Curriculum Vitae – Natsuhiko Yoshinaga

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Date of birth:	27 July, 1979, Osaka, Japan
Gender:	Male
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Citizenship:	Japan

EDUCATION

B.Sc. in Physics, Kyoto University **04/1998 - 03/2002**

M.Sc. in Physics, Kyoto University **04/2002 - 03/2004**

on the subject of "The folding transition in a single semiflexible polymer."
Supervisor: Prof. Kenichi Yoshikawa, Kyoto University

Ph.D. in Physics, Kyoto University **04/2004 – 03/2007**

on the subject of "Single semiflexible polymers at equilibrium and nonequilibrium states."
Supervisor: Prof. Kenichi Yoshikawa, Kyoto University

RESEARCH EXPERIENCE

Visiting researcher in **10/2005 – 03/2006**

Département de recherche fondamentale sur la matière condensée (DRFMC), CEA-Grenoble (France)
collaborating with Prof. Avraham Halperin
Theory Group, Institut Laue Langevin (France)
collaborating with Prof. Efim Katz

Research fellow in **04/2007 – present**

Department of Physics, Graduate School of Science, the University of Tokyo (Japan)
collaborating with Prof. Masaki Sano

LANGUAGES

Japanese (native language), English (fluent)

TECHNICAL SKILLS

Good experience with UNIX-LINUX and Windows
Good experience with C, C++

HONOR, FELLOWSHIPS and AWARD

Research Fellow of the Japan Society for Promotion of Science for Young Scientists. (DC1, No.1142) 2004-2007

Research Fellow of the Japan Society for Promotion of Science for Young Scientists. (PD, No.7662) 2007-present

REFERENCES ARE AVAILABLE ON REQUEST

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RESEARCH INTERESTS

My research area is the statistical physics of complex soft condensed materials. Soft materials contain various length and time scales, which couple together in a complicated manner. Therefore we do not have one unique method to analyze them. Starting from microscopic (for example atomic) systems is not always efficient. As a result, we need to combine number of methods or sometimes create new ways to find essential route to the reality. The importance of this field is that such systems are closely related to biological phenomena, which give us unlimited imagination and intuition. In addition, they contain most of industrial products, and sustain our comfortable lives.

My interests are how to describe these complicated systems in a simple way. Although these systems contain various time and length scales, most of the scales are slaved by a few slow and mesoscopic variables. This makes problems very clear and tractable. To perform this reduction, physical imaginations is often needed. I use simulations not only for comparison with theories and experiments but also to obtain the imaginations. We employ mainly theoretical (analytical and numerical) methods to study these problems. On the other hand, I am not confined to theoretical methods and I did study with experimental techniques, such as the fluorescent microscopy and atomic force microscopy.

Polymers are one of representations in soft materials. My research focuses on folding transition of single semiflexible polymers. In the polymer physics, various properties of flexible polymers, which have no bending rigidity, are discussed. On the other hand, the understandings of semiflexible polymers are still developing in spite of the fact that semiflexible polymers have important features of folding into organized structures. This is important because in biological systems, DNA molecules and proteins have well-organized structures and they are closely related with their functions. Therefore we have studied with atomic force microscopy the conformation of DNA molecules, especially long so that we can discuss statistical properties of single molecules. It has been clarified that such long DNA molecules make transitions into folded states with condensing agents, and we therefore investigated the effect of the specific binding with DNA on the folding transition using the intercalating molecules. We have also considered theoretically the phase transition of semiflexible polymers between the elongated coiled state and the folded states, and found that the effect of bending rigidity changes qualitative feature of the transition by coupling of density and orientational order of degree of freedoms.

On the other hand, semiflexible polymers at nonequilibrium state are far less understood even though most of the biological and chemical systems are far from equilibrium. We have studied semiflexible polymers under external mechanical loading and unloading, and folding kinetics of them. We performed simulations of mechanical unfolding and refolding and found that there is large hysteresis in this cycle. These results were analyzed with phenomenological scaling approach and the two-variable model in more general way. The scaling approach was applied for the folding and unfolding kinetics of single semiflexible polymers and compared with simulations.

PUBLICATIONS AND PRESENTATIONS

1. N. Yoshinaga and K. Yoshikawa,
"Core-shell structures in single flexible-semiflexible block copolymers: Finding the free energy minimum for the folding transition"
submitted

2. N. Yoshinaga, D. J. Bicout, E.I. Kats and A. Halperin
"Dynamic Core Shell Structures in Two State Models of Neutral Water Soluble Polymers"
Macromolecules, 40(6), 2201-2209 (2007)

3. N. Yoshinaga
"Transition kinetics of a single semiflexible polymer"
Progress of Theoretical Physics Supplement, 161, 397-402 (2006).

4. N. Yoshinaga, K. Yoshikawa and T. Ohta
"Different pathways in mechanical unfolding/folding cycle of a single semiflexible polymer"
European Physical Journal E, 17, 485 (2005).

5. K. Yoshikawa and N. Yoshinaga
"Novel scenario on the folding transition of a single chain"
Journal of Physics: Condensed Matter, 17, S2817-S2823 (2005).

6. N. Yoshinaga, K. Yoshikawa and S. Kidoaki
"Multiscaling in a Long Semiflexible Polymer Chain in Two Dimension"
Journal of Chemical Physics, 116, 9926 - 9929 (2002).

7. N. Yoshinaga, T. Akitaya and K. Yoshikawa
"Intercalating Fluorescence Dye YOYO-1 Prevents the Folding Transitionin Giant Duplex DNA"
Biochemical and Biophysical Research Communications, 286, 264-267, (2001).

International Conference, etc.:

Oral presentation

1. Natsuhiko Yoshinaga
"Folding kinetics of a single semiflexible polymer"
YITP Workshop "Soft Matter as Structured Materials"
Yukawa Institute for Theoretical Physics, Kyoto, Japan , (1-3 Aug., 2005)

2. Natsuhiko Yoshinaga and Kenichi Yoshikawa
"Folding Transitions and Organized Structures in a Single Polymer Chain"
5th International Symposium "Molecular Mobility and Order in Polymer Systems"
The House of Scientist, St. Petersburg, Russia, (20-24 June, 2005)

Poster presentation

1. Natsuhiko Yoshinaga
"The kinetics of conformational change in single macromolecules: Semiflexible polymers in the folding and unfolding transition "
OIST International Workshop on Single Molecule Analysis

Bankoku Shinryokan, Okinawa, Japan, (17 April- 21, 2006)

2. Natsuhiko Yoshinaga
"Different pathways in mechanical unfolding/folding cycle of a single semiflexible polymer"
European Polymer Congress 2005
Moscow State University, Moscow, Russia, (26 June- 1 July, 2005)

3. Natsuhiko Yoshinaga
"Phase transition in a single semiflexible polymer: hysteresis with temperature cycling"
The International Workshop on Physics of Softmatter Complexes
Tokyo Metropolitan University, Tokyo, Japan (29 Dec. - 2 Nov., 2004)

4. Natsuhiko Yoshinaga
"A Semi-flexible Polymer under Strain: Structural Transition and Hysteresis"
The 5th International Conference on Biological Physics
Gothenburg, Sweden, (23-27 August, 2004)

5. Natsuhiko Yoshinaga
"A Semi-flexible Polymer under Strain: Structural Transition and Hysteresis"
International Workshop on Dynamics of Complex Fluids
Yukawa Institute, Kyoto University, Kyoto, Japan (8-10 March, 2004)

6. Natsuhiko Yoshinaga
"Irreversibility on the Structural Transition under the Strain in a Single Semi-flexible Polymer"
(AIP Conference Proceedings, 708, 348-349 (2004))
Slow Dynamics in Complex Systems
Tohoku University, Sendai, Japan, (3-8 November, 2003)

7. Natsuhiko Yoshinaga and Kenichi Yoshikawa
"Irreversibility on the Structural Transition under the Strain in a Single Semi-flexible Polymer"
Frontiers in Chemical Biology: Biomolecular Dynamics and Force Generation, Royal Society of Chemistry
Hulme Hall, University of Manchester, UK, (4-6 September 2003)

Invited Seminar

1. "Folding and unfolding kinetics of a single semiflexible polymer under strain"
10 March, 2006 at Institut Laue Langevin (France)

2. "Statistical properties of long DNA molecules"
17 January 2006 at École Polytechnique Fédérale de Lausanne EPFL (Swissland)