

Erik Dylan Holmstrom
484 Witikonstrasse, Zurich, Switzerland 8053
phone: +41 078 829 63 74
email: erik.d.holmstrom@ku.edu

Education

2014 Ph.D. in Biochemistry from the University of Colorado at Boulder
2008 B.A. in Chemistry and Biology from Willamette University

Professional Appointments

2019 Assistant Professor at University of Kansas
2018 Postdoctoral Research Scientist at the University of Zurich
2017 EMBO Postdoctoral Fellow at the University of Zurich
2015 Postdoctoral Research Scientist at the University of Zurich

Publications

1. M. Nüesch, D. Nettles, E.D. Holmstrom*, B. Schuler.* “Conformational Dynamics and Dimensions of Short Homopolymeric Nucleic Acids.” (in Preparation)
2. E.D. Holmstrom*, Z. Liu, D. Nettles, R.B. Best, B. Schuler*, “Disordered RNA chaperones enhance nucleic acid folding via local charge screening.” (Submitted) *Nature*
3. E.D. Holmstrom, A. Holla, W. Zheng, D. Nettles, R.B. Best*, B. Schuler*. “Accurate transfer efficiencies and distance distributions of unfolded and intrinsically disordered proteins using single-molecule FRET.” *Methods Enzymol.* (2018) DOI: 10.1016/bs.mie.2018.09.030
4. K.K. Grotz, M. Nüesch, E.D. Holmstrom, M. Heinz, L.S. Stelzl, B. Schuler*, G. Hummer*. “Dispersion Correction Alleviates Dye Stacking of Single-Stranded DNA and RNA in Simulations of Single-Molecule Fluorescence Experiments.” *J. Phys. Chem. B* (2018) DOI: 10.1021/acs.jpcc.8b07537
5. F. Sturzenegger, F. Zosel, E.D. Holmstrom, D.E. Makarov, D. Nettles, B. Schuler*. “Transition path times of coupled folding and binding reveal the formation of an encounter complex.” *Nat. Commun.* (2018) DOI: 10.1038/s41467-018-07043-x
6. N.F. Dupuis, E.D. Holmstrom, D.J. Nesbitt*. “Tests of Kramers’ Theory at the Single-Molecule Level: Evidence for Folding of an Isolated RNA Tertiary Interaction at the Viscous Speed Limit.” *J. Phys. Chem. B* (2018) DOI: 10.1021/acs.jpcc.8b04014
7. Y. Liu, E.D. Holmstrom, P. Yu, K. Tan, X. Zuo, D.J. Nesbitt, R. Sousa, J.R. Stagno, Y. Wang*. “Incorporation of isotopic, fluorescent, and heavy-atom-modified nucleotides into RNAs by position-selective labeling of RNA.” *Nat. protoc.* (2018) DOI: 10.1038/nprot.2018.002
8. E.D. Holmstrom*, D. Nettles, B.Schuler*. “Conformational plasticity of the hepatitis C virus core protein during RNA-induced formation of nucleocapsid-like particles.” *J. Mol. Bio.*(2017) DOI: 10.1016/j.jmb.2017.10.010
9. E.D. Holmstrom, D.J. Nesbitt*. “Biophysical Insights from Temperature-Dependent Single-Molecule Förster Resonance Energy Transfer.” *Annu. Rev. Phys. Chem.* (2016) DOI: 10.1146/annurev-physchem-040215-112544
10. J.T. Polaski, E.D. Holmstrom, D.J. Nesbitt, R.T. Batey*. “Mechanistic Insights into Cofactor-Dependent Coupling of RNA Folding and mRNA Transcription/Translation by a Cobalamin Riboswitch.” *Cell Reports.* (2016) DOI: 10.1016/j.celrep.2016.03.087
11. M. Vieweger, E.D. Holmstrom, D.J. Nesbitt*. “Single-Molecule FRET Reveals Three Conformations for the TLS Domain of Brome Mosaic Virus Genome.” *Biophys. J.* (2015) DOI: 10.1016/j.bpj.2015.10.006
12. Y. Liu, E.D. Holmstrom, J. Zhang, P. Yu, J. Wang, M.A. Dyba, D. Chen, J. Ying, S. Lockett, D.J. Nesbitt, A. R. Ferré-D’Amaré, R. Sousa, J.R. Stagno, Y. Wang* “Synthesis and applications of RNAs with position-selective labelling and mosaic composition” *Nature.* (2015) DOI: 10.1038/nature14352
13. E.D. Holmstrom, N.F. Dupuis, and D.J. Nesbitt*. “Kinetic and Thermodynamic Origins of Osmolyte-Influenced Nucleic Acid Folding.” *J. Phys. Chem. B* (2015) DOI: 10.1021/jp512491n
14. E.D. Holmstrom, J.T. Polaski, R.T. Batey* , D.J. Nesbitt*. “Single-Molecule Conformational Dynamics of a Biologically Functional Hydroxocobalamin Riboswitch.” *JACS* (2015) DOI: 10.1021/ja5076184

15. E.D. Holmstrom and D.J. Nesbitt*. “Kinetic and Thermodynamic Studies of the Human Telomerase RNA Pseudoknot Using smFRET.” *J. Phys. Chem. B* (2014) DOI: 10.1021/jp501893c
16. N.F. Dupuis, E.D. Holmstrom, and D.J. Nesbitt*. “Molecular Crowding Effects on Single Molecule RNA Folding/Unfolding Thermodynamics and Kinetics” *PNAS* (2014) DOI: 10.1073/pnas.1316039111
17. E.D. Holmstrom, N.F. Dupuis, and D.J. Nesbitt*. “Pulsed IR Heating Studies of Single-Molecule DNA Duplex Dissociation Kinetics and Thermodynamics.” *Biophys. J.* (2014). DOI: 10.1016/j.bpj.2013.11.008
18. N.F. Dupuis, E.D. Holmstrom, and D.J. Nesbitt*. “Single Molecule Kinetics Reveal Cation Promoted DNA Duplex Formation Through Ordering of Single-Stranded Helices.” *Biophys. J.* (2013). DOI: 10.1016/j.bpj.2013.05.061.
19. E.D. Holmstrom J.L. Fiore, and D.J. Nesbitt*. “Thermodynamic Origins of Monovalent-Facilitated RNA folding.” *Biochemistry* (2012). DOI: 10.1021/bi201420a
20. J.L. Fiore, E.D. Holmstrom and D.J. Nesbitt*. “Entropic origin of Mg²⁺-facilitated RNA folding.” *PNAS* (2012). DOI: 10.1073/pnas.1114859109
21. J.L. Fiore, E.D. Holmstrom, L.R. Fiegand, J.H. Hodak, and D.J. Nesbitt*. “The Role of Counterion Valence and Size in GAAA Tetraloop–Receptor Docking/Undocking Kinetics.” *J. Mol. Bio.* (2012). DOI: 10.1016/j.jmb.2012.07.006
22. E.D. Holmstrom and D.J. Nesbitt*. “Real-Time Infrared Overtone Laser Control of Temperature in Picoliter H₂O Samples: ‘Nanobathtubs’ for Single Molecule Microscopy” *J. Phys. Chem. Lett.* (2010). DOI: 10.1021/jz100663e

Grants

2019	COBRE grant – CMADP, The University of Kansas
2019	New Faculty Start-up Package, The University of Kansas

Awards

2015	Long-Term Postdoctoral Fellowship, EMBO
2014	Machines on Genes Travel Award, FASEB
2013	Single Molecule Biophysics Conference Support, Aspen Center for Physics
2011	Graduate School Student Travel Grant, University of Colorado at Boulder
2010	NIH Molecular Biophysics Training Fellowship, University of Colorado

International Conferences

-
1. 63th Annual Biophysical Society Meeting. Baltimore, MD, USA. (2019). “*Disordered RNA chaperones enhance nucleic acid folding via local charge screening*” (Talk).
 2. 10th Biennial Workshop on Single Molecule Biophysics at the Aspen Center for Physics. Aspen, CO, USA. (2019). “*Disordered RNA chaperones enhance nucleic acid folding via local charge screening.*” (Poster).
 3. PicoQuant: Single Molecule Workshop. Berlin, GER. (2018). “*Conformational Dimensions and Dynamics of Unstructured Single-stranded Nucleic Acids*” (Talk).
 4. GRC: Single Molecule Approaches to Biology. VT, USA. (2018). “*Conformational Dimensions and Dynamics of Unstructured Single-stranded Nucleic Acids*” (Poster).
 5. PicoQuant: Single Molecule Workshop. Berlin, GER. (2017). “*Using time-resolved single-molecule FRET to study the conformational dimensions of an intrinsically disordered nucleic acid chaperone*” (Talk).

6. Biophysics by the Sea. Mallorca, ESP. (2016). “*Probing the Biophysics of Nucleic Acids Chaperones Using Single-Photon Single-Molecule FRET*” (Talk).
7. GRC: Single Molecule Approaches to Biology. Hong Kong, HK. (2016). “*Understanding Nucleic Acid Chaperones: a Two-Sided Approach*” (Poster).
8. GRS: Single Molecule Approaches to Biology. Hong Kong, HK. (2016). “*Understanding Nucleic Acid Chaperones: a Two-Sided Approach*” (Poster).
9. FRET 2: Förster Resonance Energy Transfer in the Life Sciences. Goettingen,GER. (2016). “*Shining Light on RNA-Induced Capsid Formation of an Intrinsically Disordered Protein*” (Poster).
10. FASEB: Machines on Genes. Snowmass, CO, USA. (2014). “*Single-Molecule Conformational Dynamics of a Biologically Functional Hydroxocobalamin Riboswitch*” (Poster).
11. 7th Biennial Workshop on Single Molecule Biophysics at the Aspen Center for Physics. Aspen, CO, USA. (2013). “*Kinetic and Thermodynamic Studies of the Human Telomerase RNA Pseudoknot Using smFRET.*” (Poster).
12. 56th Annual Biophysical Society Meeting. San Diego, CA, USA. (2012). “*Localized Heating of Single Nucleic Acids using Infrared Light.*” (Poster).

Previous Research Experience

Postdoctoral Research, University of Zurich

“Structural and dynamic properties of intrinsically disordered viral nucleoproteins”

- Utilized advanced single-molecule fluorescence techniques and classical biophysical methods to characterize the conformational dimensions and dynamics of the intrinsically disorder nucleocapsid domain of the hepatitis C virus (HCVcp) core protein.
- Identified a physically-motivated RNA-dependent equilibrium responsible for nucleocapsid-like particle formation of HCVcp using both smFRET and transmission electron microscopy
- Developed a quantitative model for the non-specific nucleic acid chaperone activity of the HCVcp using a variety of high time resolution fluorescence techniques
- Mapped the structural and dynamic properties of an intrinsically disordered nucleoprotein complex using quantitative multidimensional smFRET
- Characterized the conformational dynamics and dimensions of intrinsically unstructured single stranded nucleic acids to serve as a benchmark for new molecular dynamics force fields
- Investigated the salt and pH dependence of i-motif kinetics and thermodynamics
- Helped develop and refine techniques used to measure the transition path times of nucleic acid conformational transitions and the coupled binding and folding of two intrinsically disorder proteins

Graduate Research, University of Colorado at Boulder

“Single-Molecule FRET studies of Nucleic Acid Conformational Dynamics”

- Studied the ligand-induced conformational changes of the adenine, lysine, and cobalamin riboswitches—*cis*-acting RNA-based regulatory elements in mRNA—at the single-molecule level
- Tested and helped refine a hybrid method that combines solid- and liquid-phase chemistries to generate site specifically label RNAs: Position-selective Labeling Of RNA (PLOR)
- Employed single-molecule fluorescence microscopy to probe the cation-dependence of the kinetics and thermodynamics associated with the GAAA tetraloop—receptor tertiary interaction.

- Developed state-of-the-art laser-induced heating methods with precise (± 0.5 °C) and local (< 15 μ M) thermal control to substantially improve temperature-dependent measurements in single-molecule fluorescence microscopy.
- Used laser-induced heating technique to study the dissociation kinetics of duplex DNA using single-molecule microscopy.
- Designed and synthesized a fluorescently labeled pseudoknot from the human telomerase RNA to study the kinetics and thermodynamics associated with a structural motif implicated in both cancer and aging.
- Explored the kinetic and thermodynamic origin of osmolyte-, molecular crowder-, and viscogen-influenced nucleic acid folding using single-molecule fluorescence techniques.

Undergraduate Research, University of Montana
“DNA Damage Recognition by Linker Histone H1”

- Characterized the binding affinity of linker histone to DNA containing oxidative lesions like 8-oxo-guanine and spiroiminodihydantoin.

Teaching Experience

University of Zurich

- Supervised the research projects of master’s students (F. Sturzenegger, M. Nueesch, and Z. Liu)
- Supervised the research projects of four bachelor students (M. Nueesch, G. Galeno, S. Frei)
- Organized and directed three practical lab courses on ELISA (BCH308, BCH309, BCH408)

University of Colorado at Boulder

- Trained two post-doctoral researchers (N.F. Dupuis and M. Vieweger) and two graduate students to use confocal and wide field microscopes for a variety of single-molecule experimental techniques.
- Instructed three biochemistry study sections for General Biochemistry 1, General Biochemistry 2, and Survey of Biochemistry (CHEM 4711, CHEM 4731, CHEM 4611).

Professional Development

2017	Preparing to Postdoc Workshop, University of Zurich
2016	Gordon Research Symposium Section Chair, Hong Kong, HK
2013	CU Wizards Scientific Outreach Program, University of Colorado
2011	CENECI Community Outreach Program, Salish-Kootenai College
2010	RNA Club Co-organizer, University of Colorado

Professional References

Prof. Ben Schuler
University of Zurich
Biochemistry
Winterthurerstrasse 190
8057 Zurich, CH
e: schuler@bioc.uzh.ch
p: +41 44 635 5535
f: +41 44 635 5907

Prof. David J. Nesbitt
University of Colorado/JILA
Chemistry and Biochemistry
UCB 440
Boulder, CO 80309
e: djn@jila.colorado.edu
p:(303) 492-8857
f: (303) 735-1424

Prof. Rob T. Batey
University of Colorado
Chemistry and Biochemistry
Campus Box 596
Boulder, CO 80309-0596
e: robert.batey@colorado.edu
p:(303) 735-2159
f: (303) 492-5894