Davit A. Potoyan

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Department of Chemistry, Iowa State University
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APPOINTMENTS

2023-PRESENT **Associate Professor**
Department of Chemistry, Iowa State University
Department of Biochemistry, Biophysics, and Molecular Biology
Bioinformatics and Computational Biology Program

2017-2023 **Caldwell Assistant Professor**
Department of Chemistry, Iowa State University
Department of Biochemistry, Biophysics, and Molecular Biology
Bioinformatics and Computational Biology Program

2012-2017 **Postdoctoral Fellow**
Center for Theoretical Biological Physics
Rice University, Houston TX

EDUCATION

2007-2012 **PhD** in CHEMICAL PHYSICS
University of Maryland, College Park MD

2003-2007 **BS** in CHEMISTRY
Yerevan State University, Armenia

AWARDS

2022 Cottrell Scholar Collaborative award
2021 Cottrell Scholar award
2020 NIH R35 MIRA award
2012 Graduate award for excellence in research, University of Maryland, College Park MD
2011 Student Research Achievement Award, Biophysical Society, Baltimore MD

PUBLICATIONS

Work at ISU (2017-present)
†-corresponding author, *-equal contribution.

Preprints

[53] V Ramachandran, **DA Potoyan**† "Molecular Drivers of RNA Phase Separation" (2025)
DOI: 10.1101/2025.01.20.633842

[52] DP Prasanna, **DA Potoyan**† "Thermal Adaptation of Extremozymes: Temperature-Sensitive Contact Analysis of Serine Proteases" (2025)
DOI: 10.1101/2025.03.03.641325

Published or Accepted

[51] D Shukla, F Morcos, **DA Potoyan**† "Mechanisms of Thermal Adaptation of Cytosolic Malate Dehydrogenase Revealed by Deep Learning and Coevolutionary Analysis"
J Chem Theor Comp **21**, 3277 (2025)

[50] S Biswas, **DA Potoyan**† "Decoding the dynamics of biomolecular condensates: An energy landscape approach" *PLoS Comp Bio* **21** e1012826 (2025)

[49] U Patel, S Siang, **DA Potoyan**, J Roche. "Conformational landscape of the transcription factor ATF4 is dominated by disordered-mediated inter-domain coupling"
Biochemistry (2025)

[48] D Burns, V Venditti†, **DA Potoyan**† "Illuminating protein allostery by Chemically Accurate Contact Response Analysis" *J Chem Theor Comp* **20**, 8711 (2024)

[47] S Biswas, **DA Potoyan**† "Molecular Drivers of Aging in Biomolecular Condensates: Desolvation, Rigidification, and Sticker Lifetimes" *Phys Rev X Life* **2**, 023011 (2024)

[46] S Yang, **DA Potoyan**† "On microscopic origins of flow activation energy in biomolecular condensates" *J Phys Chem B* **128**, 12348 (2024)

[45] R Laghmach, M Di Piero, **DA Potoyan**†. "4D Mesoscale liquid model of nucleus resolves chromatin's radial organization" *Phys Rev X Life* **2**, 013006 (2024)

[44] V Ramachandran, **DA Potoyan**† "Energy landscapes of homopolymeric RNAs revealed by deep unsupervised learning" *Biophys J* **123**, 1152 (2024)

[43] W Brown, **DA Potoyan**†. "Phase separation of multicomponent peptide mixtures into dehydrated clusters with hydrophilic cores" *Biophys J* **123**, 349 (2024)

[42] V Ramachandran*, W Brown*, C Gayvert, **DA Potoyan**†; "Nucleoprotein phase-separation affinities revealed via atomistic simulations of short peptide and RNA fragments"
J Phys Chem Lett **15**, 10811 (2024)

[41] V Ramachandran **DA Potoyan**† "Atomistic insights into the reentrant phase-transitions in polyuracil and polylysine mixtures" *J Chem Phys* **161**, 015101 (2024)

[40] D Burns, B Khatiwada, A Singh, JA Purslow, **DA Potoyan**†, V Venditti† "An α-ketoglutarate conformational switch controls iron accessibility, activation and substrate selection of the human FTO protein" *Proc Natl Acad Sci* **121**, e2404457121 (2024)

[39] I Alshareedah, A Singh, S Yang, V Ramachandran, A Quinn, **DA Potoyan**†, Priya R. Banerjee†. "Determinants of Viscoelasticity and Flow Activation Energy in Biomolecular Condensates" *Sci Adv* **10**, 6539 (2024)

[38] D Marijan, EA Momchilova, D Burns, R Zapf, Holger W, **DA Potoyan**, TE Audas "Protein Thermal Sensing Regulates Physiological Amyloid Aggregation" *Nat Commun* **15**, 1222 (2024)

[37] CL. Vizcarra, R Trainor, AR McDonald, C Richardson, **DA Potoyan**, JA Nash, B Lundgren, T Luchko, GM Hocky, JJ Foley IV, TJ Atherton, GY Stokes "An interdisciplinary effort to integrate coding into science courses" *Nature Comp Sci* (2024)

[36] JD Levengood, **DA Potoyan**, S Penumutchu, A Kumar, Y Wang, AL Hansen, S Kutluay, J Roche, Blanton S Tolbert "Thermodynamic Coupling of the tandem RRM domains of hnRNP A1 underlie its Pleiotropic RNA Binding Functions" *Sci Adv* **10**, 6580 (2024)

[35] D Burns, V Venditti†, **DA Potoyan**†. "Temperature-Sensitive Contact Modes Allosterically Gate TRPV3" *PLoS Comp Bio* **19**, e1011545 (2023)

[34] I Malhotra, **DA Potoyan**†. "Re-entrant transitions of locally stiff RNA chains in the presence of polycations leads to gelated architectures" *Soft Matter* **19**, 5622-5629 (2023)

[33] S Sedinkin, D Burns, D Shukla, **DA Potoyan**†, V Venditti†. "Solution structure ensembles of the open and close forms of the 130 kDa Enzyme I via AlphaFold modeling, Coarse-Grained simulations, and NMR" *J. Am. Chem. Soc.* **145**, 13347 (2023)

[32] A Singh, D Burns, S Sedinkin, B Van Veller, **DA Potoyan**†, V Venditti†."Protein conformational dynamics underlay selective recognition of thermophilic over mesophilic Enzyme I by a substrate analogue" *Biomolecules* **13**, 160 (2023)

[31] D Burns, A Singh, V Venditti†, **DA Potoyan**†. "Temperature Sensitive Contacts in Disordered Loops Tune Enzyme I Activity" *Proc. Natl. Acad. Sci.* **119**, e2210537119 (2022)

[30] R Laghmach, I Alshareedah, M Pham, M Raju, PR Banerjee†, **DA Potoyan**†. "RNA chain length and stoichiometry govern surface tension and stability of protein-RNA condensates" *iScience* **25**, 104105 (2022)

[29] AE Badaczweska-Dawid, V Uversky†, **DA Potoyan**†. "BIAPSS: A comprehensive physicochemical analyzer of proteins undergoing liquid-liquid phase separation" *Int. J. Mol. Sci.* **23**, 6204 (2022)

[28] R Laghmach, M Di Pierro, **DA Potoyan**†. "Liquid state perspective on dynamics of chromatin compartments" *Front. Mol. Biosci.* **8**, 781981 (2022)

[27] R Laghmach, I Malhotra, **DA Potoyan**†. "Multi-scale modeling of protein-RNA condensation in and out of equilibrium" *Methods in Molecular Biology* **2563** (2022)

[26] I Alshareedah, MM Moosa, M Pham, **DA Potoyan**†, PR Banerjee†. "Programmable Viscoelasticity in Protein-RNA Condensates with Disordered Sticker-Spacer Polypeptides" *Nat Commun.* **12**, 1-14 (2021)

[25] R Laghmach, M Di Pierro, **DA Potoyan**† "Interplay of chromatin phase separation and lamina interactions in nuclear organization" *Biophys J.* **120**, 5005–5017 (2021)

[24] J Mueterthies, **DA Potoyan**†. "Solvent Exposure and Ionic Condensation Drive Fuzzy Dimerization of Disordered Heterochromatin Protein Sequence" *Biomolecules* **11**, 915 (2021)

[23] T Kaur, M Raju, I Alshareedah, RB Davis, **DA Potoyan**†, PR Banerjee†. "Sequence-encoded and Composition-dependent Protein-RNA Interactions Control Multiphasic Condensate Topologies" *Nat Commun* **12**, 1-6 (2021)

[22] R Laghmach, **DA Potoyan**†. "Liquid-liquid phase separation driven compartmentalization of reactive nucleoplasm" *Phys Biol.* **18** 015001 (2020)

[21] RR Dotas, TT Nguyen, CE Stewart Jr, R Ghirlando, **DA Potoyan**†, V Venditti†. "Hybrid thermophilic/mesophilic enzymes reveal a role for conformational disorder in regulation of bacterial Enzyme I." *J Mol Biol* **432**, 4481 (2020)

[20] I Alshareedaha, MM Moosa, M Raju, **DA Potoyan**†, PR Banerjee†. "Phase Transition of RNA-protein Complexes into Ordered Hollow Condensates." *Proc Natl Acad Sci* **117**, 15650 (2020)

[19] R Laghmach, M Di Pierro, **DA Potoyan**†. "Mesoscale liquid model of chromatin recapitulates large-scale organization of eukaryotic cell nuclei" *Biophys J*, **118**, 2130 (2020)

[18] J Roche, **DA Potoyan**†. "Disorder mediated oligomerization of DISC1 proteins revealed by coarse-grained molecular dynamics simulations." *J Phys Chem B* **123**, 9567 (2019)

[17] YT Lin, PG Hufton, EJ Lee, **DA Potoyan**†. "Stochastic and dynamical view of pluripotency in mouse embryonic stem cells" *PLoS Comp Bio* **14**, 1006000 (2018)

[16] M Di Pierro*, **DA Potoyan***, PG Wolynes, JN Onuchic. "Anomalous Diffusion, Spatial Coherence, and Viscoelasticity from the Energy Landscape of Human Chromosomes" *Proc. Natl. Acad. Sci.* **115**, 7753 (2018)

[15] Z Wang*, **DA Potoyan***, PG Wolynes. "Stochastic Resonances in a Distributed Genetic Broadcasting System: The $NF\kappa B/I\kappa B$ paradigm." *J. Roy. Soc. Int.* **15**, 20170809 (2018)

[14] Z Wang, **DA Potoyan**, PG Wolynes. "Modeling the therapeutic efficacy of $NF\kappa B$ synthetic decoy oligodeoxynucleotides (ODNs)." *BMC Sys. Biol.* **12**, 4 (2018)

Graduate and Postdoctoral Work (2010-2017)

[13] **DA Potoyan**, C Bueno, W Zheng, PG Wolynes, EA Komives. "Resolving the $NF\kappa B$ heterodimer binding paradox: Strain and frustration guide the binding of dimeric transcription factors" *J. Am. Chem. Soc.* **139**, 18558 (2017)

[12] **DA Potoyan**, PG Wolynes. "Stochastic dynamics of genetic broadcasting networks." *Phys. Rev. E.* **96**, 052305 (2017)

[11] **DA Potoyan**, W Zheng, DU Ferreiro, PG Wolynes, EA Komives. "PEST Control of Molecular Stripping of $NF\kappa B$ from DNA Transcription Sites." *J. Phys. Chem. B* **120**, 8532 (2016)

[10] **DA Potoyan**, W Zheng, EA Komives, PG Wolynes. "Molecular stripping in the $NF\kappa B/I\kappa B/DNA$ genetic switch." *Proc. Natl. Acad. Sci.* **113**, 110 (2016)

[9] Z Wang*, **DA Potoyan***, PG Wolynes. "Molecular stripping, targets and decoys as modulators of oscillations in the $NF\kappa B/I\kappa B\alpha/DNA$ genetic network." *J. Roy. Soc. Int.* **13**, 0560 (2016)

[8] **DA Potoyan**†, PG Wolynes. "Dichotomous noise based models of genetic switching." *J. Chem. Phys.* **143**, 195101 (2015)

[7] D Winogradoff, I Echeverria, **DA Potoyan**, GA Papoian. "The acetylation landscape of the H4 histone tail: disentangling the interplay between the specific and cumulative effects." *J. Am. Chem. Soc.* **137**, 6245 (2015)

[6] **DA Potoyan**, PG Wolynes. "On the dephasing of genetic oscillators." *Proc. Natl. Acad. Sci.* **111**, 2391 (2014)

[5] **DA Potoyan**, A Savelyev, GA Papoian. "Coarse graining the DNA: The beginning of a long journey." *WIRES Comp. Mol. Sci.* **116**, 1709 (2013)

[4] **DA Potoyan**, GA Papoian. "Regulation of the H4 tail binding and folding landscapes via Lys-16 acetylation." *Proc. Natl. Acad. Sci.* **109**, 17857 (2012)

[3] **DA Potoyan**, P. Zhuravlev, GA Papoian. "Computing free energy of a large-scale allosteric transition in Adenylate Kinase using all atom explicit solvent simulations."
J. Phys. Chem. B **116**, 1709 (2012)

[2] **DA Potoyan**, GA Papoian. "Energy landscape analyses of disordered histone tails reveal special organization of their conformational dynamics." *J. Am. Chem. Soc.* **133**, 7405 (2011)

[1] P Zhuravlev, S Wu, **DA Potoyan**, M Rubinstein, GA Papoian. "Computing free energies of protein conformations from explicit solvent simulations" *Methods.* **52**, 115121 (2010)

TEACHING

Spring, 2025	Chem 563; Statistical Mechanics.
Fall, 2024	Chem 324; Introduction to Quantum Mechanics.
Spring, 2024	Chem 563; Statistical Mechanics.
Fall, 2023	Chem 324; Introduction to Quantum Mechanics.
Fall, 2022	Chem 167; General Chemistry.
Spring, 2022	Chem 563; Statistical Mechanics.
Fall, 2021	Chem 167; General Chemistry.
Spring, 2021	Chem 563; Statistical Mechanics.
Fall, 2020	Chem 167; General Chemistry.
Spring, 2020	Chem 563; Statistical Mechanics.
Fall, 2019	Chem 324; Introduction to Quantum Mechanics.
Spring, 2019	Chem 563; Statistical Mechanics.
Spring, 2018	Chem 324; Introduction to Quantum Mechanics.
Fall, 2017	Chem 324; Introduction to Quantum Mechanics.

INVITED TALKS

2025	American Chemical Society Meeting, San Diego, CA
2024	Molecular and Cellular Biology, University of Massachusetts , Amherst, MA
2024	American Physical Society Meeting, Minneapolis, MA
2024	Biophysical Society Meeting, Philadelphia, PA
2024	Department of Biological Sciences, University of Texas, Dallas, TX
2023	American Chemical Society Meeting, Indianapolis, IA
2022	Department of Chemistry, University of California, Los Angeles, CA
2022	Department of Physics, Northeastern University, MA
2022	Department of Physics, University of Buffalo, NY
2022	Department of Chemistry, University of Maryland, MD
2022	Department of Chemistry, University of Oregon, OR
2022	Department of Chemistry, University of Minnesota, MN
2021	(virtual) NYU Chromatin Club, New York University, NY
2021	(virtual) Department of Physics, University of Buffalo, NY
2020	(virtual) Department of Chemistry, McGill University, Montreal, Canada
2019	Department of Chemistry, University of Illinois, Chicago
2019	Department of Applied Mathematics, Illinois Institute of Technology, Chicago
2018	Department of Chemistry, University of Nebraska, Omaha
2017	Center for Nonlinear Studies, Los Alamos National Lab, Los Alamos NM
2017	Department of Physics, University of Northern Iowa, Waterloo IA

SERVICE

Meetings Organized:

- *"Multi-scale Modeling of Biomolecular Condensates," ACS Spring National Meeting, San Diego, March 26, 2025*
- *ESCIP workshop "Teaching scientific computing at the dawn of AI ", Ames, IA, May 30-31, 2024*

Peer Reviewing:

- *Proc Natl Acad Sci, Biophys J, PLoS Comput Biol, J Phys Chem B, J Chem Phys, Nucleic Acids Res, Frontiers Biosci, iScience, Biomolecules, Phys Biol, Sci Rep*

Departmental Committees:

- 2023 – ISU Chemistry Graduate Admissions Committee
- 2023 – ISU Strategic Planning Committee
- 2022 – ISU Chemistry Department Vision Committee
- 2021 – ISU Chemistry Department Survey Committee
- 2020 – ISU Bioinformatics and Computational Biology (BCB) Program Admissions Committee
- 2019 – ISU Chemistry Department Website Committee
- 2018 – ISU Chemistry Department Planning Committee

CURRENT FUNDING

Grant:	**NIH R35, GM138243-01**
Title:	"Multi-scale computational investigation of functions and mechanisms of protein-RNA phase separation."
Status:	Active
Award:	$1,703,640
Period:	09/15/2020-07/31/2025 (Renewal pending for 2025-2030)
Investigators:	Davit Potoyan(PI)

PENDING FUNDING

Grant:	**NIH R35, GM138243-01R**
Title:	"Multi-scale computational investigation of functions and mechanisms of protein-RNA phase separation."
Award:	$1,846,340
Period:	09/15/2025-07/31/2030
Investigators:	Davit Potoyan(PI)
Grant:	**NSF, 2435848**
Title:	"ACED: Accelerating Inference of Protein Dynamics from Structural Data via Synergistic Use of Molecular Dynamics and AI"
Award:	$3,000,000
Investigators:	Davit Potoyan (PI), Hongyang Gao (co-PI), Vincenzo Venditti (co-PI)

COMPLETED FUNDING

Grant:	**Cottrell Scholar**
Title:	"Uncovering principles of bio-molecular condensation: from single molecules to cellular organelles"
Status:	Active
Award:	$100,000
Period:	07/01/2021-09/30/2024
Investigators:	Davit Potoyan(PI)
Grant:	**Cottrell Scholar Collaborative**
Title:	"Broadening and deepening the ESCIP network: Infusing computational science concepts into STEM courses through multidisciplinary instructor collaborative networks.""
Status:	Active
Award:	$10,000
Period:	09/01/2022-08/30/2024
Investigators:	Davit Potoyan (PI)
Grant:	**NIH R01, GM132561-01**
Title:	"Structure and function of DISC1 in the cAMP pathway"
Status:	Active
Award:	$44,445
Period:	07/01/2019-10/30/2024
Investigators:	Julien Roche(PI), Underbakke Eric(Co-PI), Stewart Charles(Co-PI) and Davit Potoyan(Co-PI)

GROUP MEMBERS

Postdoctoral researchers

Subhadip Biswas 2023-Present, PhD, University of Sheffield

Sean Yang 2023-Present, PhD, Shanghai JiaoTong University

PhD students

Grace Tiffany 2025-Present, *Biophysics*

Shalith Chamantha 2025-Present, *Chemistry*

Tuqa Ibrahim 2025-Present, *Chemistry*

Krishna Suresh 2024-Present, *Chemistry*

Sunera Arambewela 2024-Present, *Chemistry*

Zachary Miller 2024-Present, *Physics*

Divyanshu Shukla 2023-Present, *BCB*

Dulitha Prasanna 2022-Present, *Chemistry*

Vysakh Ramachandran 2022-Present, *Chemistry*

Alumni

William Brown 2020-2025, *Chemistry PhD*

Daniel Burns 2019-2024, *Biophysics PhD*

Rabia Laghmach 2018-2024, Postdoc

Chris Gayvert 2020-2023, *Biophysics MS student*

Isha Malhotra 2021-2022, Postdoc

Matthew Pham 2019-2021, *Physics undergraduate*

Aleksandra Badaczewska-Dawid 2020-2021, Postdoc

Jazelli Muetherties 2018-2020, *MS student*

Muralikrishna Raju 2019-2020, Postdoc

Daniel Pugliese Summer 2019, *Chemistry undergraduate*

Amar Srivastava Fall 2018, *Chemical Engineering undergraduate*

Fatima Almustafa Fall 2018, *Chemistry undergraduate*