

Oleg A. Igoshin

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**Research Interests:**

- **Computational system biology of signaling and genetic networks:** Evolutionary design principles of bacterial signaling networks; Bacterial development; Noise and population heterogeneity; Host-pathogen interaction during tuberculosis infection; Hematopoietic stem cells' gene regulatory networks; phenotypic switching networks in cancer; Dynamic-disorder effect on the network kinetics
- **Biophysical modeling of microbiological systems:** Pattern formation in bacterial populations, microbial biofilms, Bacterial gliding motility

**Positions:****Dates:**

- Assistant Professor, Department of Bioengineering, Rice University 01/07 -present
- Adjunct Faculty, UT Graduate School of Biomedical Sciences 11/07 - present
- Adjunct Assistant Professor, Dept Of Systems Biology, MD Anderson 09/11-present
- Postdoctoral Researcher, Department of Biomedical Engineering, UC Davis  
Advisor: Prof. Michael Savageau 10/04 -12/06  
Research Project: Signaling Pathways in *Bacillus Subtilis*

**Education:**

- PhD in Physics, Department of Physics, UC Berkeley 08/00 -08/04  
Advisor: Prof. George Oster, Dept. Molecular and Cell Biology  
Thesis committee: Carlos Bustamante, John Neu, Donald Glaser  
Thesis topic: *Modeling of pattern formation in Myxobacteria*
- MSc, Chemical Physics Department, Feinberg Graduate School, Weizmann Institute of Science, Israel, 10/98-07/00  
Advisor: Prof. A. I. Burshtein,  
Thesis topic: *Diffusion assisted electron and energy transfer*
- BSc *Summa Cum Laude*, Physics Department, Novosibirsk State University, Russia 09/94-06/98  
Advisors: Prof. A.B. Doktorov, Dr. A.A. Kipiyanov  
Thesis topic: *Application of nonequilibrium statistical mechanics methods to reacting systems.*

**Honors and awards:**

- John C Dunn Foundation Collaborative Research Award 09/09
- NSF CAREER Award 02/09
- International Collaboration Travel Award 09/08
- HHMI Predoctoral fellowship award 06/01-09/04
- Regents fellowship, UC Berkeley 08/00-05/01

**List of publications (papers):**

1. Kipriyanov, A. A., Igoshin, O. A., Doktorov, A. B., *A new approach to the derivation of binary non-Markovian kinetic equations*, Physica A **268**(1999)567-606.
2. Igoshin, O. A., Kipriyanov, A. A., Doktorov, A. B., *Many-particle treatment of nonuniform reacting systems  $A+B \Rightarrow C$  and  $A + B \Rightarrow C + D$  in liquid solutions*, Chem. Phys. **244** (1999)371-385.
3. Burshtein, A. I. and Igoshin, O. A., *Photoconductivity and singlet oxygen generation in illuminated polymer in the air atmosphere*, J.Chem.Phys. **111**(1999) 2200-2209.
4. Krissinel, E.B., Igoshin, O. A., Burshtein, A. I., *Integral, Unified and Markovian theories of biexcitonic photoionization.*, Chem.Phys. **247** (1999)261-273.
5. Kipriyanov, A. A., Igoshin, O. A., Doktorov, A. B., *The effect of chemical displacement of B species in the reaction  $A+B \Rightarrow B$* , Physica A **275**(2000)99-153.
6. Frantsuzov, P.A., Igoshin, O. A. and Krissinel, E. B., *Differential approach to the memory-function reaction kinetics*, Chem.Phys.Lett. **317**(2000)481-489.
7. Igoshin, O.A., Burshtein, A.I, *Impurity quenching of fluorescence in intense light. Violation of the Stern-Volmer law*, J.Chem.Phys. **112**(2000) 10930-10940
8. Igoshin, O.A., Burshtein A.I., *Quenching of fluorescence by irreversible energy transfer at arbitrary strong light*, Jour.Lumin. **92** (2001) 123-132.
9. Lukzen, N.N., Krissinel, E.B., Igoshin, O.A. and Burshtein, A.I., *Instantaneous and Permanent Photoionization*, J.Phys.Chem. A **105**(2001) 19-28.
10. Igoshin, O.A., Mogilner, A., Welch, R.D., Kaiser, D., Oster, G., *Pattern formation and traveling waves in myxobacteria: Theory and modeling*, PNAS, **98** (2001)14913-14918.
11. Igoshin, O. A., Mogilner, A, Welch, R.D., Kaiser, D., Oster, G., *Modeling pattern formation and traveling waves in myxobacteria*, Biopys. J., **82** (2002) 970-970
12. Wolgemuth, C.W., Igoshin, O., Oster, G., *The motility of mollicutes*, Biopys. J., **85** (2003) 828-842
13. Wolgemuth, C.W., Igoshin, O., Oster, G., *Mechanochemical motor filaments and bacterial motility*, Biopys. J., **84** (2003) 571A-571A
14. Igoshin, O., Oster, G., *Rippling of Myxobacteria*, Math Biosciences, 188 (2004) 221-233
15. Igoshin, O. A., Welch R., Kaiser, D., Oster, G., *Waves and aggregation patterns in myxobacteria*, PNAS, **101**(2004) 4256-4261
16. Igoshin, O.A., Kaiser, D., Oster, G., *Symmetry breaking in myxobacteria*, Curr. Biol **14**(2004) R459-R462
17. Igoshin, O.A., Neu, J., Oster, G., *Developmental Waves in Myxobacteria: A distinctive pattern formation mechanism*, Phys. Rev E **70** (2004) 041911 1-11
18. Igoshin, O.A., Goldbeter A., Kaiser, D., Oster, G., *A biochemical oscillator explains several aspects of M. xanthus behavior during development*, PNAS **101**(2004) 15760-15765
19. Igoshin, O.A., Price, C.W., Savageau, M.A., *Signalling network with a bistable hysteretic switch controls developmental activation of the sigma transcription factor in Bacillus subtilis*, Molecular Microbiology **61** (2006)165-184
20. Igoshin, O.A., Brody, M.S., Price, C.W., Savageau, M.A., *Distinct topologies of partner-switching signaling networks correlate with their physiological roles*, J Mol Biol, **369**(2007):1333-52
21. Veening, J-W, Igoshin, O.A., Eijlander, R.T., Hamoen, L.W., Nijland, R. and Kuipers, O.P. *Transient heterogeneity in extracellular protease production by Bacillus subtilis*,

- Nature Molecular Systems Biology, **4:184** (2008)
22. Igoshin\*, O.A., Alves, R. and Savageau, M.A., Hysteretic and graded responses in bacterial two-component signal transduction, *Molecular Microbiology*, **68** (2008): 1196–1215
  23. Chaudhury, S. and Igoshin, O.A., *Dynamic disorder-driven substrate inhibition and bistability in a simple enzyme catalysis reaction*, *J Phys Chem B*, **113** (2009): 13421-8
  24. Ray, J.C.J. and Igoshin, O.A., *Adaptable Functionality of Transcriptional Feedback in Bacterial Two-Component Systems*, *PLoS Comp Biol*, **6**(2) (2010): e1000676
  25. Narula, J., Smith, A.M. Gottgens B., Igoshin, O.A., *Modeling Reveals Bistability and Low-Pass Filtering in the Network Module Determining Blood Stem Cell Fate*, *Comp Biol* **6**(5) (2010): e1000771.
  26. Eswaramoorthy, P, Dinh, D, Dunn, D., Igoshin, O.A. and Fujita, M., *Single cell measurement of the levels and distributions of the phosphorelay components in a population of sporulating Bacillus subtilis cells*, *Microbiology*, **156** (8) (2010): 2294 - 2304
  27. Chaudhury, S. and Igoshin, O.A., *Dynamic disorder in rapid-equilibrium enzymatic system*, *PLoS One*, **5**(8) (2010): e12364
  28. Tiwari, A., Balazsi, G., Gennaro, M.L. and Igoshin, O.A., *Interplay of Multiple Feedbacks with Post-Translational Kinetics Results in Bistability of Mycobacterial Stress-Response Network*, *Phys. Biol.* **7** (2010): 036005 [**Featured IOP paper**]
  29. Narula, J., and Igoshin, O.A., *Thermodynamic models of combinatorial gene regulation by distant regulatory elements*, *IET System Biology*, **4**(6) (2010): 393-408
  30. Tiwari, A., Ray, J.C.J., Narula, J., and Igoshin, O.A., *Bistable responses in bacterial genetic networks: designs and dynamical consequences*, *Mathematical Bioscience*, **231**(2011) : 76-89
  31. Xie S., Zhang, H., Shimkets, L. and Igoshin, O.A., *Statistical image analysis reveals features affecting fates of Myxococcus xanthus developmental aggregates*, *PNAS*, **108**(2011): 5915-5920
  32. Zhang, H., Angus, S., Tran, M., Xie S., Igoshin\*, O.A. and Welch\*, R.D., *Quantifying aggregation dynamics during Myxococcus xanthus development*, *J Bacteriol.*, **193** (2011): 5164-70
  33. Ray, J.C.J., Tabor, J.J. and Igoshin, O.A., *Non-transcriptional regulation shapes relationships between bacterial network structure and function*, *Nature Reviews Microbiology*, (2011), **in press**, doi: 10.1038/nrmicro2667
  34. Ray, J.C.J. and Igoshin, O.A., *Interplay of Noisy Gene Expression and Biochemical Dynamics Influences Bacterial Operon Organization*, (2011), submitted
  35. Balazsi, G., Igoshin, O.A. and Gennaro, M.L., *The transcriptional regulatory network of Mycobacterium tuberculosis*, invited chapter, submitted

### List of publications (books):

1. Igoshin, O.A., *Integral Encounter Theory of Photochemical Transfer Reactions: Formalism and Applications*, LAP Lambert Academic Publishing AG&Co, Koln, Germany, **2009**, ISBN: 978-3-8383-0101-3