

# ***Curriculum Vitae, Erdal Toprak, Ph.D.***

## **EDUCATION**

- Ph.D., 2007, Biophysics and Computational Biology, University of Illinois at Urbana-Champaign, USA
- M.S., 2001, Physics, Bogazici University, Istanbul, Turkey
- B.S., 1998, Physics, Bogazici University, Istanbul, Turkey

## **Summer Schools**

- 2006, Physiology Summer School, Marine Biology Lab, Woods Hole, MA

## **Positions and Employment**

- 2001-2003** Graduate Research Assistant, Department of Physics, Bogazici University
- 2003-2007** Graduate Research Assistant, Department of Biophysics and Computational Biology, University of Illinois at Urbana-Champaign
- 2007-2008** Postdoctoral Research Associate, Department of Physics, University of Illinois at Urbana-Champaign
- 2008-2011** Postdoctoral Research Associate, Department of Systems Biology, Harvard Medical School
- 2011-2014** Assistant Professor, Program for Biological Sciences and Bioengineering, Sabanci University
- 2014-present** Assistant Professor, Green Center for Systems Biology, University of Texas Southwestern Medical Center

## **AWARDS**

- 2006** Physiology Summer School Fellowship, Marine Biology Laboratory, Woods Hole, MA.
- 2007** Eugene Rabinowitch Graduate Fellowship, University of Illinois at Urbana-Champaign.
- 2007** Teachers Ranked Excellent by Their Students Award, University of Illinois at Urbana-Champaign.
- 2013** The Young Scientists Award by the Turkish Academy of Sciences (TÜBA).
- 2014** Southwestern Medical Foundation Scholar in Biomedical Research.

## **Synergistic Activities**

- Co-organizer, “Stochastic Biology: from Cells to Populations”, IST Austria, May 5-7, 2014
- Faculty; UC Santa Barbara KITP Eco-Evolutionary Dynamics Summer School, 2017.

## **PROFESSIONAL ASSOCIATIONS**

- The Biophysical Society
- The American Chemical Society
- The American Society for Microbiology
- Society for Molecular Biology & Evolution

## **Ongoing Research Support**

**CDC SBIR Phase II** (Role: co-PI)

Title: *“Highly Sensitive Electrochemical Assay to Monitor Gut Microbiome”*

**NIH R01** (Role: PI, *R01GM125748*)

*Mapping epistatic interactions in molecular evolution of antibiotic resistance*

**DOD Discovery Award** (Role: PI, PR172118)

*Developing Novel Tools for Detecting Antibiotic Resistant Pathogens and Dissecting Evolution of Antibiotic Resistance*

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## Completed Research Support

Human Frontiers Science Program Research Grant (Role: co-PI)  
09/01/13 - 08/30/17

EMBO Installation Grant (Role: PI)  
2013-2018 (Terminated in July 2014 due to relocation of the PI)

Marie Curie Career Integration Grant (Role: PI)  
2012-2016 (Terminated in July 2014 due to relocation of the PI)

## Publications

1. Yusuf T. Tamer, E. Toprak, "On the Race to Starvation: How Do Bacteria Survive High Doses of Antibiotics?", *Molecular Cell*, 2017 Dec 21;68(6):1019-1021. doi: 10.1016/j.molcel.2017.12.004.
2. M.F. Cansizoglu, E. Toprak, "Fighting against evolution of antibiotic resistance by utilizing evolvable antimicrobial drugs", *Current Genetics*, 2017 (invited review).
3. H. Abdizadeh, Y.T. Tamer, O. Acar, E. Toprak, A.R. Atilgan, C. Atilgan, "*Increased Substrate Affinity in the Escherichia Coli L28R Dihydrofolate Reductase Mutant Causes Trimethoprim Resistance*", *Physical Chemistry Chemical Physics*, 2017.
4. D.H. Ayhan, Y.T. Tamer, M. Akbar, S.M. Bailey, M. Wong, S.M. Daly, D.E. Greenberg, E. Toprak, "Sequence-Specific Targeting of Bacterial Resistance Genes Increases Antibiotic Efficacy", *PLOS Biology*, September 15, 2016.
5. Okumus B, Landgraf D, Lai GC, Bakhsi S, Arias-Castro JC, Yildiz S, Huh D, Fernandez-Lopez R, Peterson CN, Toprak E, El Karoui M, Paulsson J. Mechanical slowing-down of cytoplasmic diffusion allows in vivo counting of proteins in individual cells. *Nature communications*. 2016.
6. G. Chevereau, M. Dravecka, T. Batur, A. Guvenek, D.H. Ayhan, E. Toprak, and T. Bollenbach, "*Quantifying the determinants of evolutionary dynamics leading to drug resistance*", *PLOS Biology*, 2015.
7. A.C. Palmer\*, E. Toprak\*, M. Baym, S. Kim, A. Veres, S. Bershtein, & R. Kishony. "Delayed commitment to evolutionary fate in antibiotic resistance fitness landscapes", *Nature communications*, 6, 2015.  
[doi:10.1038/ncomms8385](https://doi.org/10.1038/ncomms8385)
8. Oz, T., Guvenek, A., Yildiz, S., Karaboga, E., Tamer, Y.T., Mumcuyan, N., Ozan, V.B., Senturk, G.H., Cokol, M., Yeh, P., Toprak, E.\*, "Selection strength contributes to the complexity of antibiotic resistance evolution", *Molecular Biology and Evolution*, (Published online: June 24, 2014, \* corresponding author).  
[doi:10.1093/molbev/msu191](https://doi.org/10.1093/molbev/msu191)
9. B. Okumus, S. Yildiz, E. Toprak\*, "Fluidic and microfluidic tools for quantitative systems biology", *Current Opinion in Biotechnology*, 2014, \* corresponding author. [doi:10.1016/j.copbio.2013.08.016](https://doi.org/10.1016/j.copbio.2013.08.016)
10. E. Toprak\*, A. Veres, S. Yildiz, J.M. Pedraza, R. Chait, J. Paulsson, R. Kishony\*, "Building a Morbidostat: An automated high-throughput fluidic system for studying bacterial drug resistance in dynamically sustained drug environments", *Nature Protocols*, 2013; E.T. and R.K. are corresponding authors).  
[doi:10.1038/nprot.2013.021](https://doi.org/10.1038/nprot.2013.021)
11. E. Toprak, A. Veres, J.B. Michel, R. Chait, D.L. Hartl, R. Kishony, "Evolutionary paths to strong antibiotic resistance under dynamically sustained drug stress", *Nature Genetics*, 2012. [doi:10.1038/ng.1034](https://doi.org/10.1038/ng.1034)
12. E. Toprak, C. Kural, P. R. Selvin, "Super-accuracy and super-resolution getting around the diffraction limit.", *Methods in Enzymology*, 2010. [doi: 10.1016/S0076-6879\(10\)75001-1](https://doi.org/10.1016/S0076-6879(10)75001-1)
13. E. Toprak, A. Yildiz, M.T. Hoffman, S.S. Rosenfeld, P.R. Selvin, "Why kinesin is so processive", *PNAS*, 2009 [doi: 10.1073/pnas.0808396106](https://doi.org/10.1073/pnas.0808396106)

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14. J. G. Reifengerger, E. Toprak, H. Kim, D. Safer, H.L. Sweeney, P.R. Selvin, "Myosin VI undergoes a 180° Power stroke implying an uncoupling of the front lever arm", PNAS, 2009, (J.G.R. and E.T. contributed equally).[doi: 10.1073/pnas.0900005106](https://doi.org/10.1073/pnas.0900005106)
15. E. Toprak, H. Balci, B.H. Blehm, P.R. Selvin, "3D Particle Tracking via Bifocal Imaging", Nano Letters, 2007.[PMID: 17583964](https://pubmed.ncbi.nlm.nih.gov/17583964/)
16. E. Toprak and P.R. Selvin, "New Fluorescent Tools for Watching Nanometer-Scale Conformational Changes of Single Molecules", Annual Review of Biophysics and Biomolecular Structure, 2007.[PMID: 17298239](https://pubmed.ncbi.nlm.nih.gov/17298239/)
17. H. Park, E. Toprak, P. R. Selvin, "Single-molecule fluorescence to study molecular motors", Quarterly Reviews of Biophysics, 2007.[PMID: 17666122](https://pubmed.ncbi.nlm.nih.gov/17666122/)
18. P.R. Selvin, T. Loughheed, M.T. Hoffman, H. Park, H. Balci, B.H. Blehm, E. Toprak, "In vitro & in vivo FIONA and other acronyms for watching molecular motors walk", Single Molecules: A Laboratory Manual. Cold Spring Harbor Press. Edited by Selvin, P.R., Taekjip Ha, Univ. of Illinois, 2007.[doi: 10.1101/pdb.top27](https://doi.org/10.1101/pdb.top27)
19. J. Enderlein, E. Toprak, P. R. Selvin, "Polarization effect on position accuracy of fluorophore localization", Optics Express, 2006.[PMID: 19529183](https://pubmed.ncbi.nlm.nih.gov/19529183/)
20. E. Toprak, J. Enderlein, S. Syed, S.A. McKinney, R.G. Petschek, T. Ha, Y.E. Goldman, P.R. Selvin, "Defocused Orientation and Position Imaging of Myosin V", PNAS, 2006.[PMID: 16614073](https://pubmed.ncbi.nlm.nih.gov/16614073/)
21. E. Toprak and O.T. Turgut, "Large N limit of SO(N) Scalar Gauge Theory", Journal of Mathematical Physics, 2002.
22. E. Toprak and O.T. Turgut, "Large N limit of SO(N) Gauge Theory of Fermions and Bosons", Journal of Mathematical Physics, 2002.

## **INVITED TALKS (last 5 years)**

1. APS March Meeting, Invited Talk, March 2018.
2. Miami University, Physics Colloquium, December 2017.
3. 15<sup>th</sup> CRG Symposium: Evolution and Medicine. 6-7 October 2016, Barcelona, SPAIN.
4. 2nd American Society of Microbiology Conference on Experimental Microbial Evolution, August 3-7, 2016, Washington, DC, plenary speaker.
5. 26th ECCMID, 9-12 April 2016, "Selection pressure and antimicrobial resistance evolution", Amsterdam, Netherlands.
6. Ohio State University Mathematical Biosciences Institute Workshop: Modeling and Inference from Single Molecule to Cells, "Evolution of Antibiotic Resistance on a 6-D Hypercube", February 9-12, 2016, Columbus, Ohio.
7. Royal Society Workshop: Antimicrobial resistance: how can physicists help?, "Fighting antibiotic resistance by exploiting antibiotic hypersensitivity", October 28th and 29th, 2015, Buckinghamshire, UK.
8. UKFTNLS symposium, Microbial Evolution: theory, simulation and experiment, "Counting steps in evolution of antibiotic resistance", KU Leuven, Belgium, 6-7 May 2015 (Keynote Speaker).
9. 14th Chemical Biophysics Symposium (CBP) at the University of Toronto, "Evolution of Antibiotic Resistance through a Multi-Peaked Fitness Landscape", April 11, 2015 (Keynote Speaker).
10. EMBO YIP Meeting, "Determinism and Catastrophe in Evolution of Antibiotic Resistance ", CRG Barcelona, October 24, 2014.
11. "Is Evolution of Antibiotic Resistance Predictable?", Instituto de Biología Molecular y Celular de Plantas, Valencia, Spain, November 21, 2013
12. "Stepwise evolution of antibiotic resistance", CRG Barcelona, Spain, November 20, 2013
13. Evolution of Antibiotic Resistance On A Six Dimensional Hypercube", IST Austria, October 23, 2013

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14. “Revealing genetic pathways to antibiotic resistance”, Bogazici University, Physics and Chemical Engineering Departments Joint Seminar, April 10, 2013
15. “Antibiyotik dirençli bakterilerle mücadele edilebilir mi?”, Department of Physics, Marmara University, March 11, 2013 (delivered in Turkish).
16. “Evolution of Antibiotic Resistance On A Six Dimensional Hypercube”, Department of Industrial Engineering, Bogazici University, February 28, 2013.
17. “Following Evolution of Antibiotic Resistance (FEAR)”, Science Seminar, Koc University, December 13, 2012.
18. “Bakterilerde antibiyotik direncine sebep olan genetik yollar nasıl bulunur?”, Department of Physics, Akdeniz University, December 7, 2012 (delivered in Turkish).
19. “Evolution of antibiotic resistance on a multi-peaked fitness landscape”, Department of Molecular Biology and Genetics, Bogazici University, November 30, 2012.
20. “MORBIDOSTAT: How can we identify genetic trajectories leading to drug resistance using LEDs costing less than 1\$ ?”, 14th National Photonics Workshop, Koc University, September 2012.
21. “Evolution of antibiotic resistance through a multi-peaked fitness landscape”, University of Illinois at Urbana-Champaign Center for Living Cell, September 2012.
22. “MORBIDOSTAT: A novel fluidic apparatus for studying bacterial drug resistance”, 2nd International Workshop on Cleanroom Training, Bilkent University, June 2012.
23. “Evolutionary trajectories to bacterial drug resistance”, National Nanotechnology Research Center, Bilkent University, May 2012.
24. “Evolution of drug resistance on a maximally “rugged” fitness landscape”, California Institute of Technology Division of Biology, February 2012.
25. “Optimal survival in an evolutionary maze”, UT Southwestern Medical School Green Center for Systems Biology, February 2012.

## NEWS and HIGHLIGHTS

1. **BBC episode covering our Morbidostat work** (<http://www.bbc.co.uk/programmes/b01ms5c6>)
2. Highlights by **Molecular Biology and Evolution** (<https://mbe.oxfordjournals.org/content/31/9/2551.2.full>)
3. **Interview with Illumina iCommunity Newsletter**  
([http://www.illumina.com/documents/icomunity/article\\_2012\\_07\\_Morbidostat.pdf](http://www.illumina.com/documents/icomunity/article_2012_07_Morbidostat.pdf))
4. **Nature Genetics News and Views**  
(<http://elowitz.caltech.edu/publications/Evolution%20in%20Real%20Time.pdf>)
5. **Genome Biology** (<http://genomebiology.com/2012/13/1/140>)
6. **Science** (<http://www.sciencemag.org/content/333/6049/1562.2.full.pdf>)
7. **Faculty 1000** (<http://f1000.com/13445979>)
8. **Nature Medicine** (<http://blogs.nature.com/spoonful/2011/12/welcome-to-the-morbidostat-researchers-watch-deadly-drug-resistance-in-action.html>)
9. **The Scientist** (<http://the-scientist.com/2011/12/18/the-evolution-of-drug-resistance/>)
10. **PhysOrg** (<http://www.physorg.com/news/2011-12-whole-genome-sequencing-evolution-drug-resistance.html>)
11. **New Scientist** (<http://www.newscientist.com/article/mg21228443.300-stealth-tactics-of-bacteria-revealed.html>)
12. **Scientific American** (<http://blogs.scientificamerican.com/lab-rat/2012/01/10/discrete-steps-to-antibiotic-resistance/?print=true>)
13. **Photonics**, (<http://www.photonics.com/Article.aspx?AID=30400>)
14. **Photometrics**, (<http://www.photometrics.com/resources/technotes/pdfs/3Dparticle-tracking.pdf>)
15. **Biophotonics International**, ([http://people.physics.illinois.edu/Selvin/PRS/Biophotonics\\_Erdal.pdf](http://people.physics.illinois.edu/Selvin/PRS/Biophotonics_Erdal.pdf))