

Nicolas Clauvelin
Research Associate

Rutgers, the State University of New Jersey
BioMaPS Institute for Quantitative Biology
Prof. Wilma K. Olson's group

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Research

I am a Research Associate in the group of Prof. W. K. Olson at the BioMaPS Institute for Quantitative Biology (Rutgers University) since August 2009.

My research focus on the physical and mechanical properties of biopolymers with a strong emphasis on DNA and chromatin. I use both analytical and numerical methods to develop new models relevant to the packing and processing of DNA in cellular processes.

Education

PhD *summa cum laude* in Mechanics,
Self-contact in elastic rods: DNA supercoiling and elastic knots,
UPMC Université Paris 6, Institut d'Alembert, December 2008.
MSc in Theoretical Physics of Complex Systems (2003-2005),
UPMC Université Paris 6, ranked first.
BSc in Mathematics and Physics (2000-2003),
UPMC Université Paris 6 & ENS Cachan.

Skills

Analytical Methods:
variational calculus, differential equations, differential geometry, dynamical systems, asymptotic analysis.
Numerical Methods:
optimization, numerical analysis, Monte Carlo methods, computational physics, normal modes analysis.
Programming:
C/C++/Obj-C (STL, Boost, Cocoa, OpenGL), Mathematica, shell script, Python, HTML/CSS, SQL, LaTeX.
Systems:
*BSD, Unix/Linux, Mac OS X, server administration.
Software:
XCode, Mathematica, Adobe Illustrator.
Languages:
French, English, German

Research Experience

Research Assistant, Rutgers University, advisor: W. K. Olson

- ▶ Chromatin: mesoscale modeling of chromatin and numerical simulations with application to nucleosomal array experiments,
- ▶ DNA geometry and topology: development of new methods for the computation of DNA geometry and topology,
- ▶ DNA elasticity: one-dimensional linear elasticity applied to the study of the dynamics of DNA.

Research Assistant, UPMC Université Paris 6, advisors: B. Audoly (2009)

- ▶ Viscous threads dynamics: development and implementation of a numerical tool for the direct simulation of the dynamics of viscous threads.

PhD, UPMC Université Paris 6, advisors: B. Audoly and S. Neukirch (2005-2008)

- ▶ DNA supercoiling: analytical description of the response of DNA in extension-rotation experiments with comparison to experimental data,
- ▶ Self-contact in elastic rods: theoretical and numerical study of the geometry and mechanics of a knotted elastic rod using asymptotic analysis and matching methods.

Teaching Experience

Lecturer for the Boot Camp in Quantitative Biology (Rutgers) (2014)

Courses on Mathematica and Protein Data Bank, lectures covering the manipulation and analysis of protein and nucleic acid structures in Mathematica.

Lecturer at Rutgers University (2012)

Graduate course 16:118:617:02 Special Topics in Quantitative Biology, lectures covering geometry and topology of DNA, elasticity and statistical physics of biopolymers.

DIMACS REU mentoring (undergraduate students)

Mentoring of three students (one is currently working in our group) since 2010.

Teaching assistant (2005-2008)

2007-2008: elastic beams mechanics, graduate class,
2007-2008: mathematics for mechanics, undergrad class,
2006-2007: rigid body mechanics, undergrad class,
2006-2007: fluid mechanics, undergrad class,
2005-2006: computer sciences for physics, undergrad class.

Awards

Education Travel Award from the Biophysical Society
February 25-29, 2012 — San Diego (CA), USA

Invited to the KITP program: Biological Frontiers of Polymers and Soft Matter
Physics, May-June, 2011 — Santa Barbara (CA), USA

French Ministry of Research grant for doctoral studies
3 years funding for the period 2005-2008 (60k euros)

Journal Publications

- E. V. Nizovtseva et al, *Opposite Effects of Histone H1 and HMGN5 Protein on Distant Communication in Chromatin*, Submitted to *Nucleic Acids Research* (2014).
- N. Clauvelin, Wilma K. Olson, *The synergy between protein positioning and DNA elasticity: energy minimization of protein-decorated DNA minicircles*, arXiv:1405.7638 (2014).
Under review for *Biophysical Journal*.
[[arXiv:1405.7638](https://arxiv.org/abs/1405.7638)]
- N. Clauvelin et al, *Nucleosome positioning and composition modulate in silico chromatin flexibility* (2014).
Accepted for publication in *Journal of Physics: Condensed Matter* (Special Issue).
- P. Perez, N. Clauvelin et al, *What controls DNA looping?*, *International Journal of Molecular Sciences*, **15**(9), 15090–15108 (2014).
[[10.3390/ijms150915090](https://doi.org/10.3390/ijms150915090)]
- N. Clauvelin, Wilma K. Olson & I. Tobias, *Effect of the boundary conditions and influence of the rotational inertia on the vibrational modes of an elastic ring*, *Journal of Elasticity*, **115**(2), 193–224 (2013).
[[10.1007/s10659-013-9453-2](https://doi.org/10.1007/s10659-013-9453-2)]
- A. Colasanti et al, *Weak Operator Binding Enhances Simulated Lac Repressor-mediated DNA Looping*, *Biopolymers*, **99**(12), 1070–1081 (2013).
[[10.1002/bip.22336](https://doi.org/10.1002/bip.22336)]
- B. Audoly, N. Clauvelin et al, *A discrete geometric approach for simulating the dynamics of thin viscous threads*, *Journal of Computational Physics*, **253**, 18–49 (2013).
[[10.1016/j.jcp.2013.06.034](https://doi.org/10.1016/j.jcp.2013.06.034)]
- W. K. Olson, N. Clauvelin et al, *Insights into gene expression and packaging from computer simulations*, *Biophysical Reviews*, **4**, 171–178 (2012).
[[10.1007/s12551-012-0093-8](https://doi.org/10.1007/s12551-012-0093-8)]
- O. I. Kulaeva et al, *Internucleosomal interactions mediated by histone tails allow distant communication in chromatin*, *Journal of Biological Chemistry*, **287**, 20248–20257 (2012).
[[10.1074/jbc.M111.333104](https://doi.org/10.1074/jbc.M111.333104)]
- N. Clauvelin, W. K. Olson & I. Tobias, *Characterization of the Geometry and Topology of DNA Pictured As a Discrete Collection of Atoms*, *Journal of Chemical Theory and Computation*, **8**, 3, 1092–1107 (2012).
[[10.1021/ct200657e](https://doi.org/10.1021/ct200657e)]
- N. Clauvelin, B. Audoly & S. Neukirch, *Matched Asymptotic Expansions for Twisted Elastic Knots: a self-contact problem with non-trivial contact topology*, *Journal of the Mechanics and Physics of Solids*, **57** (9), 1623–1656 (2009).
[[10.1016/j.jmps.2009.05.004](https://doi.org/10.1016/j.jmps.2009.05.004)]
- N. Clauvelin, B. Audoly & S. Neukirch, *Elasticity and Electrostatics of Plectonemic DNA*, *Biophysical Journal*, **96** (9), 3716–3723 (2009).
[[10.1016/j.bpj.2009.02.032](https://doi.org/10.1016/j.bpj.2009.02.032)]
- N. Clauvelin, B. Audoly & S. Neukirch, *Mechanical Response of Plectonemic DNA: An Analytical Solution*, *Macromolecules*, **41**, 4479–4483 (2008).
[[10.1021/ma702713x](https://doi.org/10.1021/ma702713x)]

- B. Audoly, N. Clauvelin & S. Neukirch, *Elastic Knots*, Physical Review Letters, **99**, 164301 (2007).
[\[10.1103/PhysRevLett.99.164301\]](#)
- N. Clauvelin, B. Audoly & S. Neukirch, *Analytical Results for the Plectonemic Response of Supercoiled DNA*, Journal of Computer-Aided Materials Design, **14**, 94–101 (2007).
[\[10.1103/PhysRevLett.99.164301\]](#)

Participation in international conferences and invited talks

- Biophysical Society Meeting, *Significance of Knotted Structures for Function of Proteins and Nucleic Acids*
September 17-21, 2014 — Warsaw, Poland
Invited speaker
Protein-induced Entanglement on DNA: Connecting and Organizing Chromosomes via Multiple Loops.
- Biophysical Society Annual Meeting 2014
February 15-19, 2014 — San Francisco (CA), USA
Poster presentations in sessions *Chromatin and the Nucleoid* and *Protein-Nucleic Acid Interactions*
How do nucleosomes bundle DNA into chromatin?
Understanding how proteins shape DNA using energy minimization.
- Albany 2013: The 18th Conversation
June 11-15, 2013 — University of Albany (NY), USA
Oral presentation in session *Exciting Developments/Breakthroughs*
The synergy between DNA and nucleosomes in chromatin.
- Biophysical Society Annual Meeting 2013
February 2-6, 2013 — Philadelphia (PA), USA
Oral presentation in session *Chromatin and the Nucleoid*
The synergy between DNA and nucleosomes in chromatin.
- Biophysical Society Pennsylvania Network Meeting
September 14, 2012 — Lehigh University (Bethlehem, PA), USA
Oral presentation (selected as junior speaker)
Long-distance communication in chromatin: the synergy between DNA and nucleosomes.
- Biophysical Society Annual Meeting 2012
February 25-29, 2012 — San Diego (CA), USA
Poster presentation (Travel Award)
High-resolution simulations of chromatin looping: long-distance communication as a sequence-driven response to nucleosome positioning.
- Department of Chemistry at NYU
November 18, 2011 — New York University (NY), USA
Invited talk
Long-distance communication in chromatin.
- Biophysical Society Meeting “DNA Packaging Across Kingdoms: Chromatin & Beyond”
July 5-8, 2011 — Asilomar (CA), USA
Poster presentation
Long-distance communication in chromatin.
- KITP Program: Biological Frontiers of Polymers and Soft Matter Physics
May-June, 2011 — UC Santa Barbara (CA), USA
- Biophysical Society Annual Meeting 2011
March 5-9, 2011 — Baltimore (MD), USA
Poster presentation
Long-distance communication in chromatin.

- APS March Meeting 2008
March 10-14, 2008 — New Orleans (LA), USA
Oral presentation in session A39 *Elasticity and Geometry of Thin Objects*
Instability of an elastic knot under twist.
- EMBO Workshop “DNA Supercoiling and Topoisomerases”
June 17-22, 2007 — Fréjus, France
Oral presentation
An elastic rod model for the mechanical response of twisted DNA with plectonems.
- Third International Conference on Multiscale Materials Modeling
September 18-22, 2006 — Freiburg, Germany
Oral presentation in the *Biomaterials* symposium
N. Clauvelin, S. Neukirch & B. Audoly,
Analytical Results For The Plectonemic Response Of Supercoiled DNA,
in Proceedings of the Third International Conference on Multiscale Materials Modeling,
edited by P. Gumbsch (Fraunhofer IRB Verlag), pp. 605—608.