CHRISTIAN APONTE-RIVERA
Assistant Professor
Biomedical and Chemical Engineering Department, Syracuse University
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EDUCATION

Ph.D. Cornell University — Fall 2017
Robert Frederick Smith School of Chemical and Biomolecular engineering

M.Sc. Cornell University — Fall 2015
Robert Frederick Smith School of Chemical and Biomolecular engineering

B.S. University of Puerto Rico, Magna Cum Laude — Spring 2012
Chemical Engineering Department

PUBLICATIONS ("*" Denotes corresponding authors.)

Published

1. **Christian Aponte-Rivera*,** Andrew Wijesekera, Ting Ge*. (2025) Nanoparticle Induced Hydrodynamic Flows in Unentangled Polymer Melts. *Macromolecules* 58, no. 17 (2025): 9010–17. https://doi.org/10.1021/acs.macromol.5c00743.
2. **Christian Aponte-Rivera*.** Start-up flow of nanoscale particles and their periodic arrays: Insights from fundamental solutions of the unsteady stokes equations. *Nanoscale* **17**, 12727–12737 (2025).
    - ***Featured in the Nanoscale 2025 Emerging Investigators themed collection***
3. Emma Gonzalez, **Christian Aponte-Rivera,** Roseanna Zia*. (2021) Impact of polydispersity and confinement on diffusion in hydrodynamically interacting colloidal suspensions, *Journal of Fluid Mechanics*, 925, A35. doi:10.1017/jfm.2021.563
4. **Christian Aponte-Rivera,** Roseanna N. Zia*. (2022) The confined Generalized Stokes-Einstein relation and its consequence on intracellular two-point microrheology. *Journal of Colloid and Interface Science* **609**, 423–433
5. **Christian Aponte-Rivera**, Michael Rubinstein*. (2021) Dynamic Coupling in Unentangled Liquid Coacervates Formed by Oppositely Charged Polyelectrolytes, *Macromolecules*. 54(4):1783–1800.
6. **Christian Aponte-Rivera,** Yu Su, Roseanna N. Zia*. (2018) Equilibrium structure and diffusion in concentrated, hydrodynamically interacting suspensions confined by a spherical cavity, *Journal of Fluid Mechanics* 836:413–50.
7. **Christian Aponte-Rivera,** Roseanna N. Zia*. (2016) Simulation of hydrodynamically interacting particles confined by a spherical cavity, *Physical Review Fluids*. 1(2):023301.

EXTERNAL FUNDING

- **2025 Binational Science Foundation Seed Grant (co-PI, $180,000 award)**
    - Beyond Mean-Field approximations for Intrinsically Disordered Proteins: The effect of Bond Vector Correlations on Protein Conformations

- **2023 Petroleum Research Fund New Doctoral Investigator award (PI, $110,000 award)**
    - Proposal title: Transport and Rheology in Hydrodynamically Interacting Unentangled Polymer Nanocomposites.
- **2023 SBU-BNL Seed grant (PI, $40,000 award)**
    - Proposal title: Polymeric Characterization of intrinsically disordered tau protein: towards a molecular understanding of aggregation in prion like proteins.

BEAMTIME PROPOSALS

- 2024 Brookhaven National Laboratory National Synchrotron Light Source II
    - Proposal title: Polymeric Characterization of Intrinsically Disordered Tau Protein via Small Angle X-Ray Scattering

RESEARCH EXPERIENCE

Assistant Professor Aug 2025–Present 2025
Syracuse University
Biomedical and Chemical Engineering Department

Assistant Professor Jan 2025–Aug 2025
Stony Brook University
Department of Chemistry

IDEA Fellow Jan 2023–Jan 2025
Stony Brook University
Department of Chemistry
Independent research fellow

Postdoctoral Associate Jan 2018–Dec 2022
Duke University
Supervisor: Prof. Michael Rubinstein
Department of Mechanical Engineering and Material Science

- Developed a scaling theory to predict the dynamics of unentangled and entangled asymmetric liquid coacervates made from oppositely charged polyelectrolytes.
- Scaling theory of polyelectrolytes in solution: Developed scaling theory to predict the average shape of polyelectrolytes in solution.

Graduate Student Aug 2012–Dec 2017
Cornell University
Advisor: Prof. Roseanna N. Zia
Thesis: Spherically Confined Suspension of Hydrodynamically interacting particles: A model for intracellular transport
Robert Frederick Smith School of Chemical and Biomolecular Engineering

- Developed a simulation method to model spherically confined colloidal suspensions and rigorously account for many-body and lubrication hydrodynamic interactions.
- Calculated the short- and long-time transport properties of spherically confined colloids, finding behaviors that are qualitatively different from those of unbound suspension.

- Developed a "Confined Generalized Stokes Einstein Relation" that accounts for the effects of confinement in confined biophysical systems, such as the crowded cell interior.

ACADEMIC HONORS

1. Featured in the Nanoscale 2025 Emerging Investigators Themed Collection
2. Inducted into the Bouchet Graduate Honor Society, Spring 2018
3. The Ephrahim Garcia Graduate Student Excellence in Mentoring Award, Cornell University Fall 2018
4. NSF Graduate Research Fellowship (NSF-GRFP), Spring 2013
5. Colman Graduate Fellowship, Cornell University Fall 2012
6. Sage Fellowship, Cornell University Fall 2012
7. Magna Cum Laude Laureate, University of Puerto Rico, Mayagüez Campus Spring 2012
8. ExxonMobil Tech Scholar
9. Kimberly Clark Scholarship
10. Inducted into the Tau Beta Pi Honor Society

INVITED SEMINARS

- **"Revisiting early assumptions in polymer physics: from polyelectrolyte conformations to nanoparticle dynamics."** Department of Chemistry and Biochemistry, University of South Carolina. April 2024.
- **"Quantifying shape asymmetry of polyelectrolytes in dilute solution"** Institute of Advanced Computational Science (IACS), Stony Brook University. April 2023.

TEACHING EXPERIENCE

- Instructor. Heat and Mass Transfer Operations. (Fall 2025). Syracuse University.
- Co-Instructor. Molecular Science I. (Fall 2024, Fall 2023). Stony Brook University.
    - Lectured. Graded exams and homework. Held office hours and recitations.
- Co-Instructor. Physical Chemistry II. (Spring 2024, Spring 2023). Stony Brook University.
    - Graded exams and homework. Held office hours and recitations.
- Teaching Assistant. Fundamentals of Soft Matter. (Spring 2022). Duke University.
    - Graded exams and homework. Conducted recitations. Held office hours.
- Teaching Assistant. Intermediate Polymer Physics. (Fall 2019, Fall 2018). Duke University.
    - Graded exams and homework. Conducted recitations. Held office hours.
- Teaching Assistant. Engineering Fluid Mechanics. Spring 2016. Cornell University.
    - Designed new homework problems and exams. Held recitations and office hours.

MENTORING EXPERIENCE

- PhD thesis co-advisor to Stony Brook Chemistry Graduate Students
- Co-supervised the senior thesis of a Duke University undergraduate student – Thesis title: Predicting Intrinsically Disordered Protein Conformations Using Polyampholyte Theory.
- Postdoc mentor of undergraduate researcher in the Rubinstein group at Duke University – The student conducted simulations of semiflexible polymers.
- Postdoc mentor of summer REU student at Duke University – The student conducted simulations of symmetric coacervates made from oppositely charged polyelectrolytes.

- Postdoc mentor of high school student as part of the NCSSM Mentoring program – Developed a research plan for the student. Taught the student basic concepts in polymer physics and how to conduct molecular dynamic simulations.
- Graduate student mentor Undergraduate Summer Research Student at Cornell University – Mentored an undergraduate research student working on the development of spherically confined Brownian dynamics simulations. Provided informal mentoring on graduate school applications.

PROFESSIONAL SERVICE

- Session Co-Chair AIChE 2025 Annual Meeting: Nano and Microscale Flows
- NSF reviewer 2024
- Chemical Biology Training Program Associate Director. Stony Brook University. Spring 2023 to Present.
- Session chair AIChE 2022 annual meeting: Chaired the 2022 American Institute of Chemical Engineers Annual Meeting Charged and Ion containing polymers session
- Session chair AIChE 2021 annual meeting: Chaired American Institute of Chemical Engineers Annual Meeting Colloidal Hydrodynamics session
- Webmaster for soft-matter.com, 2020 - 2022
    - Manage website from the International Union of Pure and Applied Physics. The website aims to disseminate information of interest to the soft matter physics community.
- Symposium organizer: Organized Graduate student and postdoc session at the Duke Soft Matter Symposium
- Graduate student recruiter for the "Keeping the Ezra Promise: Any person, any study" program at Cornell University
    - Traveled to the University of Puerto Rico and conducted interviews with promising students. Successfully recruited three students into the program.
- Poster session organizer: Organized the poster session for the 2015 Graduate Research Symposium in the Robert Frederick Smith School of Chemical and Biomolecular engineering.
- CBE Buddy program
    - Aided the departmental recruitment efforts by mentoring prospective students and first year students successfully transition into their PhD track.
- Volunteered in the Parent-Student laboratory for the Spring 2015 WOMEN'S event –Helped carry out and guide students through the Parent-Student laboratory demonstration.
- Outreach event facilitator: Led the Parent-Student laboratory for the Spring 2014 WOMEN'S event –this outreach activity aimed at recruiting female high school students and was coordinated by Cornell's Chemical and Biomolecular Engineering Department.
- Outreach module development: Developed a surface tension demonstration module for the Spring 2013 WOMEN's event.
- Graduate student mentor in Cornell University's CU Empower program
- Presenter at the Tau Beta Pi Internship Talk Series Spring 2012.
- Outreach coordinator: Led of the Tau Beta Pi Fall 2011 visit to Mayagüez Municipal Elderly Center

CONFERENCE PRESENTATIONS

- **"Hydrodynamic flows and interactions in unentangled polymer melts"** Christian Aponte-Rivera, Andrew Wijesekera, Ting Ge. APS Annual Meeting. March 2024.
- **"Shape Asymmetry of polyelectrolytes in dilute solution"** Christian Aponte-Rivera, Michael Rubinstein. APS Annual Meeting. March 2023.
- **"Constraint release in entangled liquid coacervates made from oppositely charged polyelectrolytes"** Christian Aponte-Rivera, Michael Rubinstein. International Symposium on Polyelectrolytes. March 2022. AIChE Annual Meeting, November 2022
- **"Dynamics of liquid coacervates made from oppositely charged polyelectrolytes"** Christian Aponte-Rivera, Michael Rubinstein. International Symposium on Polyelectrolytes. June 2021.
- **"Dynamics of liquid coacervates: Higher charged density polyelectrolytes are in entangled semiflexible",** Christian Aponte-Rivera, Michael Rubinstein. APS Annual Meeting, March 2021.
- **"Dynamics of liquid coacervates Part II: Higher charge density polyelectrolyte is in Entangled Semiflexible regime",** Christian Aponte-Rivera, Michael Rubinstein. AIChE Annual Meeting, November 2020. International Congress on Rheology, December 2020.
- **"Dynamics of double-semidilute entangled liquid coacervates made by oppositely charged polyelectrolytes",** Christian Aponte-Rivera, Michael Rubinstein. Virtual Polymer Physics Symposium, July 2020.
- **"Dynamics of double-semidilute entangled liquid coacervates made by oppositely charged polyelectrolytes",** Christian Aponte-Rivera, Michael Rubinstein. The Society of Rheology 91th Annual Meeting, October 2019. AIChE Annual Meeting, November 2019.
- **"Dynamics of liquid coacervates formed by oppositely charged polyelectrolytes: Effects on polymer *diffusion*",** Christian Aponte-Rivera, Michael Rubinstein. APS Annual Meeting, March 2019.
- **"Dynamics of unentangled asymmetric liquid coacervates formed by oppositely charged polyelectrolytes",** Christian Aponte-Rivera, Michael Rubinstein. The Society of Rheology 90th Annual Meeting, October 2018. AIChE Annual Meeting, November 2018.
- **"Hydrodynamic entrainment in 3D confined colloidal suspensions and its implications for two-point microrheology"**, Christian Aponte-Rivera, Roseanna N. Zia. The Society of Rheology 89th Annual Meeting, October 2017; AIChE Annual Meeting, Nov. 2017; American Physical Society 70th Annual DFD Meeting, Nov. 2017.
- **"Hydrodynamic entrainment in 3D confined colloidal suspensions"**, Christian Aponte-Rivera, Roseanna N. Zia. 90th ACS Colloid & Surface Science Symposium, June 2016; The XVIIth International Congress on Rheology (ICR2016), Aug. 2016.
- **"Hydrodynamically interacting particles confined by a spherical cavity via dynamic simulations"**, Christian Aponte-Rivera, Yu Su, Roseanna N. Zia. 89th ACS Colloid & Surface Science Symposium, June 2015; The Society of Rheology 87th Annual Meeting, Oct. 2015; AIChE Annual Meeting, November 2015; American Physical Society 68th Annual DFD Meeting, Nov. 2015.
- **"Diffusion and rheology in a suspension of hydrodynamically interacting colloids enclosed by a spherical cavity",** Christian Aponte-Rivera, Roseanna N. Zia. American Physical Society 67th Annual DFD Meeting, Nov. 2014; AIChE Annual Meeting, Nov. 2014.

POSTER PRESENTATIONS

- **"Modeling transport and rheology in polymers and particle-polymer mixtures to enable the rational design of novel soft materials"** Christian Aponte-Rivera**.** AIChE Annual Meeting**,** Meet the Faculty Candidate Poster Session November 2018.
- **"Dynamics of unentangled asymmetric liquid coacervates formed by oppositely charged polyelectrolytes",** Christian Aponte-Rivera, Michael Rubinstein. Advances in cosmetic formulation design, July 2018
- **"Diffusion in 3D confinement: A model for Intracellular transport",** Christian Aponte-Rivera, Yu Su, Roseanna N. Zia. International Fine Particles Research Institute 37th General Annual Meeting Poster Session, June 2015.
- **"Diffusion and rheology in a suspension of hydrodynamically interacting colloids enclosed by a spherical cavity",** Christian Aponte-Rivera, Roseanna N. Zia. The Society of Rheology 86th Annual Meeting, Aug. 2014; NY Complex Matter Workshop, Dec. 2014.

ADDITIONAL EXPERIENCE

MURF Scholar Jun 2011–Aug 2011
California Institute of Technology
Advisor: Prof. John F. Brady
Department of Chemical Engineering

- Studied the collective motion of osmotic motors via Brownian dynamics simulation
- Modeled the dynamics of rigid assemblies of osmotic motors, as a model for chemical gradient driven nano-carriers

Undergraduate Research Assistant Aug 2010–May 2011
University of Puerto Rico, Mayagüez Campus
Advisor: Prof. Carlos Rinaldi
Department of Chemical Engineering

- Conducted Brownian dynamic simulations of a confined magnetic nanoparticle as a model for microfluidic devices that can manipulate particles using a magnetic field

ExxonMobil Chemical Company, Baytown, Texas Aug 2011 – Dec 2011
Student Engineer
Aromatics Recovery Group, Baytown Technology and Engineering Center

- Optimized aromatic extraction units using PROII modeling software
- Designed adsorbent bed to remove corrosive components of an extraction unit
- Improved refinery/chemical plant economic training modules

Undergraduate Research Assistant Jun 2010–Jul 2010
University of Puerto Rico, Mayagüez Campus
Advisor: Prof. Carlos Rinaldi
Department of Chemical Engineering

- Characterized and optimized thermal decomposition synthesis procedure of FeO3 nanoparticles using FT-IR, DLS, TEM images, and TGA analysis to adapt procedure for multiple experiments
- Identified two silane groups that bind to ferrimagnetic nanoparticles in order to create a drug delivery nanovector that can release a drug when a magnetic field is applied

ExxonMobil Chemical Company, Baytown, Texas Jan 2010–May 2010
Student Engineer
Finishing, Baytown Area Polypropylene Division

- Conducted additive tests to certify various additives for use in extruder units
- Replaced safety equipment to ensure flow of peroxide to the extruding unit; compiled safety documentation and completed calculation to re-rate the equipment

ExxonMobil R&S, Baytown, Texas Jan 2009–May 2009
Student Engineer
Operations Support Division

- Troubleshooting equipment relevant for catalytic cracking and hydrofining
- Corrected environmental calculations in TDC code for a catalytic cracking unit

Undergraduate Research Assistant Jul 2008–Jun 2008
Argonne National Laboratory
Advisor: Dr. Liaohai Chen

- Developed a technique for the detection of stem cell marker concentration gradients within a single cell utilizing RT-PCR, in combination with molecular beacons.

Undergraduate Research Assistant Aug 2007-Dec 2007
University of Puerto Rico, Mayagüez Campus
Advisor: Prof. Luis Rivera
Department of Chemistry

- Synthesized silver nanoparticles and collaborated in the cultivation of HeLa cancer cells. This would be used to study the internalization of nanoparticles into the cell nucleus to verify if apoptosis was induced.

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS

- Society of Rheology, British Society of Rheology, American Chemical Society, American Institute of Physics, American Institute of Chemical Engineers (AIChE), American Physical Society (APS)