DAVID S. TALAGA

Curriculum Vitae

Montclair State University
Department of Chemistry and Biochemistry
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ACADEMIC DEGREES

12/8/1996 — ***University of California*** — ***Los Angeles, CA***

Ph.D. degree in Physical Chemistry
Dissertation Advisor: Jeffrey I. Zink
Title of dissertation: *Time-dependent theory of vibronic interactions and gas phase photolysis studies of chemical vapor deposition precursors.*

6/4/1991 — ***Occidental College*** — ***Los Angeles, CA***

A.B. in Chemistry with a minor in Mathematics.

EMPLOYMENT

2010 – Present — ***Montclair State University*** — ***Montclair, NJ***

Associate Professor of Chemistry and Chemical Biology (2010–Present)

Faculty member directing independent research program investigating protein folding and aggregation, amyloid formation, nanopore biomolecular analysis, and single molecule biophysics.

Provide strategic and technical leadership for multi-disciplinary data-driven research group of 3–11 chemists, biologists, biochemists, physicists, and engineers, including undergraduates, doctoral students, postdoctoral fellows, and senior visiting scholars.

- Sole Principal Investigator (PI) for $2M in funding, including $1.2M from NIH R01
- CoPI for $1.0 M in NSF funding
- Participating PI for over $10M in research training grants
- Publications cited 700+ times; Ave 27 cites/pub; 20+ invited university seminars; 45+ conference presentations
- Recent research featured in *Nature Chemistry* news and on the covers of *J Mol Bio* and *J Phys Chem*
- 100% placement of lab trainees into graduate & medical programs, faculty, pharma, or industrial jobs

Provide mentorship and strategic guidance to junior faculty for research, grants, publications, and promotion.

Establish and manage internal and external collaborations to provide synergistic research capabilities.

- Li Group - U Arkansas - Nanopore fabrication and measurement expertise
- Neimark Group - Rutgers U - Coarse grain protein simulations
- Blanchard Group - Cornell Weill Med - Interfacial single molecule measurements and advanced fluorophores
- Moghe Group - Rutgers U - Functionalization of protein nanoparticles and cell motility assays
- Rueda Group - Imperial College Medical School - London, England - Modeling of protein searching on ssDNA

Relocated a 2500 sqft 4 module research facility with ~$1M in equipment providing spectroscopic, molecular biology, computational, and preparatory chemical capabilities.

- Used phased lab relocation strategy to optimize lab productivity across two research sites (Rutgers and MSU)
- Strategy minimized instrument downtime and facilitated onboarding of new researchers at MSU

Teach Biophysical Statistical Thermodynamics, Biophysical Chem, General Chem, Gen Ed Chem.

- Initiated General Chemistry readiness exam requirement
- Developed novel software package to drive class participation via real-time grading of student responses
- Initiated C- grade requirement for all chemistry course prerequisites (previously was D-)
- Major contributor to General Chemistry reform

2000 – 2010 — ***Rutgers University*** — ***New Brunswick, NJ***

Associate Professor of Chemistry and Chemical Biology (2009-2010)

Member of Chemistry and Chemical Biology doctoral program faculty (2000-2014).

Member of BioMAPS Institute and Institute for Advanced Materials, Devices, and Nanotechnology.

Chaired Chemistry Dept. "Task Force 2" for publicity, external communication, and industrial relations.

- Drove establishment of strong industry connections by initiating the seating of an industrial advisory board
- Identified key clusters of faculty research for industrial collaboration
- Developed strategy for improvement of departmental national rankings

Assistant Professor of Chemistry and Chemical Biology (2000-2009)

Served as department spokesperson for recruiting – presented all faculty research programs.

- Developed and presented series of 90 second oral/powerpoint "elevator pitch" faculty research summaries
- Enhanced recruiting, outreach, and fund-raising, targeting university administrators, prospective students, industrial managers and executives, collaborators, politicians, lobbyists, and prospective donors

Spearheaded "nano-bio" section of $629M NJ Jobs Growth & Economic Development proposal.

- Proposal led to founding of Rutgers Institute for Advanced Materials, Devices, and Nanotechnology

Designed and supervised renovations, purchasing, outfitting, and setup of a new research laboratory.

- Provided wet chemistry, spectroscopy, laser, and protein expression capabilities for single molecule, biophysical, molecular biology, and protein aggregation and folding research
- Built and programmed state-of-the-art single molecule microscope with multichannel picosecond-resolved photon-by-photon fluorescence lifetime and polarization capability

Developed strategic plan to expand chemistry doctoral program size by 80%.

- Conducted institutional research into the structural limits on program size
- Proposed policies to eliminate or circumvent limits on program size
- Created 5 year plan for implementation including resource-contingent enrollment targets

1997 – 2000 ***University of Pennsylvania*** ***Philadelphia, PA***

NIH:National Research Service Award Postdoctoral Fellow

Built novel technical platform for ultrafast protein unfolding investigations featuring:

- Temperature jump and/or optical initiation of protein folding or unfolding
- Picosecond transient mid-infrared spectrometer to measure changes in protein secondary structure
- Gapless temporal coverage from 20 ps to 1 ms (10^6 improvement) and 50 μOD noise (20x improvement)

Created novel technical platform for single molecule fluorescence studies of single molecules.

- 2-channel photon-by-photon capability for energy transfer (FRET) distance measurements
- Solution phase and interfacial protein folding measurements
- Applied approach to the folding and unfolding of a 2 helix bundle protein
- Automated data analysis to handle GB quantities of data

1991 – 1996 ***University of California*** ***Los Angeles, CA***

Graduate Research Fellow

- Designed, built and used apparatus to study the photofragmentation of gas phase single source metal-organic chemical vapor deposition precursors
- Synthesis and purification of chemical vapor deposition precursors
- Maintained and repaired excimer lasers, dye lasers, ion lasers, spectrometers, and vacuum systems
- Wrote and used parallelized super-computer code for solving multi-dimensional time-dependent Schrödinger equation

Math & Science Scholars Program: Workshop Facilitator

Graduate Teaching Fellow

- General Chemistry Lab.
- Computers in Chemistry Lab.
- Graduate Group Theory.

1988 – 1991 ***Occidental College*** ***Los Angeles, CA***

Research Assistant

Lead Chemistry Tutor - Learning Resource Center

Teaching Assistant

Important Discoveries & New Methods Introduced

- Theoretical framework for relating electrochemical impedance spectroscopy to protein structure.
- Determination of nanopore geometry using electrochemical impedance spectroscopy.
- Use of solid state nanopores to probe protein aggregation at the single molecule level.
- Discovery of Protein Stall Points arising from local charge effects in translocating proteins.
- Identification of protein unfolding during nanopore translocation.
- Identification of the role of hydrophobic interfaces in the aggregation of α-synuclein.
- Introduction of a free energy landscape formalism to model amyloid formation kinetics.
- Use of umbrella sampling Molecular Dynamics simulations to model fluorescent protein conjugates.
- Identification of multiple ligand binding modes in ß-lactoglobulin via fluorescence lifetime and stokes shift.
- Use of Atomic Force Microscopy to determine protein aggregation distributions.
- Hidden Markov models to analyze single molecule fluorescence.
- Shannon Information Theory to determine the resolution limits of photon-based single-molecule measurements.
- Step-wise photobleaching for chromophore counting.
- Novel global fitting regularization by population continuity.

Research Interests/Methods/Technical Skills/Competencies

- Protein Aggregation
- Protein Folding
- Amyloid
- Parkinson's Disease
- Interfacial Effects on Proteins
- Allosteric Interactions
- Solid State Nanopores
- Ultrafast Spectroscopy
- Raman Spectroscopy
- Statistical Data Analysis
- Hidden Markov Models
- Information Theory
- Automated data acquisition
- AFM
- Microscopy
- UV-Vis
- Programming
- Fortran
- C/C++
- LaTeX
- LabView
- Mathematica
- Circular Dichroism
- Assay Development
- Dynamic Light Scattering
- Single Molecule Fluorescence
- Binding Studies
- Instrumentation Development
- Lasers
- Nanotechnology
- Fluorescence Microscopy
- Molecular Dynamics
- Statistical Mechanics
- Spectroscopy
- Optics
- Biophysics
- Thermodynamics
- Analytical Chemistry
- Physics
- Molecular Biology
- Higher Education
- Analysis
- Problem Solving
- Mentoring
- Mathematical Modeling
- Mathematics
- Data Analysis
- Scientific Computing
- Due Diligence
- Project Coordination
- Communication
- Writing
- Design of Experiments
- Big Data
- Grant Writing
- Teaching

Prizes, Awards & Service

3/2010	NIH Study Section F04B ad hoc Member
10/2009	NIH Study Section MSFB ad hoc Member
7/2009	NIH Study Section ZRG1 BST-M 58 ad hoc Member
1/2008	NIH Study Section BBM ad hoc Member
7/2006	NIH Study Section ZRG1 F01R ad hoc Member
3/2006	NIH Study Section ZRG1 F04B-P ad hoc Member
5/2002	Research Corporation Research Innovation Award
1/1997	NIH/NRSA Postdoctoral Fellowship
6/1996	1996 UCLA Best Physical Chemistry Dissertation Award
3/1996	UCLA Graduate Division dissertation grant
9/1995	UCLA Department of Chemistry and Biochemistry travel grant
10/1994	Bauer prize for excellence in graduate research
8/1994	UCLA Department of Chemistry and Biochemistry travel grant
10/1992	UCLA Award for outstanding first year chemistry graduate student
5/1991	Occidental College chemistry comprehensive exams passed with distinction
8/1990	Alpha Chi Sigma national award for outstanding professional service (Tutoring Program)
5/1987	Damien AP Physics Award
4/1987	Academic Olympiad: Science Gold Medallist

SCHOLARSHIP

GRANTS – EXTERNAL

3/2010-7/2011 ***$32,000*** ***Sole Principal Investigator***

National Institutes of Health: NIGMS R01 GM071684 — PI: David S. Talaga
ARRA Supplement "New statistical tools for single molecule experiments"

4/2007-3/2009 ***$290,913*** ***1 of 9 Co-Investigators***

National Institutes of Health: NCRR S10 RR022375 — PI: Ronald M Levy
"Computer Cluster for Computational and Structural Biology"

9/2006-8/2012 ***$1,000,000*** ***Co-Principal Investigator***

National Science Foundation: Nanoscale Integrative Research Team (NIRT) Grant. — PI: Prabhas Moghe
"NIRT: Ligand Nanodisplay for Cellular Internalization and Super-Activation"

9/2006-8/2011 ***$3,500,000*** ***1 of 35 Participating Investigators***

National Science Foundation: IGERT Graduate Training Grant — PI: Fernando Muzio
"IGERT in Nanopharmaceuticals"

8/2004-8/2011 ***$1,135,000*** ***Sole Principal Investigator***

National Institutes of Health: NIGMS R01 GM071684 — PI: David S. Talaga
"New statistical tools for single molecule experiments"

8/2004-7/2007 ***$146,000*** ***Principal Investigator/Fellowship Sponsor***

National Institutes of Health; (National Research Services Award.)
"Function and Conformation in Glucose Binding Protein" — Fellow: Troy Messina

10/2003-8/2008 ***$4,200,000*** ***1 of 29 Participating Investigators***

National Science Foundation (IGERT) Graduate Training Grant — PI: Prabhas Moghe
"IGERT in Biointerfacial Engineering"

9/2003-8/2006 ***$874,250*** ***1 of 5 Participating Collaborators***

National Science Foundation; DBI Major Research Instrumentation — PI: Jean Baum
"Acquisition of an 800 MHz NMR Spectrometer for New Jersey Statewide Facility"

9/2002-8/2003 ***$52,254*** ***Principal Investigator/Fellowship Sponsor***

National Institutes of Health; (NRSA Senior Minority Access to Research Careers Fellowship)
"Single Molecule Studies of Unimolecular Nanocarriers" Fellow: Lawrence Johnson

9/2001-9/2004 ***$35,000*** ***Sole Principal Investigator***

Research Corporation; Research Innovation Award — PI: David S. Talaga
"Single Molecule Conformational Trajectories Reconstructed from Multi-Dim. Fluorescence by HMM."

1/1997-1/2000 ***$82,700*** ***NIH NRSA Postdoctoral Fellow***

National Institutes of Health; (NRSA) F32GM185892
"Events in DNA 2° Structural Changes by Time-Resolved IR" Sponsor: Robin M. Hochstrasser

GRANTS – INTERNAL

7/2003-5/2005 ***$20,000*** ***Sole Principal Investigator***

Busch Biomedical Research Advisory Committee

5/2003	***$1,930***	***Sole Principal Investigator***
Rutgers Research Council		
5/2002	***$3,432***	***Sole Principal Investigator***
Rutgers Research Council		

PUBLICATIONS — 2003–2013

Vitarelli MJ Jr, Talaga DS: **Theoretical models for electrochemical impedance spectroscopy and local zeta-potential of unfolded proteins in nanopores**. *Journal of Chemical Physics* 2013, **139**:105101. doi:10.1063/1.4819470

Vishnyakov A, Talaga DS, Neimark AV: **DPD Simulation of Protein Conformations: From alpha-Helices to beta-Structures**. *Journal of Physical Chemistry Letters* 2012, **3**:3081–3087. doi:10.1021/jz301277b

Vitarelli MJ Jr, Prakash S, Talaga DS: **Determining Nanocapillary Geometry from Electrochemical Impedance Spectroscopy Using a Variable Topology Network Circuit Model**. *Analytical Chemistry* 2011, **83**:533–541. doi:10.1021/ac102236k

Ledden B, Fologea D, Talaga DS, Li J: **Sensing Single Protein Molecules with Solid-State Nanopores**. In *Nanopores: Sensing and Fundamental Biological Interactions*. Edited by Iqbal SM, Bashir R. New York, NY; 2011:129–150. Chapter 6

Li J, Talaga DS: **The distribution of DNA translocation times in solid-state nanopores**. *Journal of Physics-Condensed Matter* 2010, **22.** doi:10.1088/0953-8984/22/45/454129

Pronchik J, He X, Giurleo JT, Talaga DS: **In Vitro Formation of Amyloid from alpha-Synuclein Is Dominated by Reactions at Hydrophobic Interfaces**. *Journal of the American Chemical Society* 2010, **132**:9797–9803. (Nature:Chemistry News) Supp Info doi:10.1021/ja102896h

He X, Giurleo JT, Talaga DS: **Role of Small Oligomers on the Amyloidogenic Aggregation Free-Energy Landscape**. *Journal of Molecular Biology* 2010, **395**:134–154. doi:10.1016/j.jmb.2009.10.019

Talaga DS, Li J: **Single-Molecule Protein Unfolding in Solid State Nanopores**. *Journal of the American Chemical Society* 2009, **131**:9287–9297. Supp Info doi:10.1021/ja901088b

Talaga DS: **Information-Theoretical Analysis of Time-Correlated Single-Photon Counting Measurements of Single Molecules**. *Journal of Physical Chemistry A* 2009, **113**:5251–5263. (Cover)**.** Supp Info doi:10.1021/jp8082908

Pronchik J, Giurleo JT, Talaga DS: **Separation and analysis of dynamic stokes shift with multiple fluorescence environments: Coumarin 153 in bovine ß-lactoglobulin A**. *Journal of Physical Chemistry B* 2008, **112**:11422–11434. Supp Info doi:10.1021/jp802666n

Giurleo JT, He X, Talaga DS: ***ß*-lactoglobulin assembles into amyloid through sequential aggregated intermediates**. *Journal of Molecular Biology* 2008, **381**:1332–1348. (Cover). doi:10.1016/j.jmb.2008.06.043

Giurleo JT, Talaga DS: **Global fitting without a global model: Regularization based on the continuity of the evolution of parameter distributions**. *Journal of Chemical Physics* 2008, **128**. doi:10.1063/1.2837293

Talaga DS: **Markov processes in single molecule fluorescence**. *Current Opinion in Colloid \& Interface Science* 2007, **12**:285–296. doi:10.1016/j.cocis.2007.08.014

Messina TC, Talaga DS: **Protein free energy landscapes remodeled by ligand binding**. *Biophysical Journal* 2007, **93**:579–585. doi:10.1529/biophysj.107.103911

Messina TC, Kim H, Giurleo JT, Talaga DS: **Hidden Markov model analysis of multichromophore photobleaching**. *Journal of Physical Chemistry B* 2006, **110**:16366–16376. doi:10.1021/jp063367k

Talaga DS: **Information theoretical approach to single-molecule experimental design and interpretation**. *Journal of Physical Chemistry A* 2006, **110**:9743–9757. doi:10.1021/jp062192b

Andrec M, Levy RM, Talaga DS: **Direct determination of kinetic rates from single-molecule photon arrival trajectories using hidden Markov models**. *Journal of Physical Chemistry A* 2003, **107**:7454–7464. doi:10.1021/jp035514+

PUBLICATIONS — 1993–2002

Talaga DS, Jia Y, Bopp M, Sytnik A, DeGrado WA, Cogdell RJ, Hochstrasser RM: **Single-molecule dynamics associated with protein folding and deformations of light-harvesting complexes** *Springer Series in Chemical Physics* 2001, **67**(Single Molecule Spectroscopy), 313-325. ***ISBN:3540424539***

Talaga DS, Zink JI: **Symmetry and local mode coupling in absorption and Raman spectroscopy of intervalence electronic transitions**. *Journal of Physical Chemistry A* 2001, **105**:10511–10519. Supp. Mat. doi:10.1021/jp089803285a

Talaga DS, Lau WL, Roder H, Tang JY, Jia YW, DeGrado WF, Hochstrasser RM: **Dynamics and folding of single two-stranded coiled-coil peptides studied by fluorescent energy transfer confocal microscopy**. *Proc Natl Acad Sci U S A* 2000, **97**:13021–13026. http://www.pnas.org/cgi/reprint/97/24/13021

Jia YW, Talaga DS, Lau WL, Lu H, DeGrado WF, Hochstrasser RM: **Folding dynamics of single GCN4 peptides by fluorescence resonant energy transfer confocal microscopy**. *Chemical Physics* 1999, **247**:69–83 doi:10.1016/S0301-0104(99)00127-5

Talaga DS, Hanna SD, Zink JI: **Luminescent photofragments of (1,1,1,5,5,5-hexafluoro-2,4-pentanedionato) metal complexes in the gas phase**. *Inorganic Chemistry* 1998, **37**:2880–2887. doi:10.1021/ic971340x

Cheon J, Talaga DS, Zink JI: **Photochemical deposition of ZnS from the gas phase and simultaneous luminescence detection of photofragments from a single-source precursor, Zn(S(2)COCHMe(2))(2)**. *Journal of the American Chemical Society* 1997, **119**:163–168. doi: 10.1021/ja9625891

Cheon JW, Talaga DS, Zink JI: **Laser and thermal vapor deposition of metal sulfide (NiS, PdS) films and in situ gas-phase luminescence of photofragments from M(S2COCHMe2)(2)**. *Chemistry of Materials* 1997, **9**:1208–1212. doi: 10.1021/cm960589u

Talaga DS, Zink JI: **Copper fluoride luminescence during UV photofragmentation of bis(1,1,1,5,5,5-hexafluoro-2,4-pentanedionato)copper(II) in the gas phase**. *Inorganic Chemistry* 1996, **35**:5050–5054. doi:10.1021/ic9515362

Talaga DS, Zink JI: **Choosing a model and appropriate transition dipole moments for time-dependent calculations of intervalence electronic transitions**. *Journal of Physical Chemistry* 1996, **100**:8712–8721. doi:10.1021/jp951165a

Talaga DS, Reber C, Zink JI: **Time-Dependent Theoretical Treatment of Intervalence Absorption-Spectra - Exact Calculations in a One-Dimensional Model - Comments - Reply**. *Journal of Physical Chemistry* 1994, **98**:11233–11235. doi: 10.1021/j100094a036

Simoni E, Reber C, Talaga DS, Zink JI: **Time-Dependent Theoretical Treatment 0f Intervalence Absorption-Spectra - Exact Calculations in a One-Dimensional Model**. *Journal of Physical Chemistry* 1993, **97**:12678–12684. doi:10.1021/j100151a009

Pending Publications (2013 ···)

Influence of a highly hydrophobic interface on the conformation of alpha-synuclein
Robert Booth, Michael Muñoz, Yuliana Cardenas, Marlenne Delgado, David S. Talaga

Initial dimerization step of α-synuclein leading to amyloid formation is promoted by hydrophobic interfaces
Jeremy Pronchik, David S. Talaga

Aggregation of β-lactoglobulin molecules detected using a solid-state nanopore
David S. Talaga, Jiali Li

Reconstruction of Single Molecule Langevin Dynamics using Hidden Markov Models.
Troy C. Messina, Cheng-Yen Huang, David S. Talaga

Ligand-Modulated Free Energy Landscapes of Glucose/Galactose Binding Protein: Directly Linking Molecular Dynamics Simulation and Fluorescence Experiments.
Troy C. Messina, Emilio Gallicchio, Ronald M. Levy, David S. Talaga

Exploring αSyn with covalently attached fluorophores using time-resolved and single molecule spectroscopy
Jason T. Giurleo, Jeremy Pronchik, Xianglan He, David S. Talaga

Association of α-synuclein with surfactants via tyrosine fluorescence
Jason T. Giurleo, David S. Talaga

Amyloidogenic aggregation of wild-type α-synuclein via intrinsic tyrosine fluorescence
Jason T. Giurleo, David S. Talaga

Shape of Single SiNx Nanopores from Electrochemical Impedance Spectroscopy
Michael J. Vitarelli Jr., and David S. Talaga

Doctoral Students

Dr. Jason T. Giurleo (2008)

Dr. Jeremy Pronchik (2010)

Dr. Xianglan He (2012)

Dr. Michael Vitarelli Jr. (2013)

Invited Departmental Seminars

Brigham-Young University
University of Maryland, College Park
University of Wisconsin, Madison
University of California, Riverside
Brooklyn College, CUNY
University of Toronto
Boston University
Monmouth University
New York University
Chapman University
Montclair State University
National Institutes of Health
University of Pennsylvania
University of California, Santa Cruz
Stanford University
University of Arkansas
North Carolina State University
University of Rochester
Rutgers, The State University of New Jersey, New Brunswick
Carnegie Mellon University
Washington University, St. Louis
Worcester Polytechnic Institute
Syracuse University
Weill-Cornell Medical School

Conference Presentations & Lectures, Published Abstracts

DPD Simulation of Protein Conformations: From Alpha-Helices to Beta-Structures

Aleksey Vishnyakov, David S. Talaga, Alexander V. Neimark
AICHE Annual Meeting — Computational Molecular Science and Engineering Forum — November 3-8 (2013)

Electrochemical Impedance Spectroscopy of Nanopores

David S. Talaga, Michael J. Vitarelli, Jr.
Biophysical Society Meeting February 2-6 (2013)

Electrochemical Impedance Spectroscopy of Nanopores

David S. Talaga, Michael J. Vitarelli, Jr.
Aspen Center for Physics conference on Single Molecule Biophysics January 6-13 (2013)

Characterization of Idealized Helical Repeat Proteins in Silicon Nitride Nanopores

Jiali Li, Bradly Ledden, David S. Talaga, Aitziber Cortajarena, Lynne Regan
American Physical Society, APS March Meeting 2012, February 27-March 2 (2012)

Biophysical and single molecule approaches to protein aggregation and amyloid formation

David S. Talaga.
242nd ACS National Meeting, Denver, CO, United States, August 28-September 1 (2011)

Artificial ion channel studies of the unfolding and aggregation of ß-lactoglobulin

David S. Talaga, Bradley Ledden, Jiali Li, Lynne Regan, Aitziber Lopez-Cortajarena
Aspen Center for Physics conference on Single Molecule Biophysics January 8-16 (2011)

Artificial ion channel studies of the unfolding and aggregation of ß-lactoglobulin

David S. Talaga
Gordon Research Conference on Single Molecule Approaches to Biology Il Cioco, Italy (2010)

Information theory resolution limits and hidden Markov model analysis of single molecule fluorescence

David S. Talaga
American Physical Society, Portland, OR, U.S.A., March (2010).

Free Energy Landscapes & Amyloidogenic Protein Aggregation

David S. Talaga
Biophysical Society Meeting, San Francisco, CA (2010)

Solid-State Nanopore Translocation of idealized Helical Repeat Proteins

Bradley Ledden, Aitziber Lopez Cortajarena, Lynne Regan, David S. Talaga, Jiali Li
Biophysical Society Meeting, San Francisco, CA (2010)

Information theory and single molecules

David S. Talaga
Telluride workshop on Single Molecule Dynamics (2009)

Folded and unfolded single proteins analyzed by their solid state nanopore translocation dynamics

David S. Talaga, Jiali Li
Biophysical Society Meeting (2009)

Folded and unfolded single proteins analyzed by their solid state nanopore translocation dynamics

David S. Talaga, Jiali Li
Gordon Research Conference on Single Molecule Approaches to Biology (2008)

Protein Aggregates Platform Session Chair

David S. Talaga
Biophysical Society Meeting, Long beach, CA, February 3 (2008)

Sequential Conformational Changes Occurring During Aggregation of Amyloidogenic Proteins

David S. Talaga, Jason T. Giurleo, Xianglan He.
Biophysical Society Meeting, Long beach, CA, February 3 (2008)

Single molecule studies of protein conformational dynamics

David S. Talaga
Abstracts, 234th ACS National Meeting, Boston, MA, United States, August 19-23 (2007)

Shallow free energy landscapes remodeled by ligand binding in glucose/galactose binding protein

Troy Messina, David S. Talaga, Emilio Gallichio, Ronald Levy
Abstracts, 234th ACS National Meeting, Boston, MA, United States, August 19-23 (2007)

Fluorescence probe of globular protein dynamics

Jeremy N. Pronchik, David S. Talaga, Troy C. Messina
Abstracts, 234th ACS National Meeting, Boston, MA, United States, August 19-23 (2007)

Effects of ionic liquids on intramolecular electron transfer.

Youssef Issa, Heather Lee, James F. Wichart, Edward W. Castnerm, David S. Talaga, Stephan S. Isied
Abstracts, 232nd ACS National Meeting, San Francisco, CA, United States, Sept. 10-14 (2006)

Single-molecule Polyproline Isomerization by Fluorescence Quenching due to Short-range Electron Transfer

David S. Talaga
Gordon Research Conference on Single Molecule Approaches to Biology (2006)

Single molecule studies of protein conformational dynamics

David S. Talaga
Abstracts, 234th ACS National Meeting, Boston, MA, United States, August 19-23 (2007)

Single Molecule Measurement of Fast Folding Proteins Using FRET Confocal Microscopy

Jongjin Jung, Hiyun Kim, Troy C. Messina, Jason T. Giurleo, David S. Talaga
Abstracts, 37th Middle Atlantic Regional Meeting of the ACS, New Brunswick, NJ, U.S.A., May 22-25 (2005)

Trans/Cis Proline Isomerization in Different Solvents Studied by Fluorescence Quenching due to Intramolecular Electron Transfer

Youssef Issa, David S. Talaga, Edward W. Castner, Stephan S. Isied
Abstracts, 37th Middle Atlantic Regional Meeting of the ACS, New Brunswick, NJ, U.S.A., May 22-25 (2005)

Formulating a Mechanism of Amyloid Growth using Single Molecule Spectroscopy

Jason T. Giurleo, Troy C. Messina, Hiyun Kim, Jongjin Jung, David S. Talaga
Abstracts, 37th Middle Atlantic Regional Meeting of the ACS, New Brunswick, NJ, U.S.A., May 22-25 (2005)

Single molecule studies of protein conformational dynamics

David S. Talaga
Abstracts, 37th Middle Atlantic Regional Meeting of the ACS, New Brunswick, NJ, U.S.A., May 22-25 (2005)

Identifying the mechanism for amyloid formation using single molecule spectroscopy

Troy C. Messina, Jason T. Giurleo, David S. Talaga
Abs. Pap. Amer. Chem. Soc. 229:595-PHYS U794-U794. (*2005*)

Identifying the mechanism for amyloid formation using single molecule spectroscopy

Troy C. Messina, Jason T. Giurleo, David S. Talaga
American Physical Society, Long Beach, CA, U.S.A., March (2005)

Single Molecule Protein Folding/Misfolding and Assembly into Amyloid

David S. Talaga
Aspen Center for Physics conference on Single Molecule Biophysics January 2-8 (2005)

Single molecules and single photons: Resolution limits from information theory

David S. Talaga, Troy C. Messina, Jason T. Giurleo, Hiyun Kim, Jongjin Jung
Abstracts of Papers, 228th ACS National Meeting, Philadelphia, PA, U.S.A., August 22-26 (2004)

Polyproline isomerization probed by single-molecule photo-induced electron transfer

Hiyun Kim, Youssef Issa, Jongjin Jung, Jason T. Giurleo, Troy Messina, David S. Talaga
Abstracts of Papers, 228th ACS National Meeting, Philadelphia, PA, U.S.A., August 22-26 (2004)

Optimized fluorophore counting on multiple-labeled dextran and aggregating single-labeled protein using Hidden Markov Models

Troy Messina, Jason T. Giurleo, Jongjin Jung, Hiyun Kim, Ben Strangfeld, David S. Talaga
Abstracts of Papers, 228th ACS National Meeting, Philadelphia, PA, U.S.A., August 22-26 (2004)

Determining amyloid particle size distributions by dynamic light scattering

Ben R. Strangfeld, Jason T. Giurleo, David S. Talaga
Abstracts of Papers, 228th ACS National Meeting, Philadelphia, PA, U.S.A., August 22-26 (2004)

Determining a mechanism of amyloid growth using single molecule spectroscopy

Jason T. Giurleo, Troy Messina, Ben Strangfeld, Hiyun Kim, Jongjin Jung, David S. Talaga
Abstracts of Papers, 228th ACS National Meeting, Philadelphia, PA, U.S.A., August 22-26 (2004)

Determination of single quantum dot kinetic models from photon trajectories and fluorescence lifetimes using hidden Markov models

Jongjin Jung, Hiyun Kim, Troy c. Messina, Jason T. Giurleo, David S. Talaga
Abstracts of Papers, 228th ACS National Meeting, Philadelphia, PA, U.S.A., August 22-26 (2004)

Hidden Markov Model Analysis of Single Molecule Photon Arrival Time Trajectories

David S. Talaga
20th IUPAC Conf. on Photochemistry Granada 17-22 July (2004): Single molecule/ Single cell spectroscopy

Single molecule studies of the conformational dependence of electron transfer through peptides.

Kim, Hiyun; Issa, Youssef; Jung, Jong Jin; Giurleo, Jason; Hou, Yanwen; Isied, Stephan S.; Talaga, David S.
Abstracts of Papers, 226th ACS National Meeting, New York, NY, U.S.A., September 7-11 (2003)

Amyloid self-assembly studied using single molecule Brownian motion spectroscopy

Jason Giurleo, Ben Strangfeld, Hiyun Kim, Jin Jung, Yanwen Hou, David S. Talaga
Abstracts of Papers, 226th ACS National Meeting, New York, NY, U.S.A., September 7-11 (2003)

New developments in multi-parameter fluorescence studies of single molecules

Yanwen Hou, Jason T. Giurleo, Hiyun Kim, Jongjin Jung, David S. Talaga
Abstracts of Papers, 226th ACS National Meeting, New York, NY, U.S.A., September 7-11 (2003)

Particle-size distributions during self-assembly of ß-lactoglobulin into amyloid fibrils

Jason T. Giurleo, Ben R. Strangfeld, David S. Talaga
Abstract #381, 36th Middle Atlantic Regional Meeting of the ACS, Princeton, NJ, U.S.A., June 8-11 (2003)

Probing environments of single TMR molecules by time-correlated single photon counting (TCSPC) techniques

Yanwen Hou, Youssef Issa, Hiyun Kim, Stephan S. Isied, David S. Talaga
Abstract #370, 36th Middle Atlantic Regional Meeting of the ACS, Princeton, NJ, U.S.A., June 8-11 (2003)

Single-molecule polyproline isomerization by fluorescence quenching due to short-range electron transfer

Hiyun Kim, Youssef B. Issa, David S. Talaga, Stephen S. Isied
Abstract #369, 36th Middle Atlantic Regional Meeting of the ACS, Princeton, NJ, U.S.A., June 8-11 (2003)

Hidden Markov models applied to time correlated single photon trajectories of single molecules

David S. Talaga
Abstracts of Papers – American Chemical Society (2001), 221st.

Folding and unfolding of single proteins

Robin Hochstrasser, David S. Talaga, Yiwei Jia, William A. DeGrado
Book of Abstracts, 219th ACS National Meeting, San Francisco, CA, March 26-30 (2000)

Gas phase photofragmentation of metal chelates and luminescent identification of photoproducts

David S. Talaga, Jeffrey I. Zink
Book of Abstracts, 211th ACS National Meeting, New Orleans, LA, March 24-28 (1996)

Wave packets, potential surfaces, and photo-induced intramolecular electron transfer spectroscopy

Jeffrey I. Zink, David S. Talaga, Jeffrey L. Wootton
Book of Abstracts, 210th ACS National Meeting, Chicago, IL, August 20-24 (1995), (Pt. 1)

TEACHING (COURSES TAUGHT)

Graduate Chemical Thermodynamics

This graduate and senior undergraduate course takes a probability-based approach to the two laws of thermodynamics. This approach develops understanding of the molecular basis of chemical properties like solubility, vapor pressure, surface tension, miscibility, equilibrium, phase separation, elasticity, ligand binding curves, cooperativity, polymer properties, protein folding, and more. Often in the laboratory we cannot conveniently measure the property we want to know; thermodynamics can allow us to convert the results of a convenient measurement to the inconvenient property we desire. Students in the course learn to use the software package Mathematica to derive and implement the formulas needed to make such conversions. Using those formulas students analyze experimental data to illustrate and practice thermodynamic analyses.

General Education Chemistry: Lecture and Laboratory

This is a general education laboratory science course for non-science majors. The course covers basic topics in chemistry including stoichiometry, valence electrons, Lewis structures, electronegativity and bonding, VSEPR theory, factors influencing reaction rates, gases, phases of matter, and periodic trends. The course also covers topical material that is selected by the students using an online poll. Laboratory was coordinated with course content.

Anonymous Student Comments (Montclair Evaluations):

- "Clear throughout course"
- "Class was very enjoyable and knowledgable. Topics were related to things we would comprehend more so than just some chemical names"
- "Good job! Would take this professor again"
- "The lab was really early in the morning @ 8:30, it was just hard to wake up. Overall, the lab helped understand the fundamentals of the course."
- "If I had the time to go on about how knowledgable Professor Talaga is, I would. I admire that I was able to take a class from a professor of his caliber. He was a brilliant reference to base my ideas on controversial matters that I will come across later in life. I would agree that his testing methods are a little harsh for such a low level chemistry class, but I appreciate the challenge he provided me with that I find rare with most other professors at this university.
- "(Talaga) The professor is very interesting but is extremely hard for a chem 100 class. Would never take this course again"
- "Lab and lecture were well ran and organized. Material in both classes were present in great detail and in an interesting manner."

General Chemistry I: Lecture and Laboratory

Traditional approach to General Chemistry covering: units, dimensional analysis, measurements, error, significant figures, atomic theory, nomenclature for simple compounds, periodic trends, mole, percent composition, balancing equations, determining formulas, stoichiometric calculations, acids/bases, redox reactions, ideal gases, enthalpy, calorimetry, the First Law of Thermodynamics, Hess's Law, atomic structure and periodic trends, atomic quantum numbers, atomic orbitals, electronegativity and bonding, Lewis Structures, VSEPR theory, valence bond theory and orbital hybridization, MO theory of diatomic molecules. Laboratory and course were coordinated.

Anonymous Student Comments (Montclair Evaluations):

- "Excellent Professor"
- "Talaga presented a hard to approach front. Made course more complicated than text presented."
- "Professor Talaga is very good at explaining lab and course. He is a great professor."
- "He is very helpful and wants his students to do good."
- "Was a tough teacher but taught well"
- "I thought the course could've been more understandable at a lower pace"
- "could have taught at a slower pace so students can understand clearly."
- "He was amazing and very helpful throughout the whole semester."

Biophysical Chemistry MAJOR REVISION OF COURSE

Biophysical Chemistry is a second course in physical chemistry that builds on the material (primarily thermodynamics) that was presented in Physical Chemistry I, but is focussed on those topics and applications most relevant to biochemistry. The curriculum for this class was designed from scratch. First, a list was generated of all the topics in physical biochemistry that a B.S. graduate would be well served to know. Colleagues were then consulted about what they cover in the other upper division courses required for the biochemistry and redundant topics were removed. The remaining topics served as the rough initial outline for the course and provided a template for selecting an appropriate textbook. An experimental focus was taken with the thought that most biochemists need physical chemistry in the context of the experimental methods they use. This material was supplemented by chapters of a traditional physical chemistry for biochemists textbook to round out the topics for the course.

Statistical Mechanics MAJOR REVISION OF COURSE (first offering of course in many years)

This introductory graduate course/advanced undergraduate course builds on the simple results using the partition function. It examines "bead" models of polymers and proteins and their structural transformations. Phase transitions in polymers and proteins are treated. Concepts in molecular aggregation and solvation, correlation functions, transport properties, reaction rate theory, and Kramers theory are developed.

Physical Chemistry I

Quantum mechanics, spectroscopy, kinetics.

Physical Chemistry II REVISION OF CURRICULUM TO 'QUANTUM FIRST' APPROACH

Thermodynamics, statistical mechanics.

Chemical Applications of Group Theory MAJOR REVISION OF COURSE

This introductory graduate course/advanced undergraduate course introduces the use of symmetry to analyze the structure of molecules through their electronic and vibrational spectra. Group theory is applied to molecular orbital theory along with symmetry-based reaction selection rules to understand the impact of symmetry on chemical reactivity.

Molecular Spectroscopy and Quantum Mechanics MAJOR REVISION OF COURSE

This introductory graduate course/advanced undergraduate course introduces quantum mechanical principles through the use of spectroscopic examples. The focus is on solution of the electronic and vibrational Hamiltonians, operators, state energies, transition energies and selection rules arising from the semi-classical picture of spectroscopy. Time dependent quantum mechanics is introduced in a wave packet formalism where spectra are calculated as the Fourier transform of dipole correlation functions.

Statistical Thermodynamics MAJOR REVISION OF COURSE

This introductory graduate course/advanced undergraduate course starts from simple statements of the first and second law of thermodynamics and shows how the Boltzmann factors and partition function arise naturally from these laws. The course primarily uses lattice models to illustrate the concepts of phase transitions, solubility, miscibility, colligative properties, deviations from ideality, regular solution theory, ideal polymer behavior, real polymer behavior, ligand binding, and cooperativity.

DEVELOPMENT OF MATHEMATICA-BASED PROBLEMS

CREATED "THERMOWIKI" FOR GROUP PROBLEM SOLVING: SITE DESIGN, CONTENT MANAGEMENT, SERVER ADMINISTRATION

Physical Chemistry Laboratory

Experiments and data analysis in physical chemistry. Experiments included: AFM, FTIR, Speed of Sound, Magnetic Susceptibility, NMR Relaxation, Kinetics, UV-Vis, Laser Initiated electron transfer kinetics, Quantum Structure Calculations, and NMR chemical shift prediction.

REVISION OF "LASER-INDUCED ELECTRON-TRANSFER KINETICS"

MODULE CREATED "STATISTICS AND ERROR ANALYSIS" MODULE

TEACHING (TECHNOLOGICAL INNOVATIONS)

Classroom Technology for Active Learning: Random Caller Software Package

Developed a new software package that allows the instructor to randomly choose a student to answer a question in the class.

The software can record a grade for each question, providing a record of student in-class participation and performance. The algorithm weights the random calling by number of questions answered so that at any time all students can be called upon, but over time all students will be asked nearly the same number of questions. Operationally, cold-calling techniques consists of the entire class being asked a question. There is a pause to allow the students to consider the question and perhaps write out an answer. The computer then randomly selects a student to answer the question.

This approach creates engagement of all students since any one of them can be called. Incorrect answers reveal common errors, drive discussion of the questions asked, and are given significant in-class credit.

Co-construction of knowledge through online homework collaborative writing

Deployed an implementation of MediaWIKI (the software package used by Wikipedia) to facilitate the joint solution of complex problems in Statistical Thermodynamics. Students were assigned open-ended problems online and were asked to solve the problems by composing a written entry together for the question. The MediaWIKI software kept track of the edits from the various students.

Students were graded according to their contributions to and documentation of the solution. They also gained points if they proposed alternate solutions or expanded solutions by eliminating key assumptions.