm resolution for top-down and bottom-up proteomics capabilities operated with Dionex capillary LC system; a 96-well autosampler and switcher is utilized with this system.
2. GE/Amersham 2-D gel DIGE system with robotic spot picking.
3. Two Applied Biosystems Q-star mass spectrometers. One with Agilent-nano-LC electrospray and one with MALDI source.
4. Thermo-Finnegan DECA XP-Plus and LTQ instruments, both with nanospray capability are available.
5. Beckman Biomec FX robotic liquid handling systems is available in Dr. Chance's laboratory with 96-well head and SPAN-8 flexible arm. Numerous ALPs are available including heating/cooling and vacuum filtration.
6. Pro-TOF 2000 MALDI Mass Spectrometer, with attamole sensitivity and 5 ppm resolution.
7. Additional ion trap instruments with LC-systems also available.

Other major equipment includes: Protein solutions light scattering instrument, time-resolved fluorescence using CCD detection, FTIR, and UV-Vis spectrometers.

Computation facilities:

1. Data acquisition computers attached to mass spectrometers, scanners, Beckman BioMEX FX robot, HPLCs and other analytical equipments.
2. Dedicated data analysis workstations including 2 workstations with BioWorks for mass spectrometry (MS) database searches, 2 workstations with DeCyder 2D software for 2D-DIGE data analyses.
3. High-end 4-way server for additional Mascot MS database search engine. It is ordered and will arrive any time. Mascot program is currently running on regular PC as temporary solution.
4. 32 nodes (64 CPUs) Apple XserveG5 cluster with 7TB Xserve RAID data array. The purchase is postponed to next fiscal year. We have obtained all quotes and discussed with professionals in detail. The decision is made to purchase Apple solution partly based on compatibility with existing Cluster of Genetics Department.
5. Closed-circuit camera system for trouble shooting and user instructions of Mass Spectrometers with computer recording capability.
6. Thirty personal computers are available for researchers and staff.

Administrative support of the Case Center for Proteomics occupies a dedicated administrative suite adjacent to the center's laboratory space on the 9th floor of the Biomedical Research Building at Case Western Reserve University's School of Medicine. The center's support staff includes a senior administrator and secretary to facilitate the purchasing of lab materials and supplies, maintain grant accounting and to assist in grant preparation.

Grants Support and Submissions

Ongoing Research Support

R21-DK-69952 (Chance)

9/04-8/07

NIH

Cellular Footprinting of the Transferrin: Receptor Complex

The project will develop novel LC-MS and LC-MS/MS approaches to understand membrane protein-receptor interactions specifically that of transferrin with its receptor, in live cell assays.

Total Award- \$329,333

R21-DK-70229 (Chance)

9/04-8/07

NIH

Proteomics of Type 1 Diabetes Progression

The project uses LC-MS and LC-MS/MS approaches to examine affects of streptozotocin induced diabetes on maxi k-channel protein expression and post-translational modifications in the corporal myocytes of rats.

Total Award- \$658,667

P41 EB-01979 (Chance)

9/30/95 – 8/31/08

NIH

Center for Synchrotron Biosciences

The major goals of the current funding period are : 1-Development of novel synchrotron technologies to examine time-resolved structure-function relationships of macromolecules including x-ray footprinting of nucleic acids and proteins, synchrotron infrared microscopy, and development of synchrotron x-ray beamlines; 2-Carry out collaborative research with NIH funded scientists to apply these novel technologies to their research problems; 3-Operate an X-Ray spectroscopy and diffraction service facility at the National Synchrotron Light Source.

Total Award (03-08)- \$5.1 million

PEB 001979-G1 (Chance)

NIH

Center for Synchrotron Biosciences Supplement

3/1/06-8/31/08

To improve diversity in the area of health related scientific research being performed in the parent grant EB-01979.

Total Award- \$216,300

U54 GM-74945 (Burley)

10/1/00 – 6/31/10

NIH

New York Center for Structural Genomix

(Chance, sub-contract PI)

To provide high-throughput synchrotron data collection facilities for the Protein Structure Initiative and carry out high-throughput metallo-proteomics screening of NYSGXRC target proteins.

Total Award Sub-Contract (05-10) \$1.5 million

Cleveland Foundation Center for Proteomics (Horwitz)

10/1/05-9/30/08

Cleveland Foundation

To facilitate the hiring of highly knowledgeable faculty in the areas of proteomics, mass spectrometry and genomics for the Case Western Reserve University School of Medicine and for the Cleveland Foundation Center for Proteomics.

Total Award- \$1.5 million

R21 ES014653-01 (Dearborn)

4/06-3/08

NIH

Biomarkers for Exposure to Stachybotrys

To conduct mass spectrometry studies of mold adducts.
Total Award \$415,000

R01 AA016210-01 (Rubin) 05/01/06-04/30/11
NIH
Identification and validation of alcohol biomarker signatures by proteomics
Case Subcontract (Chance- PI)
To conduct proteomic analysis of cardiovascular disease related to alcohol exposure.
Total Subcontract- \$772,500

AGA Student Research Fellowship (Lominadze) 06/1/06-7/1/07
AGA Foundation
To complete research in the area of digestive health and nutrition.
Total Award- \$3000

U54 CA100926 (Augenlicht) 8/06-7/08
Molecular-Nutrient Interactions in Colon Cancer
Proteomics Core
Total Award- \$100,000

Bioenterprise (Horwitz)
Funds to Purchase a Mass Spectrometer
Total Award-\$600,000

Pending Support

U24-DK-76174 (Brunengraber) 7/06-6/011
NIH
Mouse Metabolic Phenotyping Centers Consortium/Quantitative Expression Core
This proposal provides core facilities in proteomics for mouse projects.
Total Request - \$618,000

S10-RR-23542 (Chance) 4/07-3/08
Detector and Four Channel Digital Spectrometer
Award Request- \$424,473

S10-RR-023546 (Kiselar) 4/07-3/08
4800 Maldi TOF/TOF
Award Request- \$497,597

CTSA- Translational Technologies Core (Silverstein/Chance) 9/06-8/11
Total Request- \$5.7 million

R01- (Chance) 4/07-3/12
Novel Proteomics Approaches in Type 1 Diabetes Complications
Total Request- \$1.9 million

R21- CA-125292 (Takamoto) 9/06-8/08
Innovative Technologies for Molecular Analysis of Cancer
Total Request\$ 424,857

R03-AR054576 (Gobezie) 12/06-11/09
NIAMS Small Grant Program for New Investigators
Total Request- \$231,750

R01-(Berger) Feverfew and Parthenolide in Mouse Models of CF Total Request- \$1.2 million	12/06-11/09
R01-DE-17486 (Ghanoum) Identification of Early Phase c.albicans Biofilm Proteins Total Request- \$1.5 million	9/07-8/12
P30-Cancer Center (Gerson) Proteomics Core Total Request- \$300,000	7/07-6/12
R21-DC7866 (Alagramam) Proteome and Transcriptome of Defined Cell Types in the Ear Following Noise Damage Total Request- \$425,000	9/06-8/08

Letters of support for Grant Applications as of 6/1/06

Cynthia Bearer- Pediatrics

Carol Liedtke- Pediatrics

Vernon Anderson- Biochemistry

Alvin Schmaier- Hematology and Oncology

Mike Maguire- Pharmacology (Funded)

Michael Weiss- Biochemistry

John Lowe- Pathology

Jonathan Whittaker- Nutrition

Community Outreach

Seminar Series

1. Sept. 15th Gang Sun, Ph. D., Case, Biochemistry
Mass Spectrometric Characterization of Oxidative Modification and Turnover of Mitochondrial Proteins
2. Sept. 2nd Xiaojing Zheng, Postdoctoral Fellow candidate, Case,
Structural and Chemical Studies of Ligand Binding to the 12S subunit of transcarboxylase
3. Sept. 29th. Anne Distler, Ph.D., Case, Pharmacology
Mass Spectrometric Analysis of Mitochondrial Outer Membrane Proteins
4. Oct. 6th Mark Chance, Ph.D., Case Center for Proteomics
Present & Future Plans for the Case Center for Proteomics & Mass Spectrometry
5. Oct. 12th Elizabeth Yohannes, Ph.D., Postdoctoral Fellow Candidate, Rockefeller University Proteomics Resource Center
Genomic and Proteomic Approaches for the Analyses of Coordinated Regulation of pH Fluctuation in E. coli
6. Oct. 20th Pat Wintrode, Ph.D., Case, Physiology and Biophysics
Probing the Folding and Function of a Metastable Protein With Hydrogen Exchange and Mass Spectrometry
7. Oct. 27th Assem Zlady, Ph.D., Case, Pediatrics
Proteomic Analysis of CF Airway Epithelia
8. Nov. 3rd Yoshikazu Imanishi, Ph.D., Case, Pharmacology
Visualizing the Interactions between Photoreceptor and RPE Cells
9. Nov. 10th Jennifer Krone, Ph.D, Applied Biosystems
Tools for Proteomic Discovery
10. Nov. 17th Sam Dougaparsad, Ph.D., Beckman Coulter Inc.
The Analysis of the Proteome: New Technologies to Innovate, Simplify & Automate
11. Dec. 1st Cynthia Bearer, Ph.D., University Hospital, Pediatrics
Who Gets Fetal Alcohol Syndrome and Why?
12. Dec. 8th Jonathan Whittaker, Ph.D., Case, Nutrition
Molecular Biology of Ligand Binders by the Insulin Receptor Family
13. Dec. 15th George Stark, Ph.D., Cleveland Clinic Foundation, Genetics
Unraveling Complexity in Cytokine-dependent Signaling. How Can Mass Spectrometry Help?
14. Jan. 5th Janna Kiselar, Ph.D., Case Center for Proteomics
Conformational Activation of Arp2/3 Complex: Nucleotide- and WASp-Binding Mediate Local and Global Conformational Rearrangements.
15. Jan. 12th Wuxian Shi, Ph.D., Case Center for Proteomics
Structure-Assisted Inhibitor Design & Structure Genomics
16. Jan. 19th Tom Pietrowski, Waters, Inc.

- Integrating Nano LC/MS into Qualitative & Quantitative Proteomics
17. Jan. 26th Joann Krenisky-Purkerson, Dionex Corporation
New Advances in HPLC Technology by Dionex
 18. Feb. 2nd Dennis Livesay, Ph.D., California State Polytechnic University at Pomona, Chemistry
Elucidating protein family sequence/structure/function relationships
 19. Feb. 9th Jinsook Chang, Ph.D., Case Center for Proteomics
Proteomic Analysis of Intestinal Epithelial Cells Along Crypt - Villus Axis
 20. Feb. 16th Michael Kinter, Ph.D. Cleveland Clinic Foundation, Proteomics
Proteomic Studies of Atherosclerosis
 21. Feb. 23rd Carl Schwarz, M.S. – Sales Specialist
Advanced Maldi-TOF Technologies & Techniques, Maldi Tissue Analysis
 22. March 1st George Christ, Ph.D., Wake Forest Inst. for Regenerative Medicine, Functional Genomics Gene Transfer and Tissue Engineering
 23. March 9th Beata Jastrzebska, Ph.D. , Case, Pharmacology
Oligomeric Organization of Rhodospin-Prototypical CPCR
 24. Mar. 16th Michael Cho, Ph.D. Case, Infectious Diseases
Understanding Structural, Functional & Immunological Properties of SARS
 25. Mar. 23rd Kuman Alagraman, Ph.D., Case, Otolaryngology-HNS
Case MAP Project-A Key Initiative in Proteomics of Hearing Research
 26. Mar 30th Charles Hoppel, Ph.D., Case, Pharmacology
Mitochondrial Contact Sites: Is This Where The Action Gets Started!!
 27. April 6th John Letterio, M.D., University Hospital, Pediatric Oncology
TGF- β Signaling In T Cells: At The Crossroad Between Inflammation and Cancer
 28. April 13th Vernon Anderson, Ph.D., Case, Biochemistry
Application of Stable Isotopes To Solve Problems in Mass Spectrometry
 29. April 20th John Crabb, Ph.D., Cleveland Clinic Foundation,
Biomarker Discovery for Age-Related Ocular Diseases
 30. April 27th Shu G. Chen, Ph.D., Case, Pathology
LRRK2: Pathway to Parkinson's Disease
 31. May 11th G. Reid Asbury, Ph.D. – G.E. Healthcare
"What's Different? The Hidden Quantitative Differences in LC-MS Data Using DeCyder MS Differential Analysis Software"
 32. May 18th Thomas McCormick, Ph.D., University Hospital, Dermatology
"Proteomic Profiling of UV-Induced Changes in HaCa T Keratinocytes"
 33. May 25th Patrick Ma., M.D., Case, Hematology/Oncology
"Kinase Mutations in Lung Cancer: Structure-Function-Inhibition"

Case Center for Proteomics Inaugural Symposium

Wednesday, May 25th from 1:00-5:00 pm

Speakers: **Steven Almo**, Ph. D.
Professor, Albert Einstein College of Medicine
Stephen Burley, M. D., D. Phil., F. R. S. C.
Chief Scientific Officer & Senior Vice-President, SGX Pharmaceuticals
A. L. Burlingame, Ph. D.
Professor, Chemistry and Pharmaceutical Chemistry
Director, Mass Spectrometry Facility University of California, San Francisco
Richard Caprioli, Ph. D.
Professor of Biochemistry
Director, Mass Spectrometry Research Center, Vanderbilt University

◆ Mark Chance Seminars July 2005- to present

July 2005	Cleveland Foundation Site Visit, Cleveland, OH "Proteomics Resources for Northeast Ohio"
August 2005	7th International Symposium on Mass Spectrometry in the Health and Life Sciences San Francisco, CA, Closing Plenary lecture "Structural Proteomics of Macromolecular Assemblies by Mass Spectrometry"
August 2005	American Chemical Society 2005 National Meeting, Washington DC "Structural Proteomics of Macromolecular Complexes"
Sept 2005	Case, Department of Pharmacology Seminar Series, Cleveland, OH "Structural Proteomics of Macromolecular Complexes"
October 2005	Case, Department of Physiology & Biophysics Seminar Series, Cleveland, OH "Structural Proteomics of Macromolecular complexes"
October 2005	Case, Department of Genetics Seminar Series, Cleveland, OH "Macromolecular complexes as Engines of Biological Function"
October 2005	Case, Department of Biochemistry Retreat: Featured Speaker, Cleveland, OH Genomics, Proteomics & Biology of Human Health
Nov 2005	Amici Medicine Health Forum, Cleveland, OH "Genomics, Proteomics & The Biology of Human Health"
Jan 2006	18 th Sanibel Conference on Mass Spectrometry, Sanibel Island, FL "Structural Proteomics of Macromolecular Complexes"
Feb 2006	Case Western Reserve University, Immunology Series, Cleveland, OH "Structural Proteomics of Macromolecular Complexes"
March 2006	2006 Pittsburgh Conference, Orlando, FL "Structural Proteomics of Macromolecular Assemblies by Mass Spectrometry"
April 2006	University of Cincinnati, Interdisciplinary Graduate Program in Cell & Cancer Biology, Cincinnati, OH "Structural and Cellular Proteomics in the Post-Genomic Era"
May 2006	Cleveland Clinic Foundation, 3 rd Glioblastoma Brain Tumor Summit, Cleveland, OH "Genomics and Proteomics"
May 2006	Ohio University, Athens, Ohio "Structural and Cellular Proteomics in the Post-Genomic Era"

Posters and Presentations by Center members since June 2005

1. Amishakamal J Kizhakkedathu. "Modeling of the Cofilin-Actin Binary Complex Using Protein Footprinting Data". *54th ASMS Conference on Mass Spectrometry*, May 26–June 1, 2006, Washington State Convention & Trade Center, Seattle, Washington, organized by American Society for Mass Spectrometry
2. Amishakamal J Kizhakkedathu. "Modeling of the Cofilin-Actin Binary Complex Using Protein Footprinting Data" *Inaugural Research Symposium for the Case Center for Proteomics, Cleveland Foundation Center for Proteomics*, May 24, 2006, Wolstein Auditorium of the Case Western Reserve University's School of Medicine, Cleveland, Ohio.
3. Amishakamal J Kizhakkedathu. "Modeling of the Cofilin-Actin Binary Complex Using Protein Footprinting Data". *New Faculty Symposium*, April 21, 2006, Wolstein Auditorium of the Case Western Reserve University's School of Medicine, Cleveland, Ohio.
4. Amishakamal J Kizhakkedathu. "Mapping the cofilin binding surface on monomeric actin by using protein footprinting data". *Third Annual Ohio Mass Spectrometry Symposium*, March 20-21, 2006, Columbus, Ohio.
5. Amishakamal J Kizhakkedathu. "Synchrotron Protein Footprinting In Cofilin Binding to Monomeric Actin: Identification of The Cofilin Binding Surface and the Loci of Major Conformational Changes". *7th International Symposium on Mass Spectrometry in the Health and Life Sciences*, August 21-25, 2005, Fairmont Hotel, San Francisco, California.
6. Elizabeth Yohannes, A.I. Caplan, D.P. Lennon, and M.R. Chance. "Differential Proteome Analysis of Fetal Bovine Serum for Evaluating Batch-to-Batch Variability." *Inaugural Research Symposium for the Case Center for Proteomics, Cleveland Foundation Center for Proteomics*, May 24, 2006, Wolstein Auditorium of the Case Western Reserve University's School of Medicine, Cleveland, Ohio.
7. Elizabeth Yohannes. "What our 2-D Gel Electrophoresis can do for you" *Inaugural Research Symposium for the Case Center for Proteomics, Cleveland Foundation Center for Proteomics*, May 24, 2006, Cleveland, Ohio.
8. Elizabeth Yohannes. "What our 2-D Gel Electrophoresis can do for you" *Case Center for Proteomics and Mass Spectrometry and Mass Spectrometry Open House*, Cleveland, Ohio.
9. Elizabeth Yohannes, A.I. Caplan, D.P. Lennon, and M.R. Chance. "Differential Proteome Analysis of Fetal Bovine Serum for Evaluating Batch-to-Batch Variability." *Case School of Medicine's New Faculty Symposium*, April 21, 2006, Cleveland, Ohio.
10. Elizabeth Yohannes. "Genomic and Proteomic Approaches for Investigating pH Regulated Systems in *E. Coli*." *Chemistry Department Seminar Series*, April 14, 2006, Youngstown State University, Youngstown, Ohio.
11. Shuqing Liu, Rod K. Nibbe, Pranab K. Mukherjee, Mark R. Chance. "Proteomics Combined to Bioinformatics: Protein Expression Differentiation between Candida Biofilm and Planktonic Cells and Insights into the Potential Regulation Pathway." *S US HUPO meeting*, March 12-15, 2006, Boston, Massachusetts.
12. Shuqing Liu, Ming-Zhong Sun, Liming Liu, Thomas S. McCormick, Kevin D. Cooper, Mark R. Chance. "Proteomic Profile of Keratinocytes and Skin in Response to the Induction of UV-irradiation and Chemical-Toxicant." *J. Am. Soc. Mass Spectrometry*, Vol. 17, 97S, 2006.

13. Mark Chance, Shuqing Liu, Ming-Zhong Sun, Daniel Chen, Qing Y. Zheng, Kumar Alagramam. "Auditory Proteomics of Mouse Model for Usher Syndrome 1F." *J. Am. Soc. Mass Spectrometry*, Vol. 17, 122S, 2006.
14. Ming-Zhong Sun, Olga Zak, Guozhong Xu, Rutao Liu, Phil Aisen, Mark Chance. "Transferrin: Receptor Binding *in vivo* Using Novel Footprinting Approach." *J. Am. Soc. Mass Spectrometry*, Vol. 17, 120S, 2006.
15. M. Miyagi, V. Palamalai, R.M. Darrow, D.T. Organisciak. "Comparative Proteome Analysis of Light Exposed and Unexposed Photoreceptor Rod Outer Segments." *Annual meeting of Association for Research in Vision and Ophthalmology*, April 30 - May 4, 2006, Fort Lauderdale, Florida.
16. Chandra Sekhar Rao Kadiyala, Dagmar Hajkova, Masaru Miyagi. "Validation studies of proteolytic 18O labeling method using Lys-C and trypsin." *Annual meeting of American Society for Mass Spectrometry*, May 28 - June 1, 2006, Seattle, Washington.
17. Dagmar Hajkova, K.C. Sekhar Rao, Masaru Miyagi. "The pH Dependency of 18O Atom Incorporation into the C-terminal Carboxyl Group of Peptides by Lysyl Endopeptidase and Trypsin." *Annual meeting of American Society for Mass Spectrometry*, May 28 - June 1, 2006, Seattle, Washington.
18. Jinsook Chang, Guozhong Xu, Kelvin Davies, George Christ, and Mark R. Chance. "Identifying translated splice variants of the Maxi-K channel and their relevance to type 1 diabetes." *ASMS*, 2005.
19. Jinsook Chang, Guozhong Xu, Kelvin Davies, George Christ, and Mark R. Chance. "Identifying translated splice variants of the Maxi-K channel and their relevance to type 1 diabetes." *Diabetic retreat*, 2006.
20. Jinsook Chang, John M. Mariadason, Leonard H. Augenlicht, Mark R. Chance. "Proteomic analysis of intestinal epithelial cell differentiation along the crypt - villus axis." *Keystone symposium in Systems biology*, 2006.
21. Jinsook Chang, John M. Mariadason, Leonard H. Augenlicht, Mark R. Chance. "Proteomic analysis of intestinal epithelial cell differentiation along the crypt - villus axis." *ASMS*, 2006.
22. Jinsook Chang. Proteomic Analysis of Intestinal Epithelial Cell differentiation Along the Crypt - Villus Axis. Center for proteomics and Mass Spectrometry. 2006.
23. J. Kiselar, R. Mahaffy, T. Pollard, S. Almo, and M. Chance. "Probing Arp2/3 complex activation by ATP and WASp using radiolysis and mass spectrometry." *7th international Symposium on mass Spectrometry in the Health and Life Sciences*. August 2005, poster. Second best poster, awarded with the free registration for the 8th International meeting.
24. Katy Lundberg and Janna Kiselar. "From Sample Submission to Data Analysis." *Open house*, April 2006, poster. Case Western Reserve University.
25. J. Kiselar, P. Janmay, and M. Chance. "Time-resolved footprinting approach to examine the dynamic of Ca²⁺ dependent activation of gelsolin." June 2006, poster. *ASMS meeting*.
26. J. Kiselar. Conformational activation of Arp2/3: ATP- and WASP-binding mediate local and global conformational rearrangements. January 5, 2006, Case Western Reserve University.
27. K. Takamoto. Electrical Engineering and Computer Science Guest Lecturer, November 23, 2005, Case Western Reserve University, Cleveland, Ohio.
28. Sergei A. Ilchenko, Robert J. Cotter, Eugeny Krylov, Raanan Miller, Erkinjon Nazarov. "Differential Mobility Spectrometer coupled with the AP MALDI/MS." Oral presentation on Ohio Mass Spec Symposium. Columbus, OH, March 2006.
29. Sergei A. Ilchenko, Robert J. Cotter, Eugeny Krylov, Raanan Miller, Erkinjon Nazarov. "Miniature Differential Mobility Spectrometer Interface for Enhanced Performance of the

AP MALDI/MS System” Center for Proteomics, Case Western Reserve University, Cleveland, OH, Poster presentation, 54th conference of ASMS, Seattle, WA, May 2006.

Papers Published by Center Members since June 2005

1. Bonanno, J.B., Almo, S.C., Bresnick, B., Chance, M.R., Fiser, A., Swaminathan, S., Jiang, J., Studier, F.W., Shapiro, L., Lima, C., Gaasterland, T.M., Sali, A., Bain, K., Feil, I., Gao, X., Lorimer, D., Ramos, A., Sauder, M., Wasserman, S., Emtage, S., D’Amico, K., Burley, S.K., “New York-Structural GenomiX Research Consortium (NYSGXRC): a large scale center for the protein structure initiative”, *Journal of Structural and Functional Genomics*, 6:225-32, (2005)
2. Marinkovic, N., Gupta, S., Zhan, C., and Chance, M.R., “Synchrotron Radiation in Biosciences”, *Nuclear Instruments and Methods in Physics Research B*, 242-246, (2005)
3. Marinkovic, N., Chance M.R., “Synchrotron Infrared Microscopy”, *Encyclopedia of Molecular Cell Biology and Molecular Medicine*, 2nd Ed., Vol. 13, R. Meyers, Editor, Wiley Inc., p. 671-708, (2005)
4. Shi, W., Zhan, C., Manjasetty, B., Marinkovic, N., Sullivan, M., Huang, R, and Chance, M.R., Metalloproteomics: High throughput determination of transition metal content of metalloproteins, *Structure*, 1473-86 (2005).
5. Robinson, Shi, Sullivan, Nolan, Schneider, Berman, Lynch, Rock, Rosenbaum, Johnson, Chance, and Sweet. An Undulator Beamline for Protein Crystallography at the NSLS: Commissioning and Operation of X29. *Synchrotron Radiation News*, 27 – 30 (2005).
6. Guan, J.Q., Chance M.R. “Structural Proteomics of Macromolecular Assemblies using Oxidative Footprinting and Mass Spectrometry”, *Trends in Biochemical Sciences*, Vol. 30, Issue 10, p. 583-92, October, (2005).
7. Xu, G., Liu, R., Zak, O., Aisen, P., Chance, M.R., “Structural allostery and binding in transferring-receptor complex”, *Mol. & Cell. Proteomics*. 4:1959-1967, (2005).
8. Zhan, C., Fedorov, E.V., Shi, W., Ramagopal, U.A., Thirumuruhan, R., Manjasetty, B.A., Almo, S.C., Fiser, A., Chance, M.R., Fedorov, A.A., “The ybeY protein from *E.coli* is a metalloprotein containing nickel”, *Acta. Cryst. F*, F61, 959-963, (2005).
9. Xu, G., Kiselar, J.G., He, Q., and Chance, M.R. Secondary reactions and strategies to improve quantitative protein footprinting. *Anal. Chem.*, 77, 3029-3037, 2005.
10. Cotter, R.J., Ilchenko, S., Wang, D., Gundry, R. Tandem Time-of-Flight (TOF/TOF) Mass Spectrometry and Proteomics, *Journal of Mass Spectrometry Society of Japan*, 53(1): 7-17, 2005.
11. Cotter, R.J., Ilchenko, S., Wang, D. The Curved-Field Reflectron: PSD and CID without Scanning, Stepping or Lifting, *Int. J. Mass Spectrom.* 240: 169-182, 2005.
12. Robinson, Shi, Sullivan, Nolan, Schneider, Berman, Lynch, Rock, Rosenbaum, Johnson, Chance, and Sweet. An Undulator Beamline for Protein Crystallography at the NSLS: Commissioning and Operation of X29. *Synchrotron Radiation News*, 27 – 30 (2005).
13. Xu, G., Chance, M.R., “Radiolytic Modification of Sulfur Containing Acidic Amino Residues in Model peptides: Fundamental Studies for Protein Footprinting, *Anal. Chem.*, 77:2437-2449, 2005.

14. Xu, G., Chance, M.R., "Radiolytic Modification and Reactivity of Amino Acid Residues Serving as Structural Probes for Protein Footprinting" *Anal. Chem.*, 77(14):4549-55, (2005).
15. Manjasetty, B. A., and Chance, M. R. Crystal structure of Escherichia coli L-arabinose isomerase (ECAI), the putative target of biological tagatose production *Journal of Molecular Biology* 360(2), 297-309 (2006).
16. Manjasetty, B.A., Turnbull, A., Bussow, K., Chance, M.C., Recent Advances in Protein Structure Analysis in Recent Research Developments in Biochemistry, Vol. 7. SG Pandalai, Ed., Research Signpost, Kerala, India (2006).
17. Shi, W., Chance, M.R. Structural Genomics-High Throughput Structure Determination of Protein Domains, in *Comprehensive Medicinal Chemistry II*, Volume 3: Drug Discovery Technologies, C. Hansch, Ed., Elsevier, in press, (2006).
18. Manjasetty, B.A., Shi, W. Zhan, C., Fiser, A., Chance, M.R. "A High-Throughput Approach to Protein Structure Analysis", *Genetic Engineering*, Vol. 28: 105-128, (2006).
19. Takamoto, K.G., Chance, M.R. "Radiolytic protein footprinting with mass spectrometry to probe the structure of macromolecular complexes", *Annual Review of Biophysics and Biomolecular Structure*, Volume 35, 251-276 (2006).
20. Kiselar, J., Chance, M.R., "Oxidative Footprinting of Protein Structure", in *Mass Spectrometry Analysis of Proteins; Comprehensive Analytical Chemistry Series J*. Whitelegge, Ed., Elsevier Press, NY (in press).
21. Zheng, Q.Y., Rozanas, C.R., Thalmann, I., Chance, M.R., and Alagramam, K.N., "Inner ear proteomics of mouse models for deafness, a discovery strategy." *Brain Res.* 1091(1):113-21 (2006).
22. Mukherjee, P.K., Mohamed, S., Chandra, J., Kuhn, D., Liu, S., Antar, O.S., Munyon, R., Mitchell, A.P., Andes, D., Chance, M.R., Rouabhia, M. and Ghannoum, M.A. "Alcohol dehydrogenase modulates the ability of the pathogen *Candida Albicans* to form biofilm on catheter surfaces through an ethanol-based mechanism." *Infection and Immunity.* 74(7):3804-16 (2006).
23. Hajkova, D., K. C. Rao, K. C. S., and Miyagi, M. The pH Dependency of the Carboxyl Oxygen Exchange Reaction Catalyzed by Lysyl Endopeptidase and Trypsin. *J. Proteome Res.*, 5(7): 1667-1673, (2006).
24. Shi W., et al., Chance M.R. Beamline X29: a novel undulator source for X-ray crystallography. *J. Synchrotron Radiation*, V13:365-372 (2006).
25. Gobezie, R., Millett, P. J., Sarracino, D. S., Evans, C., and Thornhill, T. S. Proteomics: applications to the study of rheumatoid arthritis and osteoarthritis *The Journal of the American Academy of Orthopaedic Surgeons* 14(6), 325-332 (2006).