

Dr. Michael Y. Tolstorukov

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OBJECTIVE: Academic research and teaching in structural and computational biology / bioinformatics / biophysics

AREAS OF PROFESSIONAL INTERESTS AND EXPERTISE

- **Bioinformatics and computational biology**
 - **Structural genomics**
 - **Structural biology**
 - Protein-DNA interactions
 - Nucleic acid structure and conformational dynamics, hydration
- **Theoretical biophysics and numerical modeling, programming**
- **Experience in teaching for undergraduate and graduate students**

EDUCATION

- 1995-1999 **School of Radio Physics, V.Karazin Kharkov National University**, Kharkov, Ukraine
Ph.D. in Physics and Mathematics with specialty in Biophysics, 1999
Ph.D. Thesis: "Influence of hydration on dynamical properties of nucleic acids",
Supervisor: Prof. V.Ya. Maleev
- 1998 **International Centre for Theoretical Physics**, Trieste, Italy
Workshop on the Structure of Biological Macromolecules, March 16-27, 1998
- 1993-1995 **National Technical University "Kharkov Polytechnic Institute"**, Kharkov, Ukraine
M.S. in Patentology & Informatics, 1995
- 1990-1995 **School of Radio Physics, V.Karazin Kharkov National University**, Kharkov, Ukraine
Combined B.S.&M.S. in Physics of Biological Systems (with Honors), 1995
M.S. Thesis: "Study of hysteresis phenomenon in the nucleic acid-water system",
Supervisors: Prof. V.Y. Maleev, Dr. A.I. Gasan, and Dr. S.V. Gatash
B.S. Thesis: "Influence of hydration on conformational changes in biopolymers",
Supervisor: Dr. A.I. Gasan

PROFESSIONAL EXPERIENCE

8 years of academic research and teaching (since 1995):

- **Since March 2000** - Laboratory of Experimental and Computational Biology, **National Cancer Institute, National Institutes of Health**, Bethesda, MD

Titles: Visiting Fellow

Research: Structural genomics: analysis of the eukaryotic and prokaryotic genomes to understand the role of DNA structural properties for gene regulation.
DNA packing in bacterial genome: Genome-wide search for the regular patterns of sequence motifs with pronounced structural propensities that contribute to the chromatin organization.
Protein-DNA interactions: Bioinformatic analysis of the protein-DNA interactions in complexes to find correlations with DNA sequence-dependent structural deformability.
B-to-A conformational transition: B/A propensity scale for analysis of genome sequences.

- **1995 – Present** - Department of Molecular and Applied Biophysics, School of Radio Physics, **V.Karazin Kharkov National University**, Kharkov, Ukraine

Titles: Junior Research Scientist (1997-1999), Assistant Professor (June 1999 – present; the position is suspended for the period of training in LECB, NCI)

- Research:** Modeling dynamics of B-to-A conformational transition in DNA: Influence of hydration on B/A conformational equilibrium and related hysteresis phenomena.
- Teaching:** Lecturing for undergraduate and graduate students. Undergraduate course: Numerical Analysis in Biophysics with Computer Practicum. Graduate course: Computer Modeling of Biological Macromolecules. Supervising undergraduate students.

GRANTS, AWARDS, ACHIEVEMENTS

- 2000 - Present** Postdoctoral Visiting Fellow Award, NIH Visiting Program
- 1999** Travel Fellowship to attend XIII Biophysical Congress in New Delhi under IUPAB / UNESCO / ICSU Programme
- 1998** Grant from ICTP, Italy to attend the Workshop on "Structure of biological macromolecules"
- 1997** CRDF Travel Grant #97093 to attend the International Conference ANDM'97
- 1996 -1997** Post-graduate Soros Student Fellowship, IRF (Switzerland-Ukraine)
- 1995 -1998** Full Merit Post-graduate Scholarship, School of Radio Physics, Kharkov National University
- 1994** 1st prize in the Young Scientist Paper Contest, School of Radio Physics, Kharkov National University
- 1990 -1995** Full Merit Scholarship, School of Radio Physics, Kharkov National University

CONFERENCE AND SEMINAR PRESENTATIONS

- "Periodic distribution of A-tracts may facilitate bacterial genome packaging", Gordon Research Conference: Nucleic acids, Salve Regina Univ. RI, June, 2003 (poster presentation)
- "DNA deformability in nucleoprotein complexes: Local B-to-A transition facilitates protein-DNA recognition in the minor groove", Laboratory of Physical and Structural Biology, NICHD, NIH, May 2002
- Poster presentations at Biophysical Society Meetings, Boston, MA, 2001; San Francisco, CA, February 2002
- Poster presentations at the 12th and 13th Conversations on Biomolecular Sterodynamics, Albany, NY, June 2001 and June 2003
- "Non-sequence dependent interactions in DNA minor groove", Kharkov Biophysical Society, Kharkov, Ukraine, November 2001
- "Protein-DNA interactions in the minor groove", Laboratory of Prof. Wilma Olson, Department of Chemistry, Rutgers University, Piscataway, NJ, May 2000
- "Influence of hydration on DNA conformational dynamics", Institute of Theoretical Physics, Kiev, Ukraine, December 1998
- "Mathematical model of the conformational transitions and nonlinear dynamics of the nucleic acid – water system", 2nd Int. Symp.: Algorithms for Macromolecular Modelling, Berlin, Germany, May 1997

MEMBERSHIPS IN PROFESSIONAL SOCIETIES

- Since 2000: Member, Biophysical Society of America
- Since 1995: Member, Biophysical Society of Ukraine

PROFESSIONAL SERVICE

- Secretary of the School Scientific Council, School of Radio Physics, Kharkov National University, 1999-2000
- Local Organizing Committee Member, II Ukrainian Biophysical Society Congress, Kharkov, Ukraine, 1999
- Local Organizing Committee Member, International Conference on Mathematical Methods in the Electromagnetic Theory, Kharkov, Ukraine, 1998
- Paper reviewing for scientific journals (*Biopolymers*, *Bioinformatics*)

EXTRACURRICULAR ACTIVITIES

hiking, reading, classical and rock music

REFERENCES

- Dr. Victor Zhurkin** Laboratory of Experimental and Computational Biology, National Cancer Institute, NIH
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PUBLICATIONS

Book chapter:

M.Y. Tolstorukov, and K.M. Virnik, "Mathematical model of the nucleic acids conformational transitions with hysteresis over hydration-dehydration cycle." P. Deuffhard, J. Hermans, B. Leimkuhler, A.E. Mark, S. Reich, R.D. Skeel (eds.) **Computational Molecular Dynamics: Challenges, Methods, Ideas -- Proceedings of the 2nd International Symposium on Algorithms for Macromolecular Modelling, Berlin, 1997; in Series: Lecture Notes in Computational Science and Engineering**, Vol. 4, Springer-Verlag, 1998.

Journal papers:

1. M.Y. Tolstorukov, R.L. Jernigan, and V.B. Zhurkin: Protein – DNA hydrophobic recognition in the minor groove is facilitated by sugar switching. – accepted for publication in **J. Mol. Biol.** (2004).
2. M. Liu, M.Y. Tolstorukov, V.B. Zhurkin, S. Adhya, and S. Garges: A new promoter element, *UP2*, makes the *E.coli P_{lac}* promoter hyperactive and CRP independent. -- submitted to **Proc. Natl. Acad. Sci. USA**
3. K. Virnik, Y.L. Lyubchenko, M.A. Karymov, P. Dahlgren, M.Y. Tolstorukov, S. Semsey, V.B. Zhurkin, and S. Adhya: "Antiparallel" DNA Loop in Gal Repressosome Visualized by Atomic Force Microscopy, **J. Mol. Biol.** (2003), 334(1): 53-63.
4. M.Y. Tolstorukov, V.I. Ivanov, G.G. Malenkov, R.L. Jernigan, and V.B. Zhurkin: Sequence-dependent B \leftrightarrow A transition in DNA evaluated with dimeric and trimeric scales, **Biophys. J.** (2001), 81(6): 3409-3421.
5. M.Y. Tolstorukov, and V.Y. Maleev: Conformational transitions of DNA induced by changing water content of the sample: A theoretical study, **J. Biomol. Struct. Dyn.** (2000), 17 (5): 913-920.
6. M.Y. Tolstorukov, and S.V. Gatash: Self-organization and nonlinear dynamics of nucleic acid-water system, **Special Issue of Int. J. Bifurcation and Chaos** (1999), 9(2): 371-381.
7. K.M. Virnik, and M.Y. Tolstorukov: Binding energy differentiation of water molecules in DNA hydration shell, **Digest of Kharkov State Univ., Biophysical Bulletin** (1998), 422 (2): 35-38.
8. K.M. Virnik, M.Y. Tolstorukov, and V.Y. Maleev: Surface diffusion of bound water in hydrate surroundings of DNA, **Digest of Kharkov State Univ., Biophysical Bulletin** (1998), 422(2): 23-28.
9. M.Y. Tolstorukov, and K.M. Virnik: Experimental study of hysteresis phenomenon in the process of hydration-dehydration of NaDNA, **Biopolymers and Cell** (1998), 14: 524-528 (in Russian).
10. M.Y. Tolstorukov, S.V. Gatash, and V.Y. Maleev: Parameter distributed model of the conformational transitions induced with change of relative humidity in the nucleic acid samples, **Digest of Kharkov State Univ., Biophysical Bulletin** (1998), 410(1): 33-40 (in Russian).
11. M.Y. Tolstorukov, S.V. Gatash, and V.Y. Maleev: Mathematical model of nucleic acids' conformational dynamics in wetted samples, **Vesn. Problem Biol. i Med.** (1998), 16: 6-12 (in Russian).
12. K.M. Virnik, and M.Y. Tolstorukov: Calculation of fractal dimensions of DNA in various conformations, **Vesn. Problem Biol. i Med.** (1998), 2: 5-15, (in Russian).
13. M.Y. Tolstorukov, A.I. Gasan, S.V. Gatash, and V.Y. Maleev: The molecular mechanism of the sorption hysteresis in the DNA - water system, **Biophysics** (1997), 42: 847-857.

Manuscript in preparation:

M.Y. Tolstorukov, K.M. Virnik, S. Adhya, and V.B. Zhurkin: Periodic distribution of A-tracts may facilitate bacterial genome packaging.

Conference papers:

1. M. Tolstorukov, K. Virnik, S. Adhya, V. Zhurkin: Genome-wide A-tract Distribution and DNA Packaging in Pro- and Eukaryotes. **J. Biomolec. Struct. Dynam.** (2003), 20: 869-870.
2. M.Y. Tolstorukov, R.L. Jernigan, V.B. Zhurkin: Effect of sugar puckering on protein-DNA interactions in DNA minor groove. **Biophys. J.** (2002), 82: 2265.
3. M.Y. Tolstorukov, R.L. Jernigan, and V.B. Zhurkin: Non-random distribution of A-tracts in pro- and eukaryotic genomes. In: Chakravarti, A., Eisen, M., and Zhang, M., (Eds.): **Proceedings of the 2001 Meeting on Integrating Genome Sequence, Sequence Variation and Gene Expression**. Cold Spring Harbor, NY (2001), p. 67.
4. M.Y. Tolstorukov, R.L. Jernigan, and V.B. Zhurkin: Protein-DNA minor groove recognition. **J. Biomolec. Struct. Dynam.** (2001), 18: 944-945.
5. M.Y. Tolstorukov, R.L. Jernigan, and V.B. Zhurkin: Minor groove interaction profiles of protein/DNA complexes. **Biophys. J.** (2001), 80: 568a.
6. M.Y. Tolstorukov, V.I. Ivanov, L.E. Minchenkova, D.Y. Krylov, R.L. Jernigan, and V.B. Zhurkin: Trimeric Model for the B-A transition in DNA. **Biophys. J.** (2001), 80: 484a.
7. M.Y. Tolstorukov, S.V. Gatash, and V.Y. Maleev: Conformational dynamics of a nucleic acid molecule over hydration-dehydration cycle: A theoretical study. **J. Biomol. Struct. Dyn.** (1999), 16 (6): 1256.
8. M.Y. Tolstorukov, S.V. Gatash, and V.Y. Maleev: Effect of hydration on conformational dynamics of nucleic acid molecule. Spatially extended model. **Proc. of the Conference on Physics of Biological Systems**. Kiev, Ukraine (1998), p. 25.
9. M.Y. Tolstorukov, S.V. Gatash, and V.Y. Maleev: Model of conformational transitions of nucleic acid molecule induced with changing relative humidity of the sample. **Proc. of the 2nd . Congress of Ukraine Biophysical Society**. Kharkov, Ukraine (1998), p. 23 (in Ukrainian).
10. M.Y. Tolstorukov: Mathematical model of the conformational transitions and nonlinear dynamics of the nucleic acid – water system. In: Deuffhard, P. and Reich, S. (Eds): **2nd Int. Symp.: Algorithms for Macromolecular Modelling**. Berlin, Germany (1997), pp. 25-26.
11. K.M. Virnik, and M.Y. Tolstorukov: Estimation of the diffusion coefficients of water bound to the DNA surface. **Proc. of the 17th Discussion Conference: Surface and Interfacial Phenomena in Macromolecular Systems**. Prague, Check Republic (1997), p. 5.
12. K.M. Virnik, M.Y. Tolstorukov, and V.Y. Maleev: Diffusion of bound water molecules along fractal biopolymer surface. **Proc. of the 3rd Int. Conf.: The physical phenomena of condensed matter**. Kharkov, Ukraine (1997), p. 114 (in Russian).
13. M.Y. Tolstorukov, S.V. Gatash, and V.Y. Maleev: The conformational transitions with hysteresis in the nucleic acid - water system. **Proc. of the 3rd Int. Conf.: The physical phenomena of condensed matter**. Kharkov, Ukraine (1997), p. 115 (in Russian).
14. M.Y. Tolstorukov, and S.V. Gatash: Self-organization and nonlinear dynamics of nucleic acid-water system. **Proc. of the Int. Conf.: Nonlinearty, Bifurcation, Chaos: The Doors to the Future**. Lodz, Poland (1996), pp. 231-234.